

# 2011 JOURNAL OF UNDERGRADUATE RESEARCH

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# LETTER FROM THE PRESIDENT

29 March 2011

To the Cabrini College community,

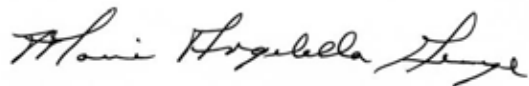
Congratulations to the *Journal of Undergraduate Research's* editorial board, faculty and contributing students for producing this third annual publication of the *Journal*. This volume represents three consecutive years of dedication to excellence by all past and current student contributors and the faculty mentors who inspire Cabrini students to engage in and to publish research.

Undergraduate research is a dynamic pedagogical tool that promotes greater gains in student learning, personal initiatives and communications skills. The opportunity for in-depth, faculty-mentored research can lead a student to lifelong creative and critical thinking. Undergraduate research is a lens focused upon transformational learning, one that does not end with a completed project or a passing grade.

Students undertaking research encounter learning on an exciting level—supposition, theory, discovery, unsuspected outcomes, challenges and hands-on education transcend the typical classroom environment. Often the experience will enhance professional and academic credentials to support applications for scholarships, awards, career employment and entry in graduate or professional schools. The experience is also a rare opportunity to develop a one-on-one rapport between a student and a faculty mentor, while simultaneously reinforcing the class subject matter. Finally, the opportunity to share research with peers builds confidence, improves communication techniques and cultivates lasting leadership skills.

Just as Cabrini's core values of respect, vision, community and dedication to excellence are central to the College's mission of an "education of the heart," undergraduate research is crucial to a successful college experience. I extend my deepest appreciation to the *Journal's* co-editors, its editorial board, its contributing students and their faculty mentors for producing the works contained in this volume and for sharing it with the Cabrini College community.

May you have continued success in all future endeavors,



Marie Angelella George, Ph.D.

# EDITORIAL STATEMENT

## ***EDITORIAL STATEMENT***

The Cabrini College Journal of Undergraduate Research is an annual, reviewed publication dedicated to the discovery, promotion and publication of outstanding work done annually by Cabrini undergraduates. The Journal's Editorial Board reviews, selects and cultivates the best work for inclusion. Drawn from The Undergraduate Arts, Research, & Symposium—an annual event where students present and showcase their research to the College community—the Board seeks academically rigorous and distinctive efforts that demonstrate Cabrini students' evolution into public intellectuals with a firm grasp of the stakes and conventions of meaningful scholarship. Articles are selected for publication based on their scholarly and rhetorical quality. They are from all disciplines, and exemplify one or more of the following accomplishments

- An original research project
- Unique contribution to the scholarship of the student's field
- A new interpretation of an intellectually important problem; phenomenon or text
- An interdisciplinary endeavor that suggests an innovative approach to an altogether new subject for scholarly inquiry.

The board also considers for publication any work of artistic merit that demonstrates academic seriousness and intellectual ambition.

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# SOCIAL SCIENCES

## **Operation Barbarism: Atrocity on the Eastern Front of World War II**

Author: Michael Spivak

Faculty Mentor: Courtney Smith, Ph.D.

Abstract: This paper recounts the barbaric nature of the war between the Soviet Union and Nazi Germany on World War II's Eastern Front. As this paper shows, the barbarism on the Eastern Front stemmed from the two countries' opposing ideologies and from Hitler's determination to annihilate the Soviet Union. This paper covers the poor treatment of both Soviet and German POWs and atrocities against civilian populations in Poland and the Soviet Union. While Jewish civilians felt the wrath of the invading Nazis, large numbers of non-Jewish Polish and Soviet civilians also perished during this brutal conflict. Ultimately, many of those who committed the atrocities never paid for their crimes, and many of the survivors never fully outlived the horror of World War II's Eastern Front.

Most of the recollections of historians, amateur and professional, recall America's involvement on the Western Front as being relatively sporting, with two opponents engaging each other in a gentleman's war fought in a modern age, where POWs were treated fairly and enemy civilians were treated with respect; however, such was not the case on the Eastern Front, where a war of annihilation was being waged. The Eastern Front's destructive magnitude exceeded simple battle casualties as scores of civilians, POWs and racial undesirables were put to death as part of systemic and individual atrocities waged by both sides. Contributing towards the immense horrors was the status of the Eastern Front as an ideological war of utter annihilation for the Germans and bitter survival for the Soviets who met each other in brutal fighting that translated to even more brutal wartime atrocities. Much of the atrocities committed by German forces against civilian personnel were ordered by high-ranking German political facets while German atrocities against Soviet military personnel often came from a mixture of confusion and misinterpretation of military commands and individual decisions to engage in atrocities. Soviet forces always engaged in wartime atrocities against German civilian and military personnel through



individual choices, as Soviet high commanders were often disinterested or placed their attention to facets of the war effort rather than troop discipline.

Before the first shots of the Second World War were fired, the stage was set for a conflict in the East that would be host to vicious wartime atrocities of extermination and general cruelty that survivors bore witness to. An issue stretching to the primordial days of Bolshevik Russia was the treatment of POWs and civilians in war, which the Soviet Union never legalized by rejecting Tsarist Russia's agreement with the Hague Convention of 1907 and by never signing to the Geneva Convention of 1929, giving the red army free range over conquered individuals<sup>i</sup>. While Germany agreed to both conventions governing captured soldiers and civilians, one can glean the respect Hitler and his followers had for precedent by examining Germany's contempt for and violations of the Treaty of Versailles to attain her goals, which included the extermination of undesirables and the establishment of Lebensraum. The Germans were preparing to wage a twofold ideological war of annihilation against the Soviet Union, a communist and supposedly Jewish state, as described by Hitler:

The impending campaign is more than a clash of arms; it also entails a struggle between two ideologies. To conclude this war is not enough, given the vastness of the space, to defeat the enemy forces. The entire territory must be dissolved into states with their own governments...The Jewish-Bolshevik intelligentsia, as the oppressor of the past, must be liquidated.<sup>ii</sup>

Fortifying German ideas of inferiority towards the Soviets included and extermination of such people as necessary for victory through Hitler's prediction that Soviet troops, especially racial minorities, would engage in "treacherous methods of fighting" described Asiatic troops as "inscrutable, unpredictable, insidious and unfeeling."<sup>iii</sup> Contributing to the conflagration of bewilderment and hate fomented by Nazi propaganda was the reciprocal nature of Soviet leadership as expressed by Joseph Stalin in a speech shortly after the war begins when he says "From now on it will be our task...to annihilate all Germans who have penetrated as occupiers, down to the last man," establishing a sense of futility in respecting human rights<sup>iv</sup>.

While many consider the Eastern Front to begin with the commencement of Operation Barbarossa, the Eastern Front actually begins with the invasion and partition of Poland, where many atrocities were committed by German and Soviet forces. Upon their swift victory against the Polish army, the German SS implemented Operation Tannenberg, a plot to deprive Poland of its key political, social and military leadership through the arrest and execution of over 16,000 politicians, clergymen, intellectuals, military officers and communists<sup>v</sup>. SS police units saw action against guerilla fighters near the German-Polish border following the invasion, where they often abused civilians to gain vital intelligence and massacred villagers in reprisal for attacks. German regular army units, spurred by tales of Polish atrocities, took part in civilian abuses by looting businesses, intimidating women and children, demolishing entire city blocks in response to gunfire and relocating thousands of Jews into organized ghettos; while, engaging in summary executions of paramilitary and uniformed Polish troops. Soviet forces occupying the Eastern section of Poland engaged in similar abuses, including the infamous Katyn Forest massacre, where the Soviet secret police called NKVD executed over 20,000 Polish nationals in the same spirit of Operation Tannenberg.

Two years after the invasion of Poland, German forces initiated Operation Barbarossa, the invasion of the Soviet Union, in an effort to fully realize Hitler's dream of Lebensraum for Germans and the extermination of massive numbers of Jews and Slavs. Atrocities against POWS were especially prevalent, as evidenced by the 90% mortality rate suffered in the first year of combat<sup>vi</sup>. Under the impression that commissars of the NKVD were the lynchpin of the Red Army, German high command issued the Commissar Order which called for the immediate execution of any Soviet soldier suspected of being a commissar; however, the order resulted in the execution of many innocent men, because of the misconception among German foot soldiers that any Soviet with a Hammer and Sickle insignia was a commissar<sup>vii</sup>. POW camps were routinely raided by Einsatzgruppen units scouring for commissars, civic employees, intelligence workers, economic leaders, communist party members and Jews to be executed.

Much more malicious, are the unorganized shootings prevalent by German troops of Soviet captives in response to stories of Soviet atrocities regardless of race or political affiliation.

Amidst the brutality of German troops, the magnitude of Soviet POWs exacerbated an already poor situation, as the number of surrendering Soviet troops exceeded not only German estimates and planning; but also, exceeded German capabilities to care for them. German estimates placed the number of Soviet captives during the summer of 1941 to be around 600,000; however, the actual number is estimated in excess of 1,500,000 captives<sup>viii</sup>. German rail workers could not convert Soviet rail systems, which were poor anyway, to move POWs by rail and the vehicle fleet simply wasn't available to move the Soviets; hence, many POWs were forced marched to their camps with little clothing, shelter, food or water. German troops seized massive amounts of land in short bursts, leaving field commanders unable to hand over POWs to the proper authorities or let them loose with the threat of joining guerilla rebels to harass the already besieged supply lines, forcing commanders to order massacres instead. Enlisted men, for racial and reciprocal reason, often felt disinclined to accept prisoners in light of Soviet abuses.

Although much blame for atrocities lies with the Germans, Soviet soldiers engaged in equally brutal and inhumane massacres of German POWs as well. Soviet actions were typically condoned by high ranking officers and politburo members as evidenced by several large scale incidents in which 180 Germans were massacred at Broniki on June 30 1941, approximately 400 Romanians and Germans killed on orders from the commander of the 225<sup>th</sup> Rifle Regiment and 80 Germans murdered by members of the 26<sup>th</sup> Rifle Division<sup>ix</sup>. Marshal Boris Shaposhnikov of the Red Army Chief of Staff was reported to have been furious when he learned of Red Army servicemen taking personal effects, money and documents along with murdering them, an admittance that such activities occurred<sup>x</sup>. An event of especial barbarism occurred near the Crimea when 160 German wounded left behind in a field hospital in a hasty retreat were dispatched by various means including having their heads bashed in, being thrown out windows or mutilated whilst alive or even having water poured on them to freeze to death. Sentiments of humanity seemed to be lost in Soviet troops as depicted by Zinaida Pytkina, a female Soviet officer, who recounted

her feelings on executing a young, helpless German major following his interrogation, “My hand didn’t tremble. It was a joy for me...The Germans didn’t ask us to spare them and I was angry...I fulfilled my task. I went back into the office and had a drink.”<sup>xi</sup>

Especially heinous were the efforts of the SS against the large Jewish population of the Soviet Union as they breached various human rights laws and war crimes laws in their insidious war against the Jewish nation. The ultra-elitist Nazi organization known as the SS was given the duty of terrorizing the Jews with the Waffen-SS and Einsatzgruppen taking center stage in the campaigns against the Jews. The Einsatzgruppen initially attempted to instigate race riots between local ethnic majorities and Jews resulting in pogroms; however, the Germans were rarely satisfied with the willingness of indigenous populations to turn on their Jewish neighbors<sup>xii</sup>. A more common and more effective tactic was to organize “death squads” who would scour the countryside for Jews in government positions, of some local importance, of the intelligentsia or of military age; march them to a relatively remote area and massacre them on site. SS units normally led the way in atrocities against Jews; however, the army routinely found itself complicit in such raids as Nazi high commanders blurred the line between Jew and saboteur, engaging the army in anti-guerilla raids rather than racial attacks. Following the ineffectiveness and costs of initial genocidal efforts, the SS instituted a wide ranging system of concentration camps, where hundreds of thousands of undesirables could be “liquidated” in a single day.

With the climactic battles of Stalingrad and Leningrad came a climatic change in wartime atrocities, as Soviet troops, who have endured five years of warfare and atrocity viewing, began to inflict damage upon German civilian populations once they entered metropolitan Germany in 1944. German civilians, made fully aware of the impending onslaught of the Red Army, recoiled as German propaganda crews revealed footage from the village of Nemmerdorf, which in Autumn of 1944 had been laid waste to by the Red Army, featuring the corpses of raped women and girls by drunken Russian soldiers<sup>xiii</sup>. Many civilians in Berlin either felt the footage and tales of Soviet atrocity to either be over exaggerated propaganda or only possible in the countryside away from the prying eyes of foreign observers, a grave

mistake. Soviet troops haphazardly raped any woman, ranging in age from elderly to pre-pubescent, multiple times as a part of what they viewed as “plunder” for their hard fought war. The magnitude of the number of rapes committed in the city stands between 95,000 and 130,000 as reported by the leading hospitals of Berlin; however, this estimate only includes those who sought medical attention<sup>xiv</sup>. Soviet soldiers generally took it upon themselves to loot stores, especially watches and bicycles, and rape women, whom they selected upon physical attractiveness; however, while dedicated party members and military officials were genuinely embarrassed and appalled by such heinous crimes, Stalin seemed passively amused at the Red Army having “some fun” after such a tough war<sup>xv</sup>.

In conclusion, the horror of the Eastern Front lies in the atrocities it bore witness to; but, the tragedy lies in the justice, or lack thereof, for the perpetrators of those atrocities. Many of the highest ranking Nazis such as Adolf Hitler, Heinrich Himmler and Joseph Goebbels committed suicide in the 11<sup>th</sup> hour while others such as Herman Goering were tried and received fair punishment. Lost within the justice dealt to the highest ranking Nazis is the evasion of justice that pursued many lower ranking Nazis, who either were either granted clemency due to Cold War maneuvering or never tried for lacked of evidence, granting no justice for the victims of their crimes. Similarly, the massacred German POWs and score of female rape victims in Berlin received no justice, only the mercy of a “normal” life under communism.

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<sup>i</sup> Bellamy, C., Absolute War.

<sup>ii</sup> Ibid

<sup>iii</sup> Ibid

<sup>iv</sup> Ibid

<sup>v</sup> Megargee, G., War of Annihilation.

<sup>vi</sup> Bellamy.

<sup>vii</sup> Megargee.

<sup>viii</sup> Bellamy.

<sup>ix</sup> Ibid

<sup>x</sup> Ibid

<sup>xi</sup> Ibid

<sup>xii</sup> Megargee.

<sup>xiii</sup> Anonymous, A Woman in Berlin.

<sup>xiv</sup> Ibid

<sup>xv</sup> Ibid

**References**

Bellamy, C. Absolute War: Soviet Russia in the Second World War. New York: Alfred A Knopf, 2007.

Megargee, G. War of Annihilation: Combat and Genocide on the Eastern Front, 1941. Lanham, Maryland: Rowman & Littlefield Publishers Inc, 2006.

Anonymous. A Woman in Berlin: Eight Weeks in a Conquered City, A Diary. New York: Metropolitan Books, 2000.

## **Gender Stereotypes and Career Choices of College Students**

Author: Elena Brown

Faculty Mentor: Melissa Terlecki, Ph.D.

Abstract: This study examined the relationship between gender stereotypes and career choices among college students. It was hypothesized that participants would associate stereotypes with each gender and profession, that the experimental group would answer according to stereotypes more than the control group, and that major and career choice of the participants would be affected by stereotypes. An ex-post facto study was used and experimental and control versions of the survey were randomly given to 50 college students. After running a one-way analysis of variance, the results of the study showed that the participants affiliated certain genders to certain careers and that the experimental group answered more stereotypically than the control group. One of the hypotheses was not supported — participants did not feel gender played a role in their choice of major or possible career. Future research should intend to uncover more about the direct and indirect effects of gender stereotypes on the career choices of college students.

Gender is a crucial part of individual identity. Unfortunately, gender identity is tainted by inaccurate gender stereotypes that are heavily present in today's society. These gender stereotypes affect many individuals to the point where they are unconsciously believed and, at times, reinforced. Gender stereotypes are commonly emphasized in the professional world and can lead young adults in college to pursue careers that are based on false stereotypes of a certain gender. The truth about gender stereotypes must be revealed in order to reduce the negative associations with certain genders and gender-specific professions.

Gender stereotypes are based on qualities that are assigned to men and women because of their

gender by society. Prentice and Carranza (2002) explored these ascribed gender-specific qualities by categorizing them based on their social desirability levels. To study this idea, Prentice and Carranza gathered 208 undergraduates (104 men, 104 women) and asked them to rate a long list of traits based on social desirability for a man, a woman, and a person (gender neutral). The participants were also asked to rate these traits based on the typicality each quality was for each gender. Qualities associated with women included sensitivity, niceness, and modesty, while men were affiliated with the qualities of strength, drive, and assertiveness. The results of this study reflected the stereotypical trait assignment for each gender, illustrating the existence of gender stereotypes and their inherent nature in the minds of college students. This study suggests that gender stereotypes are ingrained by society, and it would be interesting to note some of the ways in which these stereotypes are implanted.

One of the ways in which gender stereotypes are perpetuated is through the media. Davies, Spencer, and Steele (2005) designed a study to determine whether exposure to stereotype threat through television commercials would affect a woman's choice to be a leader or a follower in a leadership task. The study consisted of 61 undergraduate students (30 men, 31 women) who were randomly assigned to groups. One group was exposed to six gender-neutral commercials that did not speak to either sex; rather, they advertised products such as cell phones and gas stations without the use of human actors. The other group of participants viewed four gender-neutral commercials mixed with two gender-stereotypic commercials, both involving women and the need for beauty. After watching the commercials, the participants were informed of a task that would test leadership strategies and were instructed to indicate their interest in assuming the leadership role. The results of this study demonstrated that the women who were exposed to the gender-stereotypic commercials were less likely to assume leadership in the task than the women who were not exposed to these commercials. The study showed that a woman would be less likely to take on leadership positions, therefore, less likely to pursue professions requiring strong leadership. These results are important when studying the career interests among college students due to



the negative effect that the media can have on women's career choices.

The general population knows of gender stereotypes through media exposure and human interaction, but the age in which they are learned is not yet fully determined. Previous research on the subject had yielded varied results. Powlishta (2000) examined the target age for learning gender stereotypes. Researchers have proposed one view in which children are less likely to stereotype genders than adults because they are still learning about gender roles in society (Mischel, 1966). Opposing researchers have believed that children are more likely to participate in gender stereotyping than adults because children are less individualized and do not understand that gender roles are binding (Carter & Patterson, 1982; Damon, 1977; Turiel, 1978). Powlishta conducted two studies to evaluate these differing hypotheses. Study 1 included 48 child participants (8 to 11 years old), as well as 28 adults (20 to 42 years old). Participants were presented with pictures of 4 men, 4 women, 4 boys, and 4 girls and were asked to rate the people in the pictures on particular qualities associated with gender, such as gentleness for women and strength for men. The results of study 1 showed that all participants stereotyped according to gender.

Powlishta's second study incorporated 81 college students (54 women and 27 men). Participants were given a list of 48 stereotypical masculine and feminine traits and were asked to appoint each trait a number based on a scale ranging from "child-like" to "adult-like" attributions. Results showed that feminine traits were considered more childlike, whereas masculine traits were perceived as more adultlike. Powlishta's studies demonstrate that college-aged adults are influenced by the gender stereotypes that society presents. Furthermore, the feminine qualities that were distinguished as more childlike are consistent with the negative associations with women.

As Powlishta's research explained, because of society's intrinsic gender stereotypes, children learn the qualities associated with each gender at a young age. These inaccurate associations are so

convincing that they may remain with an individual from childhood into adulthood as gender identities are formed. Likewise, Oswald and Lindstedt (2006) analyzed self-stereotypes of gender among 178 college students. The first portion of the study measured participants' awareness of gender stereotypes by asking them to list traits that were associated with each gender; rating the traits as positive, negative, or neutral; and the degree to which each trait was true for each gender. The second portion of this study tested self-stereotypes, utilized the previous list of gender traits, and asked the participants to rate the degree to which each trait was true of him- or herself. Oswald and Lindstedt expanded the study by asking the participants to complete a self-esteem and self-schema survey in English, Mathematics, and Science academic areas.

Results unveiled that the participants delineated traits as masculine or feminine in accord with societal views of masculinity and femininity. Regarding self-stereotyping, the participants were more likely to selectively self-stereotype: they associated themselves with more positive stereotypes of their gender rather than negative. This finding again provides evidence that gender stereotypes are evident. Furthermore, the self-schemas related to academics illustrated that men associated positively with mathematics and negatively with English, while women did not selectively self-stereotype in any of the cognitive areas. The results of this study and others suggest that gender stereotyping may persist from childhood and into young adulthood and assists in identity formation, which is an important point to consider when studying how college students choose a career.

Oswald and Lindstedt's study touched on the idea of self-schema and academics in regards to gender. Similarly, Kiefer and Sekaquaptewa (2007) explored gender stereotypes of women in a college-level mathematics course based on the notion that women frequently experience a stereotype threat in mathematics courses due to the common idea that men outperform women in that area. Kiefer and Sekaquaptewa hypothesized that women who implicitly stereotype themselves based on gender norms are

more likely to be negatively affected when performing in mathematics courses. To test this hypothesis, the researchers studied 63 women in a semester-long Calculus course in college. The women were evaluated on many measures which included implicit gender stereotyping tests, explicit gender stereotyping tests, gender identification tests, career goal scales, and their final course performance report. The findings affirmed that the participants more often associated men with mathematics and women with humanities, similar to the conclusion in the Oswald and Linstedt study. The exam scores of the course indicated that the women with higher stereotyping scores had a poorer performance in mathematics. Likewise, the women's responses in regards to career goals demonstrated that women with higher gender stereotyping scores were less likely to pursue a career in mathematics. This study is significant when considering a college student's career choice because it suggests that women may feel a certain way about a profession in which they are not "supposed" to succeed.

Quinn and Spencer (2001) also analyzed how this stereotype acts as a threat for women in a mathematical domain. To determine this effect, 54 female and 54 male college students took two math tests: a math word problem test and a numerical test. The participants were randomly separated into groups of mixed gender and were randomly given one of the two tests. In the results of this study, women scored lower than men on the word problem test; however, on the numerical test, men and women scored similarly. These results affirmed that women and men have the potential to be equally matched in mathematical ability. This study illuminates some aspects of stereotype threat, but further research should be conducted to clarify the implications of stereotype threat, such as its effect on career choices.

Stereotype threat seems to be a frequent determinant in a woman's choice in her academic interests and career pursuits. Because of stereotype threat, some academic domains become associated with one gender over another. Steele, James, and Barnett (2002) studied how women in male-dominated academic areas are perceived and whether they feel discriminated or stereotyped against while in these

areas. First, Steele and colleagues determined which academic areas were male and female dominated, illustrating that men dominated engineering, math, and science, while women dominated humanities and social science. Second, Steele et al. presented 801 male and female participants with a questionnaire assessing how participants in each major were discriminated against in regards to his or her sex. To evaluate the stereotype threat felt by each participant in his or her major, Steele used the Stereotype Vulnerability Scale (Spencer, 1993). The results of this study revealed that women in male-dominated areas felt strong levels of sex discrimination towards themselves and other women in their field. The findings also showed that the women in male-dominated areas were more likely to feel threatened by negative gender stereotypes and more likely to consider changing majors. This study further suggests that women may feel disconnected in male-dominated fields of study because they are expected to achieve less success in that area; therefore, gender stereotypes do play a role in career choices. Again, further research needs to measure how men are affected in women-dominated academic areas.

In relation to the thought of women in gender-specific professions is the consideration of dominant female leaders. Ritter and Yoder (2004) tested this concept by reviewing Role Congruity Theory, which states that men are more likely to become leaders than women in situations when assumptions of the leadership role correspond with gender stereotypes. The researchers created a study in which 120 women and 120 men were paired up by same or opposite sex and dominance levels (low or high), which were gathered in a previous data collection utilizing a dominance scale. While being videotaped, each duo performed tasks that were considered masculine, feminine, or gender neutral in order to gauge which member of the pair would emerge as a leader while fulfilling the task. The results of the study revealed that the individual who scored highest on the dominance scale emerged as the leader during the tasks 67% of the time in same-sex partnerships. The mixed-sex duos, however, displayed that men took the lead 65% of the time, even if the woman in the pair was the high scorer on the dominance scale. If the tasks were masculine or neutral, the man was still the leader, even if he was less dominant.

These findings indicate that even if a woman possesses the dominance needed for a leadership role, gender stereotypes and masculine tasks dissuade her from taking the position. Although the presence of the video camera while the participants performed the task may have affected their performance, these findings are valuable because they reaffirm the existence of gender stereotypes and the negative perceptions of female leaders.

Leadership roles also materialize in the work force and again relate back to career. If a woman accepts the negative stereotypes about her gender, it is likely that her beliefs will affect her ability to take on leadership positions when she chooses a career. Razumnikova (2005) reviewed how gender stereotypes and life values account for career choices among the sexes. Razumnikova presented a survey to 476 participants between 17 and 22 years of age. The survey asked questions regarding which professions were considered masculine and/or feminine in order to gauge gender associations and stereotypes. For the “life values” (such as desire to achieve) portion of the research, a questionnaire with 36 questions, was used. The results of the survey showed that the participants affiliated masculine professions such as the military and construction with the consistent male stereotypes. Participants strongly associated women with home economics and only slightly with medicine, cooking, and teaching. Regarding life values, the participants acted in accord with stereotypes and preferred typically feminine or masculine values, yet some women chose more masculine values because they were in stereotypically masculine professions. These results concluded that career choices are modified by gender-roles and life values, and stereotypes in professions do exist and can affect career choices.

These studies provide evidence for the existence of gender stereotypes, as well as their influence in associating genders and careers. While these studies are important for background knowledge regarding the reality of gender stereotypes, few of them provide conclusive information on how a young adult’s career choice is based upon the perceptions of gender. Furthermore, these studies heavily focus on

women, but few mention the impact gender stereotypes have on men. This study attempts to enhance the findings of these studies and explore how closely gender stereotypes affect the career choices of male and female college students. This study is testing three hypotheses. The first hypothesis is that participants will associate stereotypes with each gender and profession. The second hypothesis is that the experimental group will answer according to stereotypes more than the control group. Finally, the third hypothesis is that the major and career choice of the participants will be influenced by gender stereotypes.

### **Methods**

**Participants:** The sample in this study included 50 Cabrini College students (25 females, 25 males). There were 25 participants randomly assigned to the control group and 25 to the experimental group. Ages ranged from 18 to 24 ( $M = 21$ ), and all academic years were included. Almost all majors were included, the most common being education. Participants were recruited using haphazard sampling. Participants included friends, acquaintances, residents of Cabrini College Apartment Complex and Woodcrest residence hall, and students of an Introduction to Psychology course.

**Materials:** A self-constructed survey consisting of forty questions was used in this study. Four of the questions requested demographic information, sixteen of the questions tested general stereotype perception, and twenty of the questions asked the participants to associate one gender with the provided careers. The experimental group was presented with stereotypical occupations such as firefighter, construction worker, and nurse, while the control group was presented with stereotypically ambiguous occupations such as musician, author, and zoologist. The purpose of these twenty gender-career associations for the two groups was to determine if the application of the gender stereotype variable created a significant difference between the groups on their amount of stereotyping. A consent form was also presented to the participants. The survey took approximately five minutes to complete. (See Appendix.)

**Procedure:** Each participant was randomly administered a control or experimental version of the survey and was asked to complete it honestly. They were also asked to sign a consent form that would not be attached to their survey responses in order to assure confidentiality. While each participant responded to the survey, I left their proximity. The majority of participants completed the survey in a dorm room, while some responded to it in a classroom or in Jazzman's café. After they finished, their survey and consent form were placed into a folder only accessible to the researcher.

**Results:** A one-way analysis of variance (ANOVA) was conducted to ascertain a significant difference in the level of gender stereotyping among careers between the experimental and control groups. The ANOVA compared the stereotypical gender and career associations of the experimental group ( $M = 38.52, SD = 1.39$ ) against the control group ( $M = 34.32, SD = 2.08$ ). The results were significant,  $F(1, 48) = 70.71, p = .00, \eta^2 = .60$ . Thus, the experimental group answered more stereotypically than the control group.

Results of question 21 showed that 98% of participants agreed that there were stereotypes associated with being male or female. Question 22 revealed that 82% of participants believed that some of these stereotypes were true, while 8% believed that they were all true. Question 27 demonstrated that 72% of participants associate genders with particular careers. These frequencies are reported in Table 1 in the appendix.

Results of question 29 revealed that 68% of participants felt that gender played no part in their choice of major and future career, while 28% felt it played some part. Question 31 illustrated that 84% did not feel discriminated against in their major because of their gender. Seventy percent of participants thought there was no possibility of being discriminated against in their career, according to question 32. Question 33 showed that 58% of participants would feel out of place in a career that is dominated by the opposite sex. These frequencies are reported in Table 2 in the appendix.

**Discussion:** Based on this data analysis, the two hypotheses were supported. The ANOVA revealed that the experimental group associated gender and careers based on stereotypes significantly more than the control group. This finding is similar to the study conducted by Razumnikova (2005) in which participants acted in accord with stereotypes when affiliating gender to occupations. Other analyses showed that the majority of participants did feel that there are stereotypes associated with gender and with careers. These results indicate that gender stereotypes have an impact on the perception of the relationship between careers and gender. However, the results also show that the participants do not feel that they have chosen a major and/or a career based on gender, nor do they feel that they will be discriminated against because of their gender in a future career. This result may be due to subconscious perceptions of personal choices and may not reflect reality. Some individuals may not realize the role of gender in their career interests, which seems incongruent with their stereotypical perceptions. The results of this study indicate importance because they illustrate the existence of gender stereotypes in the minds of college students, which may play an unacknowledged role in their college major and career choices.

Confounds of the study may have included the setting in which the participants took the survey. Some participants were in a noisy environment, while others completed the survey around friends, which may have impacted their answers. Furthermore, I wish that I could have used a larger sample – perhaps there would have been other significant effects with more participants. Future research should intend to uncover more about the direct effects of gender stereotypes on the career choices of college students. This research should finally determine whether young adults are directly guided by gender stereotypes when they choose a major and a career path or whether these stereotypes play no role in their choices. This research needs a large and diverse sample. It should aim to educate the participants about gender stereotypes and consequently encourage them to strive for any career they desire. Future research is important because it could allow individuals to realize the ability to pursue any career without societal expectations and gender restrictions. All individuals should have an equal opportunity to elect a career



based on their interests and skills without gender affecting the decision.

### References

- Carter, D. B., & Patterson, C. J. (1982). Sex roles as social conventions: The development of children's conceptions of sex-role stereotypes. *Developmental Psychology, 18*, 812-824.
- Davies, P. G., Spencer, S. J. & Steele, C. M. (2005). Clearing the air: Identity safety moderates the effects of stereotype threat on women's leadership aspirations. *Journal of Personality and Social Psychology, 88*(2), 276-287. doi: 10.1037/0022-3514.88.2.276
- Damon, W. (1977). *The social world of the child*. San Francisco: Jossey-Bass.
- Kiefer, A. K. & Sekaquaptewa, D. (2007). Implicit stereotypes, gender identification, and math-related outcomes: A prospective study of female college students. *Psychological Science, 18*(1), 13-18. doi: 10.1111/j.14679280.2007.01841.x
- Mischel, W. (1966). A social learning view of sex differences in behavior. In E. E. Maccoby (Ed.), *The development of sex differences*. Stanford, CA: Stanford University Press.
- Oswald, D. R., & Lindstedt, K. (2006). The content and function of gender self stereotypes: An exploratory investigation. *Sex Roles, 54*(7-8), 447-458. doi: 10.1007/s11199-006-9026-y
- Powlisha, K. K. (2000). The effect of target age on the activation of gender stereotypes. *Sex Roles: A Journal of Research, 42*, 271-82. Retrieved from ERIC database.
- Prentice, D. A., & Carranza, E. (2002). What women and men should be, shouldn't be, are allowed to be, and don't have to be: The contents of prescriptive gender stereotypes. *Psychology of Women Quarterly, 26*, 269-281. Retrieved from ERIC database.

- Quinn, D. M., & Spencer, S. J. (2001). The interference of stereotype threat with women's generation of mathematical problem-solving strategies. *Journal of Social Issues, 57*, 55-71. Retrieved from ERIC database.
- Razumnikova, O. M. (2005). The interaction between gender stereotypes and life values as factors in the choice of profession. *Russian Education & Society, 47*, 21-33. Retrieved from ERIC database.
- Ritter, B. A., & Yoder, J. D. (2004). Gender differences in leader emergence persist even for dominant women: An updated confirmation of role congruity theory. *Psychology of Women Quarterly, 28*, 187-193. Retrieved from ERIC database.
- Spencer, S. J. (1993). The effect of stereotype vulnerability on women's math performance. Unpublished doctoral dissertation, University of Michigan.
- Steele, J., James, J. B. & Barnett, R. C. (2002). Learning in a man's world: Examining the perceptions of undergraduate women in male-dominated academic areas. *Psychology of Women Quarterly, 26*(1), 46-50. doi: 10.1111/1471-6402.00042
- Turiel, E. (1978). The development concepts of social structure. In J. Glick & K. A. Clarke-Stewart (Eds.), *Studies in social and cognitive development* (Vol. 1). New York: Gardner.

### Appendix

*Table 1.*  
Frequencies Among Answers for Questions 21, 22, and 27.

	<u>Frequency</u>	<u>%</u>
Question 21		
Yes	49	98%
No	1	2%
Question 22		
Yes	4	8%
Some of them	41	82%
No	5	10%
Question 27		

Yes	36	72%
No	14	28%

*Table 2.*  
Frequencies Among Answers for Questions 29, 31, 32, and 33.

	<u>Frequency</u>	<u>%</u>
Question 29		
A large part	2	4%
Some part	14	28%
No part	34	68%
Question 31		
Very	0	0%
Moderately	8	16%
Not at all	42	84%
Question 32		
Yes	15	30%
No	35	70%
Question 33		
Yes	29	42%
No	21	58%

### **Career Interests**

**Elena Brown, Psychology Department, enb722@cabrini.edu, (717) 968-1937**

**Dr. Melissa Terlecki, Psychology Department, mst723@cabrini.edu**

You are invited to participate in a research study investigating career interests among college students. To help us gain further insights into this area, we are asking you to complete a survey pertaining to your thoughts, preferences, and feelings about certain careers and your own career interests.

The survey does not have any physical or emotional risks. The benefits to your participation may include a greater understanding of your interests and preferences.

The data you will provide will be recorded anonymously and your participation will be held in the strictest confidence. Your responses will not be connected to your name.

Your participation in this study is voluntary, and you may refuse to participate at any time without consequence or prejudice. The survey should take less than five minutes to complete.

We welcome questions about this survey at any time. If you have any questions regarding your rights as a participant, you can contact the Chair of the Institutional Review Board at Cabrini College, Dr. Tony Verde, at [tony.j.verde@cabrini.edu](mailto:tony.j.verde@cabrini.edu) or (610) 902-8350.

By signing your name below, you are indicating that you have read and understand the contents of this Consent Form and that you agree to take part in this study.

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Participant's Signature \_\_\_\_\_ Date \_\_\_\_\_

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Researcher's Signature \_\_\_\_\_ Date \_\_\_\_\_

**Career Interests Survey**

The following is a survey of career choices among college students. Your participation in this survey is entirely voluntary and confidential. If you have any questions, please contact Elena Brown ([enb722@cabrini.edu](mailto:enb722@cabrini.edu) or 717-968-1937).

Gender: \_\_\_\_\_

Age: \_\_\_\_\_

Year in School: \_\_\_\_\_

Major(s)/Minor(s): \_\_\_\_\_

**I. Please select the gender you more often associate with each occupation.**

1. Firefighter

2. Construction Worker

Male

Female

Male

Female

3. Nurse	Male	Female	12. Engineer	Male	Female
4. Kindergarten teacher	Male	Female	13. Sanitation worker	Male	Female
5. Lumberjack	Male	Female	14. Interior designer	Male	Female
6. Lawyer	Male	Female	15. Pilot	Male	Female
7. Police officer	Male	Female	16. Judge	Male	Female
8. School principal	Male	Female	17. Dentist	Male	Female
9. Business manager	Male	Female	18. Housekeeper	Male	Female
10. Comedian	Male	Female	19. Hairdresser	Male	Female
11. Computer programmer	Male	Female	20. Architect	Male	Female

**II. Please circle your answers to the following questions.**

1. Please select the traits you typically associate with women. (Circle as many as you wish.)

Gentleness	Kindness	Ambitious
Assertiveness	Intelligence	Manipulative
Strength	Sincerity	Cooperative
Logical	Friendliness	Independent
Sensitivity	Competitive	Generosity

2. Please select the traits you typically associate with men. (Circle as many as you wish.)

Gentleness	Kindness	Ambitious
Assertiveness	Intelligence	Manipulative
Strength	Sincerity	Cooperative
Logical	Friendliness	Independent
Sensitivity	Competitive	Generosity

3. After selecting traits for each gender, do you feel that there are stereotypes associated with being male or female?

Yes                      No

a. If yes, do you think some or all of these stereotypes are true?

Yes                      Some of them                      No

4. Which gender do you think assumes leadership positions more often?

Male                      Female

5. How comfortable would you feel being the leader of a group of individuals of the opposite sex?

Very comfortable                      Somewhat comfortable                      Not comfortable at all

6. Do you think the media portrays one gender in a leadership role over the other gender?

Yes                      No

7. Do you think the media stereotypically portrays each gender in particular careers?

Yes                      No

8. Do you think you associate genders with particular careers?

Yes                      No

9. Do you think people may choose a career based on the gender stereotypically associated with that career?

Yes                      No

10. How much of a part do you feel gender played in your choice of major and possible future career?

A large part                      Some part                      No part

11. Do you feel that if someone entered an occupation that is not typically associated with their gender,

they may become discriminated against?

Yes                      Possibly                      No

12. As a male/female, do you feel out of place and/or discriminated against in your major because of your gender?

Very                      Moderately                      Not at all

13. What career do you wish to pursue with your major?

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14. Do you think there will be a possibility of being out of place/discriminated against in your career because of your gender?

Yes                      No

15. Would you feel out place in a career that is dominated by the opposite sex?

Yes                      No

Thank you!

## **Migration and its root cause in poverty as witnessed in Guatemala**

**Author: Michelle Costa**

**Faculty Mentor: Jerry Zurek, Ph.D.**

Abstract: Guatemala, as the second poorest country in the Western Hemisphere, is the source of considerable migration northward to Mexico and the United States. During a short-term study trip in January 2010, six Cabrini students were able to witness the poverty that provides the "push" factor in migration as well as to speak with Guatemalans who have found a somewhat-stable source of income from jobs in San Lucas Toliman Mission.

Guatemala is a country that offers a vibrant spirit, rich cultures, but impoverished conditions. Guatemala is about the size of Pennsylvania, and like Pennsylvania, a region with fertile farmland, mountains and lakes. However, a 36-year civil war, from 1960-1996, tore homes and families apart, and pushed Guatemala even deeper into poverty than it was from 400 years of colonial repression.

As a result of the war a total of one million Guatemalans were reported dead or missing. Many Guatemalans, who had fled the violence as displaced citizens, returned back to Guatemala, after spending time in United Nations refugee camps in Mexico.

Although remarkable numbers sustained and continued life in their country, many felt the hit of extreme poverty and devastation and turned to the United States for salvation and hope. Guatemala's most important resource is fertile land, that makes up about one quarter of its gross domestic product. But land ownership is in the hands of the rich, while poor farmers have no land to call their own.

Due to the fact there is no economic stability, the CIA Factbook reports that three quarters of the indigenous population lives below the poverty line, one quarter in extreme poverty, and cannot provide for the families (World Factbook, Guatemala). Because conditions are so harsh and unacceptable to continue a successful life, many feel the need to migrate, in the hopes of earning enough money to feed their children at night.



A estimated number of 40,000 Guatemalans per year migrate to both Mexico and the United States (World Factbook). From recent government reports, there is about 60,000 Guatemalans that are deported from Mexico, with about 2,500 deportations from the United States per year. According to multiple studies the reason for migration often reflects back to the root causes of “push and pull” factors.

The push factors are the conditions that drive people to want to leave their homes, and pull factors are the attractions to a new area with new opportunities. During a recent trip to the community of San Lucas Toliman, Guatemala, we were able to witness and speak with men and women about their living conditions. They said that most are able to find employment each day in their community. One man told us that jobs include coffee picking and construction, both earning barely \$4 a day. Many in Guatemala live on less than that. The U.S. State Department reports that "about 51% of the population lives on less than \$2 a day and 15% on less than \$1 a day" (U.S. State Department website). He said that he was fortunate when he was able to get work that lasted for a period of time such as the coffee-picking season.

Some of these jobs that last for an extended period of time are a result of the presence of Father Greg Shaffer, a priest from New Ulm, Minnesota. He started his service at San Lucas in 1962 and has been present ever since. He has overseen the gradual construction of a “socio-economic” program that is devoted to the enhancements and enrichments of the “whole person.” His mission is to address the immediate effects of poverty and the underlying causes (Schaffer, public presentation, Jan. 6, 2010).

If the conditions in a better location like San Lucas Toliman are barely acceptable how are the people in other parts of Guatemala supposed to survive, without a supportive community such as the San Lucas mission? More and more people are escaping to the States with one

purpose: To save the lives of their families one undocumented step at a time. As this becomes a more popular route to attempt, the cost of coyotes only continues to escalate.

The payment to a coyote for a border crossing, many sources say is about \$5,000-\$10,000 to be taken to the border and an additional \$1,500 to actually cross it. Many think the journey is completed with a payment so steep, but the danger and chance of abuse is greater than any sum of money.

Often times people are physically and sexually abused, robbed, or trafficked into other injustice industries. Young and old, men and women, all face the heartbreaking journey to reach American soil to provide the basic necessities a family needs to survive.

San Lucas, under the supervision and care of Father Greg, has flourished as a village that provides sustainability and advancements, but even then, low wages barely serve or cover financial needs. One man we spoke to said that bread and meat were “luxuries.” Tortillas and meat once a month in soup were the norm.

People of San Lucas are much more fortunate than those in surrounding areas. However, recently the town has been seeing growth and movement of young people towards the capital of Guatemala City.

From there more and more have decided to illegally migrate to the States, due to the greater employment opportunities. After interviews with people of the community many agree that migrating to the States is very hard on families, and in most cases parents do not return and leave children to be raised by grandparents. Some have even faced situations where husbands remarry while away.

Family separation is the most challenging issue that needs to be observed when examining the need for U.S. immigration law reform. Because there is such a lack of work visas

to the U.S., people do not have any other choices but to be undocumented and hidden in the shadows without a legal identity.

Immigration reform in the U.S. would allow workers to come legally here for a time on a temporary work visa and then return home. Or if a wage earner was already here, he could earn a path to legalization and bring his family to the U.S.

Through the San Lucas mission it has also been recognized that the younger generation is losing touch of the Mayan culture, and long to be in the States to provide for themselves in an independent manner. The hard working people of San Lucas have been granted the largest gift of being guided by a man of such powerful aspirations, but there still lies the desire of a better life outside the lake of Atitlan.

#### References

- Burpee, G., Heinrich G., & Zemanek, R. (2008) *Integral Human Development: The Concept and the Framework*. Baltimore: Catholic Relief Services.
- Schaffer, G. public presentation, January 6, 2010.
- U. S. Central Intelligence Agency (2010). *World Factbook*. Guatemala: Economy. As retrieved from <https://www.cia.gov/library/publications/the-world-factbook/geos/gt.html>.
- U. S. Department of State (2010). *Guatemala*. As retrieved from <http://www.state.gov/r/pa/ei/bgn/2045.htm>.

Title: African American Soldiers in the Civil War

Author: Jeffrey T. Young

Faculty Mentor: Courtney Smith, Ph.D.

**Abstract:** This paper examines the contributions of African American soldiers in the American Civil War. It examines the reasons why African American men fought for the Union Army, the treatment they received, and their performance during key battles. This paper also examines the role Frederick Douglass played in encouraging African American men to enlist in the Union Army. Additionally, this paper highlights the efforts of the 54<sup>th</sup> Massachusetts Regiment, the regiment made famous in the movie Glory starring Denzel Washington and Matthew Broderick.

When African Americans were finally allowed to fight for their country in the American Civil War, many of them stepped up and seized the opportunity. For example, the film Glory, starring Denzel Washington and Matthew Broderick, sheds important light on the contributions of a Massachusetts regiment comprised of all blacks that fought bravely for the North. In a war that would greatly affect all black Americans' way of life, this paper will examine the many factors in which the black soldiers became involved in the war. Some of the important questions that will be answered include: how many blacks fought for the North, what was their motivation for fighting, how were the black soldiers treated, and how did blacks perform in the battles they fought in.

From 1861 to early 1863, African American soldiers were barred from taking place in the fighting by the Militia Act of 1792.<sup>i</sup> President Abraham Lincoln and his advisers strongly considered recruiting black soldiers right away, but decided against it in order to not alienate the border states. Finally on New Year's Day 1863, Lincoln's all important Emancipation Proclamation went into effect, freeing all of the slaves in the Confederacy.<sup>ii</sup> This executive order also allowed the integration of black soldiers into the formerly all white Union army. The initial African American soldiers for the Union were volunteers who stepped up in the North's dire need of healthy men to fight the war against the South. After the initial surge in African American recruits, interest in joining the army from black Americans quickly started to dwindle.<sup>iii</sup> African American men greatly needed a heroic figure to encourage and inspire them into enlisting into the armed forces of the Union. This heroic figure came in the form of one Frederick Douglass.

Frederick Douglass freed himself from the possession of his slave master in 1838, and from then until the day that he died, he worked hard in pursuit of equal rights for African Americans. He is probably the most well known and most influential African American abolitionist in United States history. Before Lincoln passed the Emancipation Proclamation, Douglass heavily urged Union leaders to act upon his primary belief: that because the war was being fought to end the enslavement of African Americans, they should be able to participate in the war themselves. Once the Emancipation Proclamation went into effect, Douglass strongly aided in the rapid rise of African American recruitment by telling all black men that they would be promised full American citizenship if they fought for their country in the war. Not surprisingly, two of Douglass' own sons were strongly involved in the African American war endeavor as well.<sup>iv</sup>

Overall, all of Douglass' tireless efforts for his cause succeeded. A grand total of approximately 179,000 African American men (10% of the United States Army) served their country well during the Civil War; in addition to that number, another 19,000 black men served in the United States Navy during the war.<sup>v</sup> However, with so many African Americans serving in the bloodiest war ever fought on U.S. soil, many of them were not lucky enough to make it out alive. Approximately 40,000 of black soldiers died during the

course of the Civil War, 30,000 of disease or infection; thousands of other black soldiers sustained major injuries.<sup>vi</sup>

Since racism was so deeply engrained into American society at the time, every African American soldier experienced racism during his service. Every African American regiment had to be commanded by a white officer. Many of these white officers strongly derided and despised their very own men. However, “the vast majority of white officers fully supported the war effort and service with blacks. For them, the war had always been or had become one of reunion and abolitionism.”<sup>vii</sup> The most prominent example of a white officer who led an all African American unit is Colonel Robert Shaw of the 54<sup>th</sup> Massachusetts Voluntary Infantry Regiment. This group launched an assault on the Confederate stronghold of Fort Wagner in South Carolina on July 18, 1863. Although they were unable to capture the fort, the 54<sup>th</sup> Massachusetts Regiment gained nationwide renown for their bravery and courage in the heat of battle. This acclaim helped in the recruitment of African American soldiers. Even Lincoln commended the group, saying that the battle was an important factor in the final victory for the Union.<sup>viii</sup>

One of the members of the 54<sup>th</sup> Massachusetts Regiment, Corporal James Henry Gooding, chronicled his life in the army during the Civil War. He wrote about all aspects of army life, including the attack on Fort Wagner, the lack of black officers, the ongoing racism, and the unequal pay of black and white soldiers. In a letter to President Lincoln demanding equal pay, Corporal Gooding spoke some very profound words. He said, “the patient, trusting Descendants of Afric’s Clime [sic] have dyed [sic] the ground with blood, in defense of the Union, and Democracy...now if the United States exacts uniformity of treatment of her Soldiers, would it not be well and consistent to set the example herself by paying all her soldiers alike?”<sup>ix</sup>

Overall, if African American soldiers were never allowed to fight in the Union Army, we may still be living in a country where slavery is commonplace. The African American soldiers’ consistent acts of bravery and courage in battle helped the Union defeat the insurgent Confederates in a war where the outcome could have gone either way. The integration of African Americans into the Union Army also paved the way for a more than century long battle for equal rights for all in the United States.

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<sup>i</sup> “Militia: United States” *Encyclopedia Americana*, 112.

<sup>ii</sup> “Emancipation Proclamation,” 884-85.

<sup>iii</sup> Weidman, B., “Black Soldiers in the Civil War.”

<sup>iv</sup> Blight, D.W., 312-14.

<sup>v</sup> Weidman, “Black Soldiers in the Civil War.”

<sup>vi</sup> Ibid.

<sup>vii</sup> Glatthaar, J. T., 81.

<sup>viii</sup> “History of the 54<sup>th</sup>,” <http://www.54thmass.org>

<sup>ix</sup> Gooding, Corporal J.T., 119-120.

References

Blight, D. W. "Frederick Douglass." *Encyclopedia Americana*. 74th ed. 19 vols. Danbury, CT: Grolier, 2001.

"Emancipation Proclamation." *Encyclopedia of the American Constitution*. 2<sup>nd</sup> ed. 2 vols. New York, NY: Macmillan Reference USA, 2000.

Glatthaar, J. T. *Forged in Battle: The Civil War Alliance of Black Soldiers and White Officers*. New York, NY: The Free Press, 1990.

Gooding, Corporal J. H. *On the Altar of Freedom: A Black Soldier's Civil War Letters from the Front*. Amherst, MA: The University of Massachusetts Press, 1991. 119-20.

"History of the 54th." 54thmass.org. Company B, 54<sup>th</sup> Massachusetts Volunteer Infantry Regiment, n.d. Web. 18 Apr 2010.

"Militia: United States." *Encyclopedia Americana*. 74th. 19 vols. Danbury, CT: Grolier, 2001.

Weidman, B. "Black Soldiers in the Civil War." The U.S. National Archives and Records Administration, 1999. Web. 18 Apr 2010.

## **The Effects of Service-Learning on Undergraduates**

Author: Kathryn Juliana  
Faculty Mentor: Melissa Terlecki, Ph.D.

Abstract: A research study was conducted with the purpose of discovering the relationship between participation in a service-learning trip and attitudes toward compassion and social justice. The Davis Interpersonal Reactivity Index was used to study compassion with sub-scales measuring empathetic concern and perspective taking. The Student Service-Learning Course Survey (SSLCS) was employed to measure social justice attitudes with sub-scales measuring personal competence, interpersonal relationships, charity and social justice responsibilities. Participants in two service-learning trips, one abroad to Ecuador and other to the Appalachian region of West Virginia were compared to student athletes on the men's and women's lacrosse teams who participated in spring training trips. Results for the Davis Interpersonal Reactivity Index showed the men's lacrosse team member's difference between pre and post scores was significantly lower than service-learning groups but significantly higher than the women's lacrosse group. The service-learning trip groups had significantly higher differences in mean scores for the charity sub-scale of the SSLCS than either athletic group. Both the Ecuador and Appalachia groups had a higher difference in mean score than the women's lacrosse team on the social justice sub-scale, but lower than men's lacrosse. Thus the service trips have some effect on social justice and empathy attitudes, but there are also other variables at work.

### **Introduction**

Learning is often expected to occur inside the classroom. Many spend over two decades in a classroom learning everything from basic writing, reading and arithmetic to college courses in major or trade-based programs. Although these skills are necessary and serve as a basis of knowledge for any career, does it prepare you for the "real world"? Many colleges and universities have begun to develop curricula that include learning experiences outside of the classroom. Institutions of higher education are searching for programming that will encourage

students not only to be successful in the world of academia, but also become engaged citizens in the community. Colleges and universities are attempting to engage their students through service-learning with the goal of teaching them about the reality of the society we live in. By employing service-learning, undergraduates gain exposure to social justice issues, and hopefully a commitment to resolving them.

Plante, Lackey and Hwang studied students who participated in one of seven different immersion trips to measure compassion.<sup>8</sup> They compared these students to a control group who did not participate in an immersion program. Results showed significantly higher compassion scores in students who partook in an immersion trip. It is suggested that compassion developed because “participants spend a great deal of time in developing areas with others who are suffering from poverty, violence, natural disasters, and disease. It is likely that upon return, students felt that their daily stressors and hassles were minimal compared with those of the people they had encountered”.<sup>8</sup> While this particular study does not speak to social justice issues, it does measure compassion, which is a step in becoming socially just.

Prentice designed a study to evaluate the effectiveness of eight community colleges in the process of developing service learning programs.<sup>9</sup> Prentice created a survey to be distributed before and after a service-learning course to assess civic engagement which was defined as “active participation in the public life of a community in an informed, committed, and constructive manner, with a focus on the common good”.<sup>9</sup> The same survey was also given to a group of non-service curricula students to serve as a control. The comparison was created for three types of citizens defined by Westheimer and Kahne – the “personally responsible” citizen, the “participatory” citizen and the “justice-oriented” citizen.<sup>12</sup> A personally responsible citizen is described as an individual who volunteers or donates, a participatory citizen is more active in the community, and the justice-oriented citizen analyzes and addresses injustice. Results showed there were no significant differences between service-learners who had one service-learning experience and non-service learners. However, students with two or more service-learning



experiences had significantly higher scores than students with no service-learning. This research suggests that long-term service-learning programs may be more effective. Participation in one service-learning program does not necessarily directly correlate with socially just attitudes, but with increased service-learning opportunities, the probability of becoming socially just increases.

Other studies have taken a qualitative approach to assess the success of service-learning programming. Einfeld and Collins interviewed students involved in a university AmeriCorps program who had served at least three hundred hours.<sup>3</sup> Many students reported more awareness of social justice issues through their AmeriCorps experience. Participants consistently reported gaining knowledge about experiences outside of their own, and therefore gaining an understanding of other's perspectives and therefore the ability to empathize with their clients. One student reported, "You're helping out. You're here...to learn...to absorb everything that these people have to offer you. And you're trying to better them, but you have to realize that they're bettering you as well".<sup>3</sup> This student demonstrates an understanding that the people she is "helping" are equal to her and have knowledge to share, just as she has knowledge to share with them. Einfeld and Collins also note that although participants felt empowered to make a change in the community, most did not convey a commitment to social justice. Due to the length of time spent with a specific community, participants were able to feel a strong connection to the specific community partner they worked with; however, it did not necessarily transfer to a social justice attitudes toward all communities.

Research has also focused attention on the intention to continue involvement due to a service learning experience. A study by Moely, McFarland, Miron, Mercer and Ilustre studied undergraduate students spending two to four hours a week for ten weeks in a service-learning program and compared them to students not involved in a service-learning program.<sup>6</sup> To measure intentions for civic involvement, Moely et.al. employed the Civil Attitudes and Skills Questionnaire (CASQ) which has six smaller scales that measure civic action, interpersonal and problem-solving skills, political awareness, leadership skills, social justice attitudes and diversity

attitudes. By the end of the semester, students involved in service-learning articulated plans to be involved in civic activities in the future, and exhibited an increase in the social justice perspective, but did not show changes in diversity attitudes. Students who experienced service-learning enjoyed their experience; felt accomplished and understood the reasons why they were needed, but perhaps did not necessarily commit to social justice because their diversity scores did not change. Without the realization that diversity impacts individuals and communities, one may not have a complete understanding of social justice, and therefore cannot fully commit to it.

However, research has found that immersion programs can affect attitudes toward diversity in a cross-cultural setting.<sup>4,5,10</sup> Ference studied fifty-four education majors who participated in an immersion program in either a Latino community in Georgia, or in Italy.<sup>4</sup> Many students experienced being a member of the numeric minority for the first time. One student commented, “an experience that caused me to feel like an outsider occurred at 7-year-old Raphita’s soccer game. When we showed up we were the only white people there; everyone else was Latino. I felt like everyone was looking at us and wondering why we were there. This experience definitely was an eye-opener in understanding how minorities feel among us”.<sup>4</sup> As a result of such experiences, participants became more aware of issues of racism and discrimination, and therefore developed some socially-just attitudes. Perhaps an experience in a difference culture, not just a different setting, helps to facilitate such attitude reform.

Peterson reviewed service-learning programs with the goal of describing a successful course. She suggests that programs are most successful when students spend an extended period of time working *with*, not *for* a community partner.<sup>7</sup> Courses thrive when they not only include a service-learning component, but also class time to discuss the service-learning experiences. A discussion gives the proctor an opportunity to introduce topics such as social justice that students may not have explored on their own while also giving students a chance to discuss their struggles and gain insight into solutions.

Cordero and Rodriguez studied a course taken by a group of social work students that included preparation and processing class time in addition to their immersion trip to Puerto Rico.<sup>2</sup> The goal of this particular program was not only to foster a better understanding of diversity, but also to promote social justice attitudes. One student's journal reflected the success of the program in the form of a letter expressing her acknowledgment of her privilege, the injustice in the world, and the desire to fight for its demise. The letter states,

“I feel guilty that while I have been reared and raised in privilege, that you have suffered abuse under the same household. I know you have tried to expose your oppressor but I swear I didn't know... Your resilience is inspiring, your perseverance astounding. I know it's hard but keep fighting. I want for you the peace that you have wanted for so long. I promise to stay in touch and do what I can”.<sup>2</sup>

Such reactions were typical of students who participated in this program which suggests that even those that perhaps already have a tendency toward socially just attitudes, like social workers, can benefit from and have a renewed commitment to social justice through involvement in an immersion experience.

Service-learning also serves as a chance for students to experience first-hand what they are learning from textbooks. Often an individual can learn more from other people's experiences than from words in a book attempting to accurately describe those experiences. Having class discussions about other clients' experiences also allows every student in the class to learn about experiences from all of the community partners involved. Peterson also recognizes that by encouraging service-learning, the political and social landscape can change.<sup>7</sup> Using this logic, in order to create a program that focuses on social justice, there must be a significant amount of time dedicated to the experience and the opportunity to discuss it. In order to create a focus on social justice, the program must be specifically designed to center on social justice. Research has shown that participation does not necessarily correlate to a focus on social justice, but perhaps a

forced discussion of systemic issues will open some students to a commitment, or at least the realization of its existence, or more accurately its non-existence.

To establish a social justice oriented service-learning program, the institution must distinguish the difference between charity and social justice. While painting and cleaning does provide temporary support for a community center, it does not address the issue of *why* that community center has to exist. Many undergraduate students have either not had exposure to such experiences, or not employed critical thinking about them. In order for programs to be effective, there must be a clear focus and goal of promoting social justice. There is not a clear definition of the perfect program, but it is encouraging that institutions are attempting to find it. Students generally benefit from service-learning programs regardless of their specific attitude outcomes. Cabrini's new social justice curriculum is one of many trying to create students who will be engaged academically and also involved in the larger community. Now that Cabrini has chosen this path, it is necessary to research whether this curriculum is meeting its goals and what specifically Cabrini students are learning as a result of the Engagement of the Common Good curriculum and the service-learning trips already in effect. The current study seeks to discover if participation in a service-learning trip increases social justice and compassion attitudes.

### **Methods**

**Participants:** Cabrini College undergraduate students were the participants in this study.

Participants were specifically selected due to their membership in either a group participating in a service trip or athletic team participating in a spring training trip.

This study included eighteen males and 29 females, 12 of who were freshman, 11 sophomores, 9 juniors and 15 seniors.

Six were participants in a service-learning trip to Duran, Ecuador, 15 traveled to Montgomery, West Virginia on a service-learning trip in the Appalachia region, 12 are members of the women's lacrosse team who went to Florida on a spring training trip and 14 are members of the men's lacrosse team who participated in a spring training trip to Virginia.

**Materials:** The survey included a modified version of the Student Service-Learning Course Survey (SSLCS) which measures personal competence, charitable responsibility, social justice responsibility and interpersonal relationships using a 7-point Likert scale (Wang, Ye, Jackson, Rodgers & Jones, 2005). In addition, a modified version of the Davis Interpersonal Reactivity Index measuring compassion through two sub-scales, empathetic concern and perspective taking using a 5-point Likert scale was used. In total the survey consisted of 43 questions and took approximately 15 – 20 minutes to complete.

**Procedures:** Participants in the immersion trips were asked to complete the surveys during scheduled group meetings. Both the Ecuador and Appalachia groups had pre and post meetings to prepare for the trip and then to process after it. The researcher was a participant in both of these trips and received permission from the staff and students leaders to spend meeting time on the distribution and completion of surveys.

The researcher scheduled a meeting with the athletic teams to distribute the pre-tests. To complete the post-tests, the researcher provided the respective coaches with surveys for their team to complete on the bus on route to an away game.

Each participant was given an unlimited amount of time to complete the survey, although it took approximately 15 minutes to finish. The researcher distributed surveys and explained the purpose of the research, confidentially and consent to the group, and chose an area which was not the focal point of the room to be available for questions. Completed surveys were placed in a manila envelope in the front of the room to ensure anonymity.

To match pre and post tests, students were asked to provide their school identification numbers on the survey. Surveys were matched, labeled and then separated from the consent forms. Only surveys with valid matches were used, all other surveys were discarded. The data was entered into SPSS for analysis. Composite scores were calculated for every sub-scale as well as the full Davis Interpersonal Reactivity Index and SSLCS measures. Composite scores were then entered into a second SPSS database and split by pre and post-scores.

**Results:** A one-way repeated measures analysis of variance was utilized for each scale and sub-scale to measure differences in pre and post scores between groups. Results of the repeated measures analysis on the Davis Interpersonal Reactivity Index showed a significant time effect, Wilk's  $\Lambda = .09$ ,  $F(3, 43) = 6.92$ ,  $p < .001$ . (See Table 1) Bonferroni post hoc tests illustrated the men's lacrosse members score differences ( $M_{pre} = 40.21$ ,  $SD_{pre} = 3.56$ ;  $M_{post} = 41.71$ ,  $SD_{post} = 5.53$ ) were significantly lower than the Ecuador group, ( $M_{pre} = 46.67$ ,  $SD_{pre} = 1.75$ ;  $M_{post} = 48.50$ ,  $SD_{post} = 5.68$ ,  $p < .01$ ), Appalachia group ( $M_{pre} = 44.27$ ,  $SD_{pre} = 2.96$ ;  $M_{post} = 46.13$ ,  $SD_{post} = 3.36$ ,  $p < .05$ ) and higher than the women's lacrosse members ( $M_{pre} = 45.92$ ,  $SD_{pre} = 3.94$ ;  $M_{post} = 46.03$ ,  $SD_{post} = 6.29$ ,  $p < .005$ ). Further analysis on the sub-scales showed the differences were in the empathetic concern sub-scale, Wilk's  $\Lambda = .88$ ,  $F(3, 43) = 5.80$ ,  $p < .05$ . (See Table 2) Men's lacrosse scores ( $M_{pre} = 19.57$ ,  $SD_{pre} = 2.10$ ;  $M_{post} = 20.21$ ,  $SD_{post} = 3.29$ ) were significantly lower than service-learning groups – Ecuador ( $M_{pre} = 22.33$ ,  $SD_{pre} = 1.03$ ;  $M_{post} = 25.00$ ,  $SD_{post} = 3.69$ ,  $p < .05$ ) and Appalachia ( $M_{pre} = 21.73$ ,  $SD_{pre} = 1.58$ ;  $M_{post} = 22.73$ ,  $SD_{post} = 1.16$ ,  $p < .05$ ) and higher than women's lacrosse ( $M_{pre} = 23.00$ ,  $SD_{pre} = 2.76$ ;  $M_{post} = 22.92$ ,  $SD_{post} = 3.91$ ,  $p < .005$ ). No significant differences were found between group's pre and post-scores for the perspective taking sub-scale.

No significant differences were found in the composite scores for the Student Service Learning Course Survey. However, significant differences were found for the interpersonal relationship (Wilk's  $\Lambda = .99$ ,  $F(3, 43) = 12.45$ ,  $p < .001$ ) (See Table 3), charity (Wilk's  $\Lambda = .99$ ,  $F(3, 43) = 13.15$ ,  $p < .001$ ) (See Table 4), and social justice (Wilk's  $\Lambda = .99$ ,  $F(3, 43) = 11.79$ ,  $p < .001$ ) (See Table 5) sub-scales. No significant differences were found for the personal competence sub-scale. Men's lacrosse had had a significantly higher difference between their pre and post interpersonal relationship scores ( $M_{pre} = 37.07$ ,  $SD_{pre} = 7.17$ ;  $M_{post} = 39.29$ ,  $SD_{post} = 9.47$ ) than Ecuador ( $M_{pre} = 24.67$ ,  $SD_{pre} = 5.13$ ;  $M_{post} = 20.83$ ,  $SD_{post} = 4.83$ ,  $p < .001$ ), Appalachia ( $M_{pre} = 25.4$ ,  $SD_{pre} = 6.41$ ;  $M_{post} = 32.00$ ,  $SD_{post} = 7.70$ ,  $p < .001$ ) and women's lacrosse ( $M_{pre} = 30.41$ ,  $SD_{pre} = 8.02$ ;  $M_{post} = 32.00$ ,  $SD_{post} = 4.99$ ,  $p < .05$ ).

Results for the charity sub-scale showed the Ecuador group's difference in scores ( $M_{pre} = 38.5$ ,  $SD_{pre} = 3.02$ ;  $M_{post} = 40.00$ ,  $SD_{post} = 1.41$ ) were significantly higher than the men ( $M_{pre} = 26.14$ ,  $SD_{pre} = 7.66$ ;  $M_{post} = 26.21$ ,  $SD_{post} = 7.37$ ,  $p < .001$ ) and women's ( $M_{pre} = 33.17$ ,  $SD_{pre} = 7.08$ ;  $M_{post} = 26.92$ ,  $SD_{post} = 6.96$ ,  $p < .01$ ) lacrosse team member's scores. The Appalachia group's difference in scores ( $M_{pre} = 35.13$ ,  $SD_{pre} = 5.66$ ;  $M_{post} = 37.27$ ,  $SD_{post} = 4.18$ ) were also significantly higher than the men's ( $p < .001$ ) and women's ( $p < .05$ ) lacrosse teams scores. There were no significant differences found between Ecuador and Appalachia groups or men and women's lacrosse (See Table 4).

Similar results were found for the social justice sub-scale. The Ecuador group's difference between scores ( $M_{pre} = 37.73$ ,  $SD_{pre} = 3.67$ ;  $M_{post} = 39.00$ ,  $SD_{post} = 2.19$ ) was significantly higher than both the men's ( $M_{pre} = 25.21$ ,  $SD_{pre} = 6.53$ ;  $M_{post} = 26.71$ ,  $SD_{post} = 7.03$ ,  $p < .001$ ) and women's ( $M_{pre} = 31.08$ ,  $SD_{pre} = 5.25$ ;  $M_{post} = 25.92$ ,  $SD_{post} = 6.58$ ,  $p < .005$ ) lacrosse teams. The Appalachia group's score differences ( $M_{pre} = 33.73$ ,  $SD_{pre} = 5.97$ ;  $M_{post} = 34.87$ ,  $SD_{post} = 4.88$ ) were, again, significantly different from the men's ( $p < .001$ ) and women's ( $p < .05$ ) lacrosse teams (See Table 5).

Thus, the service learning groups had significantly higher scores on the charity sub-scale, and were higher than women's lacrosse on the social-justice sub-scale, but not the whole SSLCS measure. Men's lacrosse had significantly lower scores on the Davis Interpersonal Reactivity Index measure and the empathetic concern sub-scale than the service-learning groups, but higher than women's lacrosse. At the same time, however, they also had significantly higher scores on the interpersonal relationship sub-scale.

**Discussion:** Results were varied, and did not completely support the original hypothesis, however, there was still a relationship found between participation in a service-learning trip and compassion and social justice attitudes. Both of the groups who participated in a service-learning trip had significantly higher scores on the charity sub-scale, one of the scales that most accurately assesses social justice attitudes. This suggests that the service-learning trip did have some effect

on the students who participated because their scores increased after the service trip, while both the athletic teams' scores decreased or remained consistent. While all Cabrini students have some kind of education about social justice issues, it is one thing to read about them in a textbook, and another to see them and talk to people experiencing them. A deeper understanding of social justice issues and what it looks like when needs go unmet by different communities are gained by participation in a service-learning trip. Service-learning trips allow a student to challenge their pre-conceived ideologies about social issues and those who suffer from them. This experience is distinct from the regular classroom experience. This is supported by the statistical analysis which demonstrates the service-learning trip groups had a significantly higher increase in scores between their pre and post-tests. Although the service trip groups also had higher pre test scores, suggesting such trips attract social justice oriented students, their scores still increased significantly compared to the other groups. However, this social justice outlook applied to charitable responsibility, not necessarily social justice responsibility.

While the service-learning groups had significantly higher scores on the social justice sub-scale than that the women's lacrosse team, they had significantly lower scores than the men's lacrosse team. This could be the same factor that potentially affected the compassion composite score. Perhaps in some way, a service-learning trip opens your eyes to social justice issues, but also forces one to realize that one cannot claim to be as socially just as one would like. Social justice issues are complicated and difficult. It is much easier to become charitably responsible because that involves helping people, not necessarily fixing the system. The service trips obviously had some effect on the students who participated because the scores did rise after the trip, and the difference was significantly different than the women's team. Perhaps there are unknown factors about the members of the lacrosse team sample or their spring training trip that is also having an effect on the scores.

Analysis of the compassion measure showed that the men's lacrosse team had a lower difference in scores than the service groups, but higher than women's lacrosse. Although this



suggests that the service-learning trips did have an impact on compassion, it cannot fully be attributed to the experience because there was also a difference between the athletic teams. Perhaps there is a gender effect on compassion because in our society, males are not as likely to openly express emotions like compassion. The women's lacrosse and Ecuador groups were completely female, and there were only four male participants in the Appalachia group. Male athletes are perhaps also expected to uphold the expectations of the "masculine gender role" in our society more than other males, exaggerating the potential effect of gender. This idea is perhaps also validated by the sub-scale analysis. Significant differences were found between groups only on the empathetic concern sub-scale, not on the perspective taking sub-scale. Males may be socially prohibited from expressing compassion, but not necessarily viewing the world in a different perspective. However, this does not explain why men's lacrosse had a significantly higher difference than the women's lacrosse team. One can only speculate these differences. Perhaps the members of the men's lacrosse team were also enrolled in courses which advocated for compassion for others, or perhaps there was a particular experience in Virginia that did not exist in Florida. Perhaps gender is the factor which created a difference between men's lacrosse and the service trips, but some other variable must have affected the men's lacrosse team that did not affect the women.

An unexpected result was the higher scores of the men's lacrosse team on the interpersonal relationship scale, which largely consists of diversity questions. It is surprising that the service-learning trip groups did not have increasing diversity scores, especially because the Ecuador group was immersed in an entirely different culture. Two factors could be involved in this phenomenon. The first is that experiencing a service-learning trip and a different culture creates the realization that one was and is not as culturally competent as perhaps originally thought. The stereotypes or associations one may have for a group or groups of people may cross your mind as a result of a service-learning experience because of the topics explored. Many people may not be aware of the stereotypes and prejudice they hold within themselves until they

are forced to reconcile with it. There could also be a gender effect on this topic because women in our society are trained to be nervous, anxious and aware of their safety, which may become a diversity issue. Women are taught to be alert to their surroundings and conscious of their actions, which may result in avoiding diversity because of the potential danger of the unknown or people different than oneself.

A limitation of this study is the sample used. Because the groups were specifically chosen groups of people, the gender and number of participants could not be changed. There were certainly more females than males in this study, however, the ratio is an accurate representation of the male to female ratio at Cabrini. The sample sizes were also all very small. The Ecuador group's size of six was smaller than all the other groups, but the other three groups were reasonably even in number. For better results, however, the sample size should be increased or the research continued every year.

Because the survey asked questions about topics all Cabrini students know they are supposed to be increasing their knowledge about, there could be a social desirability in my sample. It is possible that people increased their scores to reflect both themselves and Cabrini in a better light. The researcher was also a participant in both service trips, which may have caused those groups of people to either answer more honestly, or skew the results even more because participants had a relationship with the researcher. The researcher was also not present during the post-tests of the athletic teams which may have lead to a lack of concentration or seriousness about the survey.

There is so little research on the effects of service-learning specifically on social justice. It is important to evaluate programs based on the goals in place for the people who experience them. Because Cabrini and many other institutions are focused on social justice, it is important to discover if students are indeed gaining knowledge about that topic. It is clear from this research that the service-learning trips are effective in some way at shaping the attitudes of the students who participate, but because there were significant differences between groups, it also suggests

students may be leaving Cabrini without a proper education in social justice. However, as the new curriculum comes into effect, it is important to keep evaluating the attitudes of the students. Research should continue on the field of social justice and service-learning in general and certainly in the outcomes of Cabrini programming.

### References

- <sup>1</sup> Bringle, R.G., Phillips, M.A., & Huasch, M. (2003). *The measure of service learning: Research scales to assess student experiences*. Washington, D.C.: APA.
- <sup>2</sup> Cordero, A. & Rodriguez, L.N. (2009). Fostering cross-cultural learning and advocacy for social justice through an immersion experience in Puerto Rico. *Journal of Teaching in Social Work, 29*, 134-152. doi: 10.1080/08841230802238195.
- <sup>3</sup> Einfeld, A. & Collins, D. (2008). The relationships between service-learning, social justice, multicultural competence, and civic engagement. *Journal of College Student Development, 49*, 95-109. Retrieved from <http://web.ebscohost.com/ehost/detail?vid=12&hid=3&sid=fe911dc5-a bd9-4053-9b55-fa24c20b8945%40 session mgr11&bdata=JnNpdG U9ZWhvc3QtG12ZQ% 3d%3d#db=ehh&AN=32012792>.
- <sup>4</sup> Ference, R. (2006). Building and sustaining short-term cross-cultural immersion programs in teacher education. *AILACTE Journal, 11*, 10-24.
- <sup>5</sup> Ference, R. & Bell, S. (2004). A cross-cultural in the U.S.: Changing preservice teacher attitudes toward Latino ESOL students. *Equity & Excellence in Education, 37*, 343-350. doi: 10.1080/10665680490518605.
- <sup>6</sup> Moely, B.E., McFarland, M., Miron, D., Mercer, S. & Ilustre, V. (2002). Changes in college students' attitudes and intentions for civic involvement as a function of service-learning experiences. *Michigan Journal of Community Service Learning, 9*, 18-26. Retrieved from <http://web.ebscohost.com/ehost/detail?vid=8&hid= 9&sid=df332eaf-3fbc-4e96-bbdc26f590e8d726%40sessionmgr11&bdata= JnNpdGU9ZW hvc3QtG12ZQ%3d%3d#db=eric&AN=EJ661219>

- <sup>7</sup> Peterson, T.H. (2009). Engaged scholarship: Reflections and research on the pedagogy of social change. *Teaching in Higher Education, 14*, 541-552. doi: 10.1080/13562510903186741
- <sup>8</sup> Plante, T.G., Lackey, K. & Hwang, J.Y. (2009). The impact of immersion trips on development of compassion among college students. *Journal of Experiential Education, 32*, 28-43. Retrieved from <http://web.ebscohost.com/ehost/detail?vid=3&hid=105&sid=bc9fa769-62dd-4fd9-b840-617e00297bd4%40sessionmgr113&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=aph&AN=43476726>.
- <sup>9</sup> Prentice, M. (2007). Social justice through service learning: community colleges as ground zero. *Equity & Excellence in Education, 40*, 266-273. doi: 10.1080/10665680701396735.
- <sup>10</sup> Vaughan, W. (2005). Educating for diversity, social responsibility and action: Preservice teachers engage in immersion experiences. *Journal of Diversity, 12*, 26-30.
- <sup>11</sup> Wang Y., Ye, F, Jackson, G., Rodgers, R., & Jones, S. (2005). Development of student service learning course survey (SSLCS) to measure service-learning course outcomes. *Association for Institutional Research, 3*, 1-15.
- <sup>12</sup> Westheimer, J., & Kahne, J. (2004). What kind of citizen? The politics of educating for democracy. *American Educational Research Journal, 41*(2), 237-269. Retrieved from <http://web.ebscohost.com/ehost/detail?vid=7&hid=9&sid=faaded12-bc2d-4b2a-86cf-bf572b67cc4c%40sessionmgr4&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=eric&AN=EJ737108>.

Appendix A

Table 1

*Mean Scores for Davis Interpersonal Reactivity Index*

	<b>Pre</b>	<b>Post</b>	<b>Difference</b>
<b>Ecuador</b>	46.67	48.50	1.83
<b>Appalachia</b>	44.27	46.13	1.86
<b>Girls Lacrosse</b>	45.92	46.08	0.16
<b>Boys Lacrosse</b>	40.21	41.71	1.50

Table 2

*Mean Scores for Empathetic Concern Sub-Scale*

	<b>Pre</b>	<b>Post</b>	<b>Difference</b>
<b>Ecuador</b>	22.33	25.00	2.67
<b>Appalachia</b>	21.73	22.73	1.00
<b>Girls Lacrosse</b>	23.00	22.92	-.08
<b>Boys Lacrosse</b>	19.57	20.21	0.64

Table 3

*Mean Scores for Interpersonal Relationship Sub-Scale*

	<b>Pre</b>	<b>Post</b>	<b>Difference</b>
<b>Ecuador</b>	24.67	20.83	-3.84
<b>Appalachia</b>	25.40	26.27	0.87
<b>Girls Lacrosse</b>	30.41	32.00	1.59
<b>Boys Lacrosse</b>	37.07	39.29	2.22

Table 4

*Mean Scores for Charity Sub-Scale*

	Pre	Post	Difference
<b>Ecuador</b>	38.50	40.00	1.50
<b>Appalachia</b>	35.13	37.27	2.14
<b>Girls Lacrosse</b>	33.17	26.92	-6.25
<b>Boys Lacrosse</b>	26.14	26.21	.07

Table 5

*Mean Scores for Social Justice Sub-Scale*

	Pre	Post	Difference
<b>Ecuador</b>	37.67	39.00	1.33
<b>Appalachia</b>	33.73	34.87	1.14
<b>Girls Lacrosse</b>	31.08	25.92	-5.16
<b>Boys Lacrosse</b>	25.21	26.71	1.50

## Appendix B

### Compassion and Social Justice Questionnaire

ID Number: \_\_\_\_\_

**The following statements inquire about your thoughts and feelings in a variety of situations. For each item, indicate how well it describes you by choosing the appropriate rating using the following scale.**

1	2	3	4	5
Does not describes me well				Describes me very well

\_\_\_ 1. I often have tender, concerned feelings for people less fortunate than me.

\_\_\_ 2. I sometimes find it difficult to see things from the "other guy's" point of view.

\_\_\_ 3. Sometimes I don't feel very sorry for other people when they are having problems.

\_\_\_ 4. I try to look at everybody's side of a disagreement before I make a decision.

- \_\_\_ 5. When I see someone being taken advantage of, I feel kind of protective towards them.
- \_\_\_ 6. I sometimes try to understand my friends better by imagining how things look from their perspective.
- \_\_\_ 7. Other people's misfortunes do not usually disturb me a great deal.
- \_\_\_ 8. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.
- \_\_\_ 9. When I see someone being treated unfairly, I sometimes don't feel very much pity for them.
- \_\_\_ 10. I am often quite touched by things that I see happen.
- \_\_\_ 11. I believe that there are two sides to every question and try to look at them both.
- \_\_\_ 12. I would describe myself as a pretty soft-hearted person.
- \_\_\_ 13. When I'm upset at someone, I usually try to "put myself in his/her shoes" for a while.
- \_\_\_ 14. Before criticizing somebody, I try to imagine how I would feel if I were in their place.

Adapted from Davis Interpersonal Reactivity Index; Davis, 1983.

**The following statements inquire about your thoughts and feelings in a variety of situations. For each item, indicate how well it describes you by choosing the appropriate rating using the following scale.**

1	2	3	4	5	6	7
Strongly						Strongly
Disagree						Agree

- \_\_\_ 1. I am very aware of my own weaknesses and strengths.
- \_\_\_ 2. I think most women tend to respond to situations emotionally, while men respond by thinking.
- \_\_\_ 3. I know how to communicate my ideas in a situation that is new to me.
- \_\_\_ 4. I become annoyed with people who frequently try to change the rules.
- \_\_\_ 5. I find it annoying when I hear people speaking in a language I don't understand.
- \_\_\_ 6. I know how to communicate my ideas in a cross-cultural situation.
- \_\_\_ 7. I deal with students who are different from me (for example, of another race, or who speak a different language) by being polite and staying away from them as much as possible.

- \_\_\_ 8. I would prefer not to room with someone who is from a different culture or race.
- \_\_\_ 9. I avoid groups where I would be of the minority race.
- \_\_\_ 10. I know how to lead in a cross-cultural situation.
- \_\_\_ 11. I generally keep my beliefs to myself in order to avoid offending others.
- \_\_\_ 12. I know how to lead in a new situation.
- \_\_\_ 13. There are some topics that should never be discussed in a college classroom.
- \_\_\_ 14. I sometimes use phrases or words such as “immigrants to the United States should speak English”, “white trash”, or “people on welfare are only looking for a free ride”.
- \_\_\_ 15. I know that I can make a positive difference in the lives of others.
- \_\_\_ 16. I am confident that I can help in promoting equal opportunities for all people.
- \_\_\_ 17. I know how to become involved in helping others who are less fortunate than me.
- \_\_\_ 18. I know how to organize efforts for social changes.
- \_\_\_ 19. I am confident that I can help with individuals in need.
- \_\_\_ 20. We should reach out in charitable ways to specific people in need.
- \_\_\_ 21. I have a responsibility to help those less fortunate than me.
- \_\_\_ 22. I have a responsibility provide community service.
- \_\_\_ 23. I have a responsibility to help social justice efforts directed at social justice changes in society.
- \_\_\_ 24. I will act in charitable ways to help people in need.
- \_\_\_ 25. I will act to work for social justice changes in society.
- \_\_\_ 26. We should create programs and public policies to address social issues.
- \_\_\_ 27. This society needs to increase social and economic equality.

Please circle the gender with which you identify.

Male                  Female                  Other

Please circle your class year.

Freshman          Sophomore          Junior          Senior



Appendix C

**Service-Learning Research**

**Katie Juliana – [kmj725@cabrini.edu](mailto:kmj725@cabrini.edu)**  
**Dr. Melissa Terlecki – [mst723@cabrini.edu](mailto:mst723@cabrini.edu)**

**Purpose of the Study**

The purpose of this study is to examine the effects of service learning on students. As a part of a requirement for Sociology Research Methods, I am trying to determine the relationship between participation in an immersion trip and one's attitudes toward social justice, charity, and diversity, empathy, and compassion.

**Procedures**

The following survey will ask you questions regarding your attitudes toward social justice, charity, diversity, empathy, and compassion. Please answer the questions to the best of your ability and with complete honesty. Your responses will remain confidential and anonymous. I will be the only individual looking at your responses to which your name will in no way be attached. If at any time during the questionnaire you feel uncomfortable, you have the right to terminate your participation. If you do not wish to participate, please indicate this at the bottom of this form. You will in no way be penalized. If you have any questions about the questionnaire, please feel free to ask me. The questionnaire should take approximately 10-15 minutes to complete.

**Discomforts and Risks**

There are no possible discomforts and risks for this study, but as previously mentioned, if you feel uncomfortable, you have the right to terminate your participation.

**Contact Person**

If at any time you have any questions or concerns, do not hesitate to contact me ([kmj725@cabrini.edu](mailto:kmj725@cabrini.edu)) or Dr. Terlecki ([mst723@cabrini.edu](mailto:mst723@cabrini.edu)) via email. If you have any questions regarding your rights as a participant, you can contact the Chair of the Institutional Review Board at Cabrini, Dr. Tony Verde, at [tony.j.verde@cabrini.edu](mailto:tony.j.verde@cabrini.edu).

**Your completion of this questionnaire indicates your agreement/disagreement to participate in this study.**

\_\_\_\_\_ I will participate in this study.    \_\_\_\_\_ Initial    \_\_\_\_\_ Date

\_\_\_\_\_ I will **NOT** participate in this study    \_\_\_\_\_ Initial    \_\_\_\_\_ Date

Initialed by investigator \_\_\_\_\_ Date \_\_\_\_\_

## **Stereotype Threat and its Effects on Females**

**Author: Chase Montgomery**

**Faculty Mentor: Melissa Terlecki, Ph.D.**

Abstract: The goal of this study was to examine the effects stereotypes have on the short term memory capacity of women. It is believed that when individuals are exposed to stereotypes of one's in group, such as being female, their short term memory becomes affected, hindering performance. The participants in this experiment were female Cabrini College students. Participants were randomly selected to be in the control and experimental groups. The experimental group was exposed to the stereotype that men perform better on the task they were about to complete. The control group was not exposed to the stereotype. Participants used a computer program which asked them to recall words and numbers that were shown to them on a monitor. The difference in performance between the experimental and control group was analyzed using correlations and t-tests. It was believed that the females in the experimental group would perform worse than the females in the control group, however, this was not the case. There was no significant difference in performance between the control and the experimental groups. There was no comparison made between genders.

Stereotyping is when specific characteristics are applied to an entire group of people. Most often, these stereotypes are negative in nature. Even though the stereotypes that may apply to an individual's in-group are not necessarily true, nor apply to an individual, people can be affected by negative stereotypes without even realizing it. This is called stereotype threat. Stereotype threat is when a person's fear that their performance or actions will confirm an existing stereotype of the group in which that person identifies with impairs their performance on a given task. Stereotype threat exists across all races, genders, and ages. It is important to understand how stereotype threat can affect people and how we can possibly eliminate its effects. This study hopes to find a connection between stereotype threat and the

short term memory of females. More specifically, it seeks to learn if informing females that males perform better on this specific memory test yields adverse effects on females' performance.

Stone, Lynch, Sjomeling, and Darling (1999) carried out a study that measured the performance of 40 white and 40 black athletes (both male and female), when they were made conscious of perceived stereotypes for each group. The stereotypes involved in this study were that black athletes had a higher natural athletic ability when compared to white athletes, but had a lower athletic intelligence when compared to white athletes. The participants were asked to participate in a game of golf in order to study their athletic performance. Before they participated in the game of golf, they completed a questionnaire that did one of two things: primed them to believe they were being measured on athletic ability, or that they were being measured on athletic intelligence. The participants in the control group were given a questionnaire that did not prime them. The results showed that the black athletes performed better when under the impression they were being graded on athletic performance than those who thought they were being graded on athletic intelligence. As for the white athletes, the opposite was found. Whites performed better when they believed they were being measured on their athletic intelligence and not their athletic ability.

Anderson and Thelk (2008) believed that by simply adding a request to know the participant's gender at the beginning of a test would initiate stereotype threat. The participants in the study involved 1,329 first-year students entering a public, mid-Atlantic university. The study utilized math/science tests and arts/humanities tests. For the control group, the participants were not asked to record their gender at the beginning of the test. For the experimental group, the participants were asked to identify whether or not they were male or female. The results showed that there was no significant difference between the group that was asked to identify their gender and the group that was not asked to identify their gender. These results did not replicate what the researchers expected.

Johns, Inzlicht, and Schmader (2008) created a study that determined whether or not emotion regulation, caused by stereotype threat, hindered performance on various cognitive tests. These tests included tests of working memory capacity, Stroop tasks, and a math assessment test. Participants in the experimental group were simply told their performance could be hindered because they were female. In the control group, participants were not exposed to stereotype threat but were given a questionnaire asking questions about how anxious they were and how hard they tried to suppress this anxiety, if applicable. Participants who were exposed to the stereotype threat were also given the questionnaire after they completed their cognitive tests. The results showed that the individuals who were exposed to stereotype threat felt more anxiety and worked harder to control this anxiety than the participants who were not exposed. Also, those exposed had poorer performance compared to those who were not exposed.

Schmader and Johns (2003) also conducted an experiment which focused on how stereotype threat can affect working memory capacity, or the ability to store information in short term memory. In this experiment the participants (31 men and 28 women) listened to a recording of a psychology researcher who discussed the task they were about to participate in. The researcher told the members of the control group that the task in which they were participating was a very reliable test of “working memory”. For the experimental group, the researcher told the group it was a reliable test of “quantitative capacity” and that women have trouble in this area. This primed the stereotype threat for the women of the experimental group. The participants in both groups were asked to recall as many words as they could from a set of words, testing working memory capacity. The results showed that women exposed to the stereotype threat recalled fewer words than the women not exposed to the stereotype threat and had no effect on the men.

Jamieson and Harkins (2007) followed up Schmader and Johns’ (2003) study with research of their own. They agreed that stereotype threat can adversely affect cognitive performance because cognitive resources are being spent on processing information associated with the negative stereotype. In their study, participants performed tests which involved eye movement. The eye movement was inferred

for be a reaction time for visual stimuli presented on a computer screen. The control group was not exposed to stereotype threat while the experimental group was exposed to stereotype threat. In order to trigger stereotype threat, the participants in the experimental group were shown instructions that stated the tests they were about to take have been known to show gender differences favoring males. The data collected from their experiment did not support the evidence collected by Schmader and Johns' (2003) because there was no significant difference between the performance of the group exposed to stereotype threat and the group that was not exposed to stereotype threat.

Rivardo, Rhodes, and Klein (2008) conducted a study that measured the performance of liberal arts students once exposed to stereotype threat. The study included 112 liberal arts students at a Catholic liberal arts college. The students were put into three separate groups. The control group was simply told they were taking a math test. There were two experimental groups. The first experimental group was told that they were taking a math test that usually exposed gender differences. The second group was told the same thing, but was then told what stereotype threat was. The gathered data did not show a significant difference in performance between any of the groups.

Davies, Spencer, and Steele (2005) conducted a study which assessed the effects that stereotype threat had on women's desirability to be a leader. Thirty-one men and 30 women participated in this study. The participants were divided in to a control group and an experimental group. The control group watched four commercials that did not display any type of gender roles or stereotypes. The experimental group watched the same commercials but had two extra commercials placed in between that showed women in stereotypical gender roles. Immediately after viewing the commercials, the two groups were given a questionnaire that informed them the researchers were in need of leaders for an upcoming task. It asked them to rate how interested they were in the leadership role based on a scale from "1 to 7", with "7" being a strong interest. The data gathered showed that the women exposed to the commercial depicting stereotypical gender roles were less interested in the role of being a leader than the women in the control group who were not exposed to stereotype threat.

Beaton, Tougas, Rinfret, Huard, and Desisle (2007) researched the idea that the number of women present can affect their susceptibility to stereotype threat. Women were asked to complete a math test after being exposed to stereotypes. The data collected showed that when a woman was exposed to a stereotype individually, they performed worse than women who were exposed to stereotypes as a group. Also, the women were asked to fill out a questionnaire designed to measure the women's anxiety when exposed to stereotypes. The individual women reported higher anxiety than the women who were exposed as part of a group. This is an interesting study because it shows that a group's numbers can combat the effects of stereotypes.

Huguet and Regner (2009) created an experiment to test stereotype threat in children at French public schools. There were 92 girls and 107 boys involved in this research. The children were told that they would be taking a test that would measure either their geometry skills or drawing skills, though they were both actually the same test. They were given one and a half minutes to study a complex shape and then given five minutes to recreate it on a piece of paper, using their memory. Once the test was completed they were given a questionnaire which asked them questions about geometry skills for each gender. The data showed that the girls underperformed compared to boys when they believed the test was measuring their geometry abilities, but outperformed boys when they believed the test was measuring their drawing ability. In regards to the questionnaire, the girls actually rated themselves higher than boys when it came to geometry skills, which is counter stereotypic.

Yeung and Hippel (2007) wanted to study how stereotype threat affected women's performance while driving, using the stereotype that women are not good drivers. Eighty-eight females, with ages ranging from 17 to 42, were asked to take part in the study by taking a test in a driving simulator. The women were split into two groups; the experimental and the control groups. The control group watched a video of a researcher explaining that the video was intended to assess driving ability. The experimental group watched a video of the researcher who said they were trying to understand why women are poorer drivers. When in the driving simulator, the participants were told they must complete the course as fast as

possible while staying within the speed limit and that they must keep the car as closely to the center of the road as possible. They were not told that they would have to avoid a pedestrian jay walking. The gathered data showed that women's ability to stay within the speed limit and their ability to keep the car centered were not affected by stereotype threat, however, it did reveal that women were more likely to strike the jay walker by 59% when they were exposed to stereotype threat. Woman not exposed to the stereotype were only 25% as likely to hit the jay walking pedestrian.

Previous research has shown that stereotype threat does exist and can affect individuals in many different ways. The studies have shown that it doesn't matter what gender, race, or age a person is; they can still fall victim to stereotyping. Stereotype threat can influence both physical performance as well as mental performance; it can even change a person's motivation, as shown in the study testing women's desirability to be a leader. However, some studies have shown that individuals may not fall victim to stereotype threat once they are exposed. These individuals who are not affected by stereotype threat may have confidence in their abilities or realize that stereotypes cannot be applied to everyone. The results from these studies show the importance of eliminating stereotypes whenever and wherever possible. Whether in the classroom, on the playing field, or at work, stereotyping can affect people in ways that they do not even know about.

## **Methods**

### **Participants**

The study was comprised of 26 female Cabrini college students. The ages of the participants ranged from 18 to 22 years old. The mean age of the participants was 20. The majors of the participants were spread out across ten different majors. The academic years represented included freshman, juniors, and seniors. Although the sample size was small there was much diversity among the participants. The method of recruitment was haphazard sampling and snowball sampling. Friends were asked to participate

and were encouraged to bring others they knew to take part in the research. Also, students were recruited by going from door to door in the dorms and asking for their participation.

### **Procedure**

My study consisted of an experiment using the randomized posttest design. The test was used to assess the abilities of the females once exposed to stereotype threat compared to females who are not exposed to stereotype threat. The test taken by the participants is found on the CogLab 2.0 disc (Francis et al, 2007). The lab is entitled “Memory Span”. It was used to collect data on the participant’s working memory performance once they were exposed to stereotype threat. The test gathered data in five separate categories; numbers, different letters, similar letters, short words, and long words. The participants completed 25 memory tasks which took around 15 minutes to complete. The CogLab 2.0 program then analyzed the data and found the average amount of information that person could hold in their short term memory. Also, a short questionnaire was used in order to collect demographics. These questions included age, academic year, and major.

The experiment was given in a controlled environment where the participants took the test one at a time and were randomly assigned to one of two groups, the control group or the experimental group. There was no one present while the participants were completing the test. In the control group, I explained that this was a simple memory test looking into short term memory (which prevented exposure to stereotype threat). In the experimental group, I explained that this memory test is used to compare females to males and that males perform better on this test. This statement was used in an attempt to trigger the stereotype threat in women. When the participants finished the experiment, their results were stored on the computer for later analysis. Once the experiment was completed the participants were debriefed and I explained that deception was used.



## Results

An independent samples t-test was conducted to evaluate the differences in short term memory capacity between those exposed to stereotype threat and those who are not. The average total number of items recalled for the control group was 26.92,  $SD=4.97$ . The average for total number of items recalled for the experimental group was 25.15,  $SD=5.14$ . While the experimental group did recall fewer items than the control group, the difference was not enough to be considered significant,  $t(24) = .89, p = .38$ .

An independent samples t-test was also used to compare the two groups based on the five categories of information to be remembered; numbers, different letters, similar letters, short words, and long words. There was no significant difference found for any of these categories. (Numbers,  $t(24) = .707, p = .49$ , different letters,  $t(24) = .86, p = .40$ , similar letters,  $t(24) = -.241, p = .81$ , short words,  $t(24) = .80, p = .43$ , long words,  $t(24) = 1.35, p = .19$ ).

## Discussion

Although previous research was able to find significant differences in cognitive abilities, (including memory) between those exposed to stereotypes and those who were not exposed, this study was unable to yield similar results. Yes, the control group did have the ability to recall more items than the experimental group, which would seem to support the hypothesis, however, this difference was not found to be significant.

There are many things that could have factored into the results of the data collected. One factor may be the small size of the sample; if more participants were included then there may have been greater differences found. Also, it should be noted that when some of the females were informed that they were expected to perform poorly because males perform better on this test, they stated that they had become very competitive. This was noted several times from the participants in the experimental group, and was common among the participants who were female athletes. This competitiveness may have given the participants more drive and desire to perform better, possibly skewing the results. Also, the fact that the

researcher administering the experiment was a male may have had an impact on the competitiveness.

Before taking the test, many of the participants already doubted their memory abilities, which could have led them to perform negatively once they discovered the test would be looking into their short term memory.

In conclusion, there was no significant difference found between those exposed to stereotype threat and those who were not. Even though this experiment was unsuccessful, other research has shown that there are effects caused by stereotype threat. Information gathered by this study indicates a good direction to further this research. The females who were members of sports teams became more competitive once they were informed males perform better on the memory test. Perhaps a new study could delve into the notion that being an athlete or a participant in competitive activities renders you less likely to be influenced by stereotype threat. Regardless of the results from this study, the success of other experiments shows the need for continued research in order to explain and understand this phenomenon. By understanding stereotype threat, strategies can be made that can help limit or prevent its effects. This will allow everyone, despite age, gender, or race, to perform at their full potential.

### References

- Anderson, R. & Thelk, A. (2008). The effects of reporting one's gender on general education test performance. *Journal of General Education*, 57(3), 170-190. Retrieved from ERIC database.
- Beaton, A., Tougas, F., Rinfret, N. Huard, N., & Delisle, M. (2007). Strength in numbers? Women and mathematics. *European Journal of Psychology of Education*, 22(3), 291-306. Retrieved from PsycINFO database.
- Davies, P., Spencer, S. & Steele, C. (2005, February). Clearing the air: Identity safety moderates the effects of stereotype threat on women's leadership aspirations. *Journal of Personality and Social Psychology*, 88(2), 276-287. Retrieved September 23, 2009, doi:10.1037/0022-3514.88.2.276
- Francis, G., Neath, I. & VanHorn, D. (2007). *CogLab on a CD, Version 2.0*. Belmont, CA: Wadsworth

Publishing.

- Huguet, P. & Régner, I. (2009, July). Counter-stereotypic beliefs in math do not protect school girls from stereotype threat. *Journal of Experimental Social Psychology*, 45(4), 1024-1027. Retrieved September 23, 2009, doi:10.1016/j.jesp.2009.04.029
- Jamieson, J. & Harkins, S. (2007). Mere effort and stereotype threat performance effects. *Journal of Personality and Social Psychology*, 93(4), 544-564. doi:10.1037/0022-3514.93.4.544.
- Johns, M., Inzlicht, M. & Schmader, T. (2008). Stereotype threat and executive resource depletion: Examining the influence of emotion regulation. *Journal of Experimental Psychology: General*, 137(4), 691-705. doi:10.1037/a0013834.
- Rivardo, M., Rhodes, M. & Klein, B. (2008). Lack of stereotype threat at a liberal arts college. *College Student Journal*, 42(3), 832-841. Retrieved from PsycINFO database.
- Schmader, T. & Johns, M. (2003, September). Converging evidence that stereotype threat reduces working memory capacity. *Journal of Personality and Social Psychology*, 85(3), 440-452. Retrieved September 23, 2009, doi:10.1037/0022-3514.85.3.440
- Stone, J., Lynch, C., Sjomeling, M. & Darley, J. (1999, December). Stereotype threat effects on Black and White athletic performance. *Journal of Personality and Social Psychology*, 77(6), 1213-1227. Retrieved September 23, 2009, doi:10.1037/0022-3514.77.6.1213
- Yueng, N. & Hippel, C. (2008). Stereotype threat next term increases the likelihood that female drivers in a simulator run over jaywalkers. *Accident Analysis and Prevention*, 40(2), 667-674. Retrieved September 22, 2009, from [http://www.sciencedirect.com/science/?\\_ob=ArticleURL&\\_udi=B6V5S-4PT77M9-2&\\_user=519921&\\_coverDate=03%2F31%2F2008&\\_alid=1021740250&\\_rdoc=11&\\_fmt=high&\\_orig=search&\\_cdi=5794&\\_sort=r&\\_docanchor=&view=c&\\_ct=5674&\\_acct=C000025962&\\_version=1&\\_urlVersion=0&\\_user](http://www.sciencedirect.com/science/?_ob=ArticleURL&_udi=B6V5S-4PT77M9-2&_user=519921&_coverDate=03%2F31%2F2008&_alid=1021740250&_rdoc=11&_fmt=high&_orig=search&_cdi=5794&_sort=r&_docanchor=&view=c&_ct=5674&_acct=C000025962&_version=1&_urlVersion=0&_user)

**Appendix**

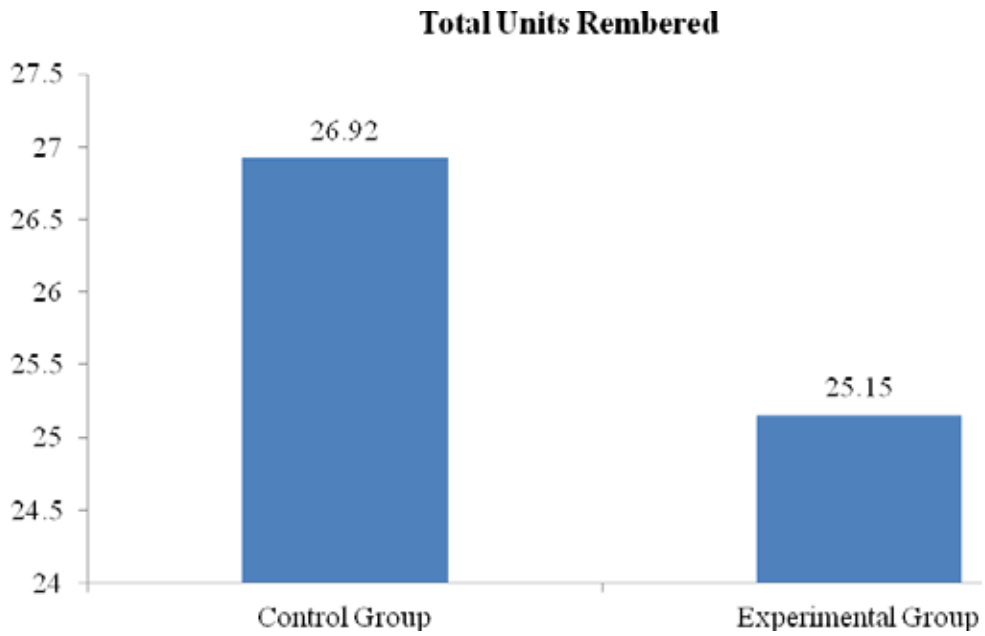


Figure 1. *A Simple Bar Graph comparing the mean total units remembered between the control and experimental groups.*

## **German Resistance Movement During World War II**

**Author:** Jeffrey T. Young

**Faculty Mentor:** Courtney Smith, Ph.D.

**Abstract:** The main argument of this project will be to show that during a very dark period of German history there were those who did not accept, believe, condone, or adhere to the bizarre actions of their leaders. These resisters may have shown their objections by simple means like shopping in Jewish store, but others who defied this tyrannical regime resisted and for many made the ultimate sacrifice with their lives. This paper is not dealing with what some in Germany should have done to halt Adolf Hitler's rise to power, but instead to show that during this time period that there were Germans who did protest the actions of the Nazi Party and the consequences that many paid for their convictions.

This paper will address the July 20<sup>th</sup> assassination attempt on Adolf Hitler's life. In addition, this writing will mention other resistance groups, but it will focus on the military resistant movement. The main argument of this project will be to show that during a very dark period of German history there were those who did not accept, believe, condone, or adhere to the bizarre actions of their leaders. These resisters may have shown their objections by simple means like shopping in Jewish store, but others who defied this tyrannical regime resisted and for many made the ultimate sacrifice with their lives. This paper is not dealing with what some in Germany should have done to halt Adolf Hitler's rise to power, but instead to show that during this time period that there were Germans who did protest the actions of the Nazi Party and the consequences that many paid for their convictions. The writing will also demonstrate the quandary that the military had to overcome. Unlike the religious or political opposition which based its objections on moral or political differences, the military had to justify their movement as not an act of treason but as an act of nationalism and patriotism.

Polling today does clearly show that the vast majority of Germans do have a very negative opinion of the Third Reich and support Angela Merkel's statement condemning Iranian president Ahmadinejad's ridiculous assertion that the history of the Holocaust needs to be revised (see Appendix A). The statistics revealed the lack of knowledge from 1970 and 1984 about the daring assassination attempt on Adolf Hitler's life, which was just one of 42 assassination attempts on his life (see Appendix B). Several conclusions could be drawn; that Germans just want to forget their past, or the German people do not want to acknowledge that the assassination attempt may have been justified, but was actually an act of treason. Dr Axel Smend the son of one of the July 20<sup>th</sup> conspirators recalls that when growing up in post war Germany his mother had to go to school because he was fooling around in school and his teacher needed to speak to his mother about this behavior. During the conversation the teacher realized who Dr. Smend's father was and the teacher made the comment, "I guess we should expect this type of behavior from the son of a traitor."<sup>i</sup> This type of attitude was not uncommon in Germany after World War II. There wasn't any great yearning for a return to the life under Nazi regime, but Germans did look unkindly upon those who they perceived as traitors to their country not heroes.

Today there is a very different outlook on the July 20<sup>th</sup> conspiracy. This was the official German comment on the movie *Valkyrie*, "But the movie has now even got a seal of approval from the German government. Bernd Neumann, the German government's federal commissioner for culture, said in a statement on Monday: "The film contributes successfully towards making this little-known chapter of German history known to an international audience."<sup>ii</sup> Another example of the changing attitude towards the July 20<sup>th</sup> assassination attempt is how German schools now incorporate this event as a learning tool: "German foundation Stiftung Lesen wanted to encourage school children to think about civil courage based on the example of Colonel Claus von Stauffenberg, who tried to assassinate Adolf Hitler."<sup>iii</sup> The Germany of today looks at its past and is learning and finally recognizing that there were those who loved their country and tried to save it from a group of mad men.

### ***Military Resistance***

Comprising a resistance group in the military was difficult at first since Adolf Hitler's early reform directives were very pleasing to the German military. On July 20, 1933, Hitler proclaimed Army Law, which superseded civilian courts and restored the tradition of the army being separate under the law. This act was very pleasing to the officer corps. Hitler also promised the military was that he was going to rebuild the army to levels higher than the restricted level imposed by the Versailles treaty. Additionally, he promised the navy that he would begin to construct new battleships that would triple what the Versailles treaty mandated. All of this made the resistance's recruitment push that much more difficult.

On August 2, 1934, Hitler announced that every member of the military must swear an oath of loyalty to him personally. The requirement was made into with the passage of the Law of the Oath of the Wehrmacht (defense force). The oath read, "I swear before God to give my unconditional obedience to Adolf Hitler, fuehrer of the Reich and of the German people, Supreme Commander of the Wehrmacht, I pledge my word as a brave soldier to observe this oath always, even to peril of my life."<sup>iv</sup> This oath was a dilemma for the soldier; it was common practice for a soldier to pledge loyalty to a commander in chief, but this oath required soldiers to make a more personal commitment. Hitler knew that by having military swear allegiance to him, he made any insubordination or criticism an act of treason. All of these actions were taken before Hitler began eliminating civil rights and committing the early atrocities. He had come to power through legal means, so his authority had to be obeyed. Many of the generals considered the Nazi philosophy reprehensible, but as long as Hitler was fulfilling his promises, none of the generals saw any justification to overthrow his regime.

The undisputed leader of a small group of military resisters was General Ludwig Beck, who became the face of the military resistance against Hitler and the Nazi party. He was recognized as an exceptional leader with a keen and organized mind, a man whose character was unquestionable. Beck held the position of the head of Truppenamt (Department of the Army). He was approached discreetly in a plot to overthrow Hitler in 1936, but he considered the action to be a purely political matter and not a military one. Beck always considered the Nazis a problem and not Hitler, but that thinking changed on

November 5, 1937 when Hitler issued military directives to have the armed forces prepare for war. Beck and the other generals were stunned by the directive and he realized that it was not the Nazis but Hitler who was driving his country to war. These directives caused many in the diplomatic core to protest as well. Foreign Minister Konstantin von Neurath protested to Hitler that his actions would lead Germany into war with Britain and France. Neurath threatened to resign which suited Hitler, who replaced Neurath with Joachim von Ribbentrop. At the same time, 16 generals were forced to resign; 44 others whose loyalty was being questioned were reassigned. This shuffling around of high ranking military officials, along with Hitler's purging of the diplomatic core, all lit the spark which ignited the military resistance movement.

On October 1, 1938, the invasion of Czechoslovakia was being pressed hard by Hitler, but Beck was adamantly opposed to that action. He had sent a series of communications to Hitler asking him to reconsider his decision. Hitler considered Beck's views as pessimistic and rejected them. Beck continued to press his argument that Germany could easily defeat Czechs, but it would draw France, Britain, and even the United States into a conflict, and Germany was not prepared for an extended military clash. Beck was not alone in this endeavor. General Hans Oster, Abwehr (Army Counter-Intelligence) chief of staff was in total agreement with Beck. These two held positions of power that allowed the resistance movement to operate efficiently and able to avoid detection. Oster's position within the Abwehr was able to deflect Gestapo from prying too closely to resistance activities, and Beck's reputation as an honorable man gave him the ability to recruit other top military leaders to join in the resistance movement.

Early setbacks for the military resistance movement against Hitler were attributed to the military triumphs that the German armed forces experienced early in the war. Hitler's popularity soared from 1938 to 1942. German forces experienced victory after victory, and even though most generals detested the Nazi philosophy, they knew that any attempt to remove their commander in chief in this atmosphere would be considered an act of treason. Several assassination attempts were planned, but for a variety



reasons failed. Most did not even get an opportunity to be attempted because of Hitler's erratic schedule. He would constantly change plans at the last moment, which foiled the resistance plans.

All of this changed in the beginning of 1943, as Germany's military fortunes started to take a change for the worst. The forces at Stalingrad under General Friedrich Paulus, commander of the Sixth Army, surrendered to the Red Army on February 2, 1943. The 91,000 who surrendered were starving and suffering from frostbite. Hitler had refused to allow Paulus to retreat, which turned out to be one of history's greatest military blunders. This was the first sign that was recognized by everyone except Hitler that the war was lost. Following his surrender, Paulus took part in radio broadcast urging military leaders to overthrow or assassinate Hitler. Military leaders believed that the longer Hitler remained in power would spell disaster for the German army and the entire nation. German military resistance knew that this was the perfect opportunity to begin planning their operations to bring down Hitler and his entire regime. A series of assassination attempts were planned with the most daring being attempted on July 20, 1944, Operation Valkyrie.

### *Valkyrie*

*Operation Valkyrie* was not the first serious attempt at an assassination attempt by the military. The first was the 1938 Coup which was planned on the eve of the Czechoslovakia invasion. The plan was to seize key installations and effectively disarm the Nazi paramilitary organizations. The generals, especially Beck, knew that the German people would not rally to support another war. Among the German military that was part of the coup were Chief of the German General Staff at the time, Franz Halder, Field Marshal Erwin v. Witzleben, General Carl-Heinrich von Stülpnagel, and many senior army generals as well as Hans Oster. Unfortunately, the British and the French were also frightened of starting another war, so all parties caved into Hitler's desires and the coup fizzled out. Another attempt was organized by First General Staff Officer, Oberstleutnant Henning von Tresckow, who was appalled by the way the war was being conducted. He considered orders such as the Commissar Order:

In the fight against Bolshevism it is *not* to be expected that the enemy will act in accordance with the principles of humanity or international law. In particular, the *political commissars* of all kinds, who are the real bearers of resistance, can be expected to mete out treatment to our prisoners that is full of hate, cruel and inhuman.

The army must be aware of the following:

1) In this battle it would be mistaken to show mercy or respect for international law towards such elements. They constitute a danger to our own security and to the rapid pacification of the occupied territories.

2) The barbaric, Asiatic fighting methods are originated by the political commissars. Action must therefore be taken against them *immediately*, without further consideration, and with all severity. Therefore, when they are picked up in battle or resistance, they are, as a matter of principle, to be finished immediately with a weapon.

In addition, the following regulations are to be observed:

#### **Operational Areas**

1) Political commissars operating *against our armies* are to be dealt with in accordance with the decree on judicial provisions in the area of "Barbarossa." This applies to commissars of every type and rank, even if they are only suspected of resistance, sabotage or incitement to sabotage.<sup>v</sup>

Tresckow saw these and orders like them to be clear violations of international law. He then started investigating if any other senior military personnel shared his views and the trail led to Beck. When the German armed forces' fortunes began to decline, plans started to be organized to eliminate Hitler's regime. Tresckow kept trying to get his superior, Feldmarschall von Kluge, to join the conspiracy, who finally consented after the loss at Stalingrad. Tresckow convinced Hitler's staff that he should visit Army Group Centre, where the assassination would take place. Two bombs were placed onto Hitler's plane so that it would explode after the airplane was in the air. Bad luck fell upon the resistors when the detonator worked but the explosives failed to ignite. The resistance did not quit, but two other attempts by Rudolf-Christoph Freiherr von Gersdorff and Axel von dem Bussche failed due to Hitler's erratic schedule. Additionally, the device used to assassinate Hitler was destroyed in an Allied bombing raid.

In the summer of 1943, the military resistance was scattered because of the need for different forces being deployed throughout the European theatre. Responsibility for the assassination had been transferred from Army Group Centre to Olbricht's GAO, in late 1943, but Olbricht was burdened with his own duties and needed a reliable assistant to coordinate the details for Operation Valkyrie. Beck,

Tresckow and other members of the resistance decided on a young Lieutenant Colonel of the General Staff, with whom his staff had worked well in the past, Claus Graf Schenk von Stauffenberg. **He had a reputation with a stellar military record for his actions with the Sixth Panzer Division's campaign's in Poland and France. His service also included 18 month tour of duty during Operation Barbarossa, where he witnessed firsthand the brutality of the SS. His Russian service disillusioned him with the Third Reich. The disaster at Stalingrad further alienated Stauffenberg from Hitler's strategy. As soon as the battle for Stalingrad finished, he asked for a transfer to a new front, and he was sent to the Tenth Panzer Division in Tunisia, just in time to join the last days of the fierce battle of the Kasserine Pass.** On April 7, 1943, his car drove into a mine field and he was seriously wounded. He lost his left eye and suffered injuries to his left ear and knee. He also lost his right hand, and the surgeons had to amputate part of that arm as well as the ring and little fingers of his left hand. The doctors doubted that he would survive; if he did, they thought, he would not regain his sight. Stauffenberg returned home in the early autumn of 1943 for recovery and convalescence. He had been in a military hospital in Munich prior to this time, and there he made his most important contacts with the people preparing a plot to assassinate Hitler.

*Operation Valkyrie* was originally designed to occur if a serious threat of revolt arose from the millions of slave laborers imported to work in Germany from all the occupied territories. In response to that threat, Hitler ordered the Home Army to develop a General Staff plan for suppressing such an uprising. The plan was given the code name *Valkyrie*. The military resisters would use these plans as part of the coup; they planned to secure Berlin and place their own personnel in vital positions throughout the military hierarchy and critical government offices. *Valkyrie* also planned for a smooth transition from Nazi control to the new government, which would be led by Beck. On July 20, 1944 Stauffenberg would carry the first stage of the coup out by planting a bomb at a meeting at Wolfsschaze. The bomb was concealed in his briefcase which he would place close to where Hitler would be standing. Stauffenberg

was able to arm the bomb, he was able to place his briefcase almost right next to where Hitler was standing, and he was able to exit the conference center before the explosion.

The first stage was the only phase of *Operation Valkyrie* that was a success. Stauffenberg's briefcase was moved just before it detonated so Hitler was not near the bomb when it exploded. The Home Army was deployed in Berlin, and the SS as well as other high ranking Nazi officials were placed under arrest. All seemed to be operating as plan until it was discovered that Hitler had survived the assassination attempt. The commander of the "Grossdeutschland Battalion," the unit responsible for sealing off the government district of Berlin, turned against the conspiracy - but only *after* speaking with Hitler personally. Major Remer, who was part of the conspiracy, first carried out his military orders meticulously. Goebbels, however, put a call through to the Wolfschanze, demanded to speak to Hitler personally, and then handed the receiver over to the awestruck major. Major Remer became Hitler's ardent supporter at once. Hitler personally promoted him two ranks and ordered him to crush the coup with his troops. From one minute to the next Remer went from keeping guard on the Propaganda Ministry to being the man determined to put down the coup.

From this point forward the entire operation unraveled. By the evening of July 20, the conspirators were under arrest. Friedrich Olbricht, Claus Graf Stauffenberg, Albrecht Ritter Mertz von Quirnheim and Werner von Haeften were shot shortly after midnight. In the months to come, 5,000 of the resisters as well as sympathizers were executed. Retribution was brutally carried out and was not just limited to the resisters: "On August 3, 1944, Himmler announced the infamous doctrine of *Sippenhaft*, 'blood guilt.' Under this doctrine, guilt was hereditary because of 'diseased blood.' Guilt extended to all members of the family, including the aged and the very young."<sup>vi</sup> Luckily the fortunes of war had run out for the Nazis and this doctrine was never fully implemented.

### ***Conclusion***

During a very dark period of German history, there were those who did not accept, believe, condone, or adhere to the bizarre actions of their leaders. These resisters may have shown their objections

by simple means like shopping in Jewish store, but others who defied this tyrannical regime resisted and for many made the ultimate sacrifice with their lives. The military resistors were all too aware that their actions could and did result in the death sentences, but these possibilities did not deter these people from their goal of removing Hitler and his regime. The people highlighted in this paper are only a few there were countless others. How could someone like Hitler come to power? The same question can be asked about Pol Pot of Cambodia, Saddam Hussein of Iraq, Radovan Karadzic of Serbian Bosnia, Idi Amin of Uganda, and Mao Zedong of China. Since the beginning of time, there have been despicable individuals that have come to power and committed unspeakable atrocities. Humanity will always be able to combat these tyrants as long as individuals that have been highlighted in this paper are part of our society. In the movie, "Valkyrie", Tom Cruise who portrays von Stauffenberg cried out before being killed by a firing squad, "Long live our sacred Germany!"<sup>vii</sup> Till the very end von Staffenberg still believed in the righteousness of his country, but he believed that Hitler was destroying the land that he and the resistors loved.

## Appendix

- <sup>i</sup> History Channel documentary, "Valkyrie: The Plot to Kill Hitler",
- <sup>ii</sup> Spiegel Online International web site, <http://www.spiegel.de/international/germany/0,1518,602336,00.html>
- <sup>iii</sup> Spiegel Online International web site, <http://www.spiegel.de/international/germany/0,1518,605426,00.html>
- <sup>iv</sup> Terence Prittie, "Germans Against Hitler,"
- <sup>v</sup> <http://www.jewishvirtuallibrary.org/jsource/Holocaust/commissar.html>
- <sup>vi</sup> Michael C. Thomsett, "The German Opposition to Hitler"
- <sup>vii</sup> *Valkyrie*. DVD. Directed by Bryan Singer. Performed by Tom Cruise and Kenneth Branagh. USA / Germany: United Artists, 2008.

## References

- Burns, Kevin, dir. *Valkyrie: The Plot to Kill Hitler*. History Channel. February 10, 2010.
- Cro. "Stauffenberg's Daughter Praises 'Valkyrie'" Spiegel Online International. <http://www.spiegel.de/> (accessed February 8, 2010).
- Dgs. "Teaching Ethics with Tom Cruise: 'Valkyrie' Classroom Material Slammed for Omitting Scientology." Spiegel Online International. <http://www.spiegel.de/> (accessed March 8, 2010).
- Prittie, Terence. *Germans Against Hitler*. First American ed. Boston: Little, Brown, 1964.
- Vashem, Yad. "The Commissar's Order for 'Operation Barbarossa'" Jewish Virtual Library. <http://www.jewishvirtuallibrary.org/index.html> (accessed April 10, 2010).
- Thomsett, Michael C. *The German Opposition to Hitler*. Jefferson: McFarland & Company, 1997.
- Valkyrie*. DVD. Directed by Bryan Singer. Performed by Tom Cruise and Kenneth Branagh. USA / Germany: United Artists, 2008.

A. In December 2006, Iranian president Mahmoud Ahmadinejad hosted in Tehran the International Conference to Review the Global Vision of the Holocaust—a seminar seeking to "revise" the veracity of such events. German chancellor Angela Merkel expressed dismay, saying, "I would like to make clear that we reject with all our strength the conference taking place in Iran about the supposed non-existence of the Holocaust." <http://www.angus-reid.com/polls/view/14733>

**B. Polling Data**

Looking back at the time of the Third Reich, would you say National-Socialism was completely negative, mostly negative, some negative and some positive aspects, or mostly positive?

	<b>2007</b>	<b>1991</b>
Completely negative	21%	17%
Mostly negative	34%	36%
Some negative, some positive	40%	42%
Mostly positive	1%	2%
Not sure	5%	3%

*Source: TNS Emnid / Bertelsmann Stiftung*

*Methodology: Interviews with 1,004 German adults, conducted from Jan. 21 to Jan. 26, 2007. Margin of error is 3.1 per cent. "Germans Assess Legacy of Nazism." Angus Reid Public Opinion.*

<http://www.visioncritical.com/category/public-opinion/>  
(accessed March 8, 2010).

# SCIENCES



## **Wine Chemistry: Measuring the Effects of Oak Tree Elevation in Ellagitannin Alcohol Absorption**

Derreck Shenk

Faculty Mentor: Melinda Harrison, Ph.D.

### **Abstract**

American White Oak trees were used for this study to determine whether elevation plays a role in the rate of absorption of alcohol for these trees if used in a wine barrels. In order to perform the experiments, samples were obtained from the interior of White American Oaks by using a coring device to drill to the center of the tree and get a sample of the core. After sending the samples to a collaborator the ground up wood samples were used to carry out the experiment. Wood samples were soaked in a 63% ethanol solution for different periods of time and the ellagitannins from the wood were able to permeate into the ethanol mimicking that of wine soaking in an oak barrel. A total of seven trees were sampled and were split into high elevation and low elevation categories. A mer absorbance analysis using the Folin-Ciocalteu colorimetric assay and statistical analysis utilizing a p-test. Results indicate there is not a statistically significant difference between elevation and absorbance of ellagitannins.

### **Introduction/Background**

The use of wine barrels (especially oak barrels) to store and age wine is a centuries old tradition. Wine aged in oak barrels is enhanced with the addition of vanilla, oak, and spicy overtones. French Oak was first used to make wine barrels but eventually American White Oak was used to lower the costs for North American Vintners. The ellagitannins (which are hydrolysable tannins) account for 10% of the mass of oak heartwood. The ellagitannins precipitate protein and strip metal cofactors out of enzymes in the heartwood resulting in resistance to decay. The oxidation of ellagitannins attributes to the distinct aromas and flavors found in wines. Ellagitannins are a very high proportion of extractable phenols from both American and European cooperage oaks (**Figure 1**). They can be measured using simple techniques and besides attributing to the aroma of wine also help determine the wood's permeability. Permeability of the wood selected for the barrel is very important to a vintner when preparing wine. The larger the pores of the wood, the more porous the wood and better extraction. The smaller the pores of the wood, the less

porous the wood and the slower the extraction. Extraction technique is specific to whatever flavor the vintner is trying to achieve (**Figure 2**).

Over the course of the past couple decades, there have been many different studies on the effects of ellagitannins on the fermentation process of wine and where they come from. Ellagitannins are found in the heartwood of White American Oak Trees along with many other types of trees that can be used in the production of oak barrels. These ellagitannins play an extremely important role in regulating the oxidation process by absorbing the oxygen dissolved within the wine and also facilitates the hydroperoxidation of the wine constituents. The ellagitannins in the oak barrels are able to rapidly absorb oxygen, therefore very little oxidation occurs when the wine is fermenting. This helps make sure that the wine stays the crimson red color that red wine should have; rather than a yellowish color that could occur if oxidation was allowed to take place for too long. Another importance of the ellagitannins in the fermentation process of the wine is that the regulation of the oxidation also helps to give red wine its taste because ellagitannins are present in the wine for many years after it has been fermenting in the oak barrels. The way that the ellagitannins help prevent the oxidation of the wine is through the creation of a hydroperoxidizing pool so that the harsh effects of oxidation does not occur and hurt the fermentation of the wine.<sup>5</sup>

One of the experiments performed on ellagitannins regarding their effects on the aging process of wine in oak barrels was to first isolate different ellagitannin samples through the use of different column chromatography techniques. The ellagitannins were isolated so they could study the production of the different chemicals made and could then be identified in the finished wine to get a better idea of their function. The ellagitannin chromatography results were compared between commercialized wines and it was clear that some of the chromatography samples showed the same results as the components making up the ellagitannins such as ellagic acid. It was shown through this experiment that around half of the phenols present in the chromatography sample of the wines were ellagitannins making it quite clear that the ellagitannins present in the heartwood of the wood used to make the oak barrels are extremely

important in the overall quality of the wine both in the fermentation process and the actual finished product of the wine.<sup>3</sup>

Another study performed was to compare the American Oak to the European Oak when using them to make wine barrels and what their effects on the production of the wine may be. One of the main focuses of the comparison was to determine the different ellagitannin levels expressed in both of the wood samples due to the fact that the ellagitannins in the wood have a major effect on the final product of the wine. The study determined that the ellagitannin levels in the American Oaks were much lower than those found in the European Oaks meaning that there will be a difference in the oxidation processes used in each of the barrels. This experiment showed that the presence of ellagitannins in the wood used to make the oak barrels is going to have a profound effect on the color, taste, and many other properties of the final commercialized wine product.<sup>1</sup>

A third experiment tried to determine the different environmental properties that can affect the ellagitannins found within the heartwood of woods used to make barrels for the aging process of wine. Not only did the experiment focus on the properties of the ellagitannins themselves but also the different properties of trees on their levels and properties of their ellagitannins. One of the properties of the trees that affect the level of ellagitannins in the tree is the age of the tree because it was shown that the younger the tree, the more ellagitannins are present within the outer heartwood of the tree. The reason that there are higher levels of ellagitannins in younger trees is because the older trees have converted the ellagitannins into free ellagic acid which can be found in older trees inner heartwood. Another characteristic of the trees that can affect ellagitannins is the tree location and origin. The location of the tree will affect the different resources available to the tree and the genetic information required in the trees origin will affect its abilities to use the ellagitannins. Based on all of these factors and more, the presence of ellagitannins in wine has varied greatly depending on the type of wood used to make the barrels in which the wine was aged. The experiment showed that the levels of ellagitannins in the wine may have a large affect on why wines from different companies and different years have diverse tastes from one another.<sup>2</sup>

Yet another experiment focused on the ellagitannins in oak barrels used for the aging of other alcoholic spirits like cognac and brandy. They focused on the breakdown of ellagitannin into ellagic acid as the alcohol sits within the oak barrels because the alcohol solubilizes the ellagitannins and spreads them throughout the wood. There are many factors that may affect the rate at which the ellagitannins are solubilized into ellagic acid such as the heat in which the samples are stored and the type of tree in which the wood barrels came from. Another difference between the varying tastes associated with different brands of alcohol can be due to whether the barrels used to age the alcohol were new or reused because the reused barrels are not going to have as many ellagitannins as the new barrels.<sup>4</sup>

Although there have been a lot of studies to determine the different properties of the trees that may affect the way in which ellagitannins affect wine aging, there have been no studies showing the affects of tree elevation on ellagitannins ability to absorb alcohol. Because of the lack of studying on elevation, we performed an experiment to try and determine if elevation did have an effect on ellagitannins and their properties. Our hypothesis was that the higher elevation that the wood comes from the more efficient the ellagitannins in the wood would be at absorbing alcohol. To determine whether or not elevation did have an effect on the wood samples ability to absorb alcohol, we compared the absorbance ability for ethanol. The oak tree samples were tested from varying elevations and compared them to one another to figure out their ethanol absorption ability.

### **Materials and Methods**

Wood samples were obtained from Conrad-Weiser State Forest and White American Oak Trees were located that had varying elevations. Oak tree width was important, not too thick so that we could not get to the heartwood but not too thin that we went past the heartwood, the elevation was recorded using a GPS system equipped with an altimeter. An increment borer was used to extract cores from the trees. The heartwood portion of the wood sample was separated from the outer wood by using its darker color to differentiate and then stored in plastic straws. Next the wood samples were sent to our collaborator from Duquesne University so that the samples could be ground up into fine chips and dried.

After obtaining the wood samples from the forest the different solutions were prepared that were going to be used throughout the experimental procedure. The first solution that was made was the 3% sodium carbonate solution that was a weight per volume solution. To make the solution, take 30 grams of sodium carbonate and add to 1000mL of deionized water before bringing the solution to a boil on a hot plate so that the sodium carbonate could be mixed into the DI water. Once the solution was thoroughly mixed and cooled, a few more crystals of the sodium carbonate were added to the beaker and then allowed to incubate for 24 hours then the solution was vacuum filtered. Another solution that was made for the experiment was the 63% ethanol solution that was made by adding 630mL of 100 percent ethanol into a small amount of DI water before filling the solution to 1000mL with DI water. The last solution needed to perform the different tests done in the experiment was the 0.4M Folin-Ciocalteu solution that was made using the  $C_1V_1=C_2V_2$  equation to add the correct amount of Folin-Ciocalteu reagent to DI water to reach the 0.4M concentration of solution. The solutions were made at the beginning of the experiment and then made throughout whenever the solutions needed to be replenished or replaced.

Once all of the solutions were made, the experiment itself could be run for the different wood samples from the varying elevations. For each sample of wood, a total of three trials were run on it so that an average and standard deviation could be taken for the different samples. To run a sample we first placed the sample into an incubator set at 50°C with the caps unscrewed slightly along with drying beads to dry out the samples overnight. The next day the sample was removed from the incubator and three 0.05 grams of the wood were measured and one of the samples was placed into 8mL of the 63% ethanol solution so that the sample could soak in the ethanol for different time periods. After 1, 2, 3, 4, 5, and 20 minutes of the sample soaking in the ethanol, a 20μL sample of the ethanol and wood was placed into a test tube containing a chemical cocktail comprised of 1.98mL of DI water; 1mL of the 3% sodium carbonate solution and lastly 1mL of the 0.4mL of the Folin-Ciocalteu solution after the ethanol sample was added. The test tube was then covered in parafilm and placed into a 50°C water bath and allowed to incubate for 20 minutes before the test tube was removed and its contents were placed into a cuvette and the absorbance was measured at 760nm. The same procedure was done for the remaining two trials and

all of the absorbencies were recorded and entered into Excel so that some statistical analysis could be performed. The mean and standard deviation was found for each soak time for each of the three high samples and the four low samples. The cut off elevation between a sample that was considered high and one that was considered low was 1000 meters(m) and the samples that we had were from 1303 m, 1299 m, 1294 m, 949 m, 740 m, 709 m, and 620 m. Next, all of values for the high samples at a particular soak time were taken and compared to the values for the low samples at the same soak time using a student t-test at the 95% confidence interval to determine the p-value. The t-test compares the averages between the two samples and the standard deviations between the two samples; we wanted the high elevation samples to have a higher average and a lower standard deviation than the low samples to get a p-value of less than 0.05 which indicates a statistical significant difference between the high and low elevation samples.

## **Results**

Table 1 shows the results obtained from the sample with the highest elevation of 1303 m. Throughout the different samples run there were a few times when the numbers obtained from the spectrophotometer were extremely high or low when compared to a majority of the other results which can explain why the standard deviation for some of the soak times from the first high sample are greater than the optimal standard deviation. The two minute soak has the highest standard deviation of 0.06 and is due mainly to the 0.138 absorbance measured for the second sample. As indicated in the table there is not an increase in the absorbance vs time the wood soaked in the ethanol but rather the numbers are consistent with one another regardless of time.

Table 2 shows the results that the spectrophotometer obtained from the second highest sample elevation of 1299 m. This sample had much more consistent numbers than those that were obtained from the first sample. The highest standard deviation for the second sample was also for the two minute soak but for this second sample it was only 0.016 rather than the 0.06 standard deviation observed in the first sample. Like the first sample, there is no general increase in the absorbencies as the soak time goes up, but there is a small increase observed between the one minute soak and the twenty minute soak.

Table 3 represents the results that were obtained from the last high elevation sample run for the experiment and had an elevation of 1294 m. The two minute soak had the highest standard deviation again with a 0.055 standard deviation calculated. The overall numbers obtained from the three trials for the two minute soak were much higher than those in the first two samples except for the third trial which had an extremely low reading of 0.018 which can also explain the high standard deviation. Like the first two high samples run, there is no general increase in the absorbencies detected as the soak times increased and there is no real correlation between the soak times and absorbance.

Table 4 moves on to the low samples run and represent the sample that had the highest of the low elevation samples with an elevation of 949 m. Unlike two of the three high samples, the standard deviations for all of the soak times are rather low and there are no absorbencies that stand out as extremities. Also, there is a general, steady increase observed in the averages for each soak time between the one minute soak and the four minute soak and the remaining two soaks stay around the same as the four minute soak. These absorbencies are more consistent than the higher samples but the absorbencies obtained are also slightly smaller in number for this first low sample than the three higher samples run.

Table 5 shows the second low sample run with an elevation of 740 m and although its standard deviations calculated were slightly higher than those seen in the first low sample they are still much lower than a majority of the standard deviations observed in the three high samples. Unlike the first low sample run, the second low sample does not show a general increase in the average absorbencies measured but a slight increase is seen from the average of the one minute soak and the average of the twenty minute soak, although the averages dip down slightly the three minute soak.

Table 6 represents the third low sample tested in the experiment and had an elevation of 709 m. The standard deviations calculated in the third sample are around the same as those obtained from the first low sample although the absorbencies are higher than the ones measured in the first and second low samples. The twenty minute soak for the third sample had the highest average than any of the other soaks for all of the other low samples.

Table 7 shows the fourth low elevation sample run and was the last sample run for experiment and had an elevation of 620 m. Like all of the other low samples, the standard deviations calculated were much lower than those observed in the samples with elevations over 1000 m and the numbers are pretty consistent with one another with no great increase in the absorbencies measured. Overall, the low samples seemed to have lower standard deviations than the high samples and did not have as much extremely high or low absorbency detected like the high samples did.

Table 8 shows the averages and standard deviations for all of the low elevation samples at the various soak times as well as showing the same information for all of the high elevation samples at varying soak times. The last column of the table shows the p-values that were detected using the student t-test at the 95% confidence interval to compare all of the high elevation samples to the low elevation samples to determine if a statistical significant difference is present. The lowest p-value obtained when comparing the two samples was for the two minute soak and had a value of 0.1049 and the highest was the five minute soak with a value of 0.4694.

## **Discussion**

Based on the first three tables representing the high elevation samples and the four tables for the low elevation samples, the averages for the samples were very similar but the low samples had a lot less variation in the absorbencies observed. The variation of the lower elevation samples was less than the high samples and their standard deviations were much lower than those of the high samples. The p-values for all of the different soaks when comparing the high elevations to the low elevations did not show a significant difference statistically. Since there was no significant difference in the absorbencies detected between the high and low samples then the conclusion is that elevation does not seem to have an effect on the alcohol absorption of ellagitannins in White American Oak Trees.

There are many reasons why the samples could have varied so much from trial to trial and why a statistically significant difference was not observed between the high and low elevations. The reason why there were sometimes extremely high absorbencies when compared to the other absorbencies could be because the samples were oxidized extremely quickly by the oxygen that mixed with the samples when



the samples were transferred from the test tube to the cuvettes, throwing off the absorbance readings. A reason why there were some extremely low absorbance readings could be because there was some trouble when it came to the Folin-Ciocalteu solution and its proper concentration. The first bottle of Folin-Ciocalteu reagent used for the experiment was very old and could have been contaminated. A new reagent was purchased but the absorbencies observed when using the new Folin-Ciocalteu reagent were extremely low when compared to the other samples. Another problem faced was that the day in which the samples were obtained was a very wet and rainy one which made it difficult to differentiate between the heartwood and the outer wood because the entire sample was the dark color of the heartwood. Because the samples were wet when they were obtained, the extreme wetness could have had an effect on the drying out process and therefore on the entire experiment.

Although there has been no significant statistical difference found between the high elevation samples and the low elevation samples, there were many positive issues solved through the process of the experiment. Some of the problems that were encountered when performing the different procedures were able to be corrected with the help of Dr. Melinda Harrison. The problem involving the Folin-Ciocalteu solution was fixed by figuring out the proper concentration of the original reagent to be 1M rather than 2M so the solution being made originally was too dilute which would explain the low results. When the proper concentration was used the absorbencies obtained were much closer to the correct amounts but a new problem was faced with the rapid oxidation of the samples when transferring the contents of the test tube to the cuvettes which gave extremely high results. In order to solve this particular problem, capped cuvettes were used to carry out the entire experiment by adding the chemical cocktail of water, sodium carbonate, Folin-Ciocalteu solution, and the wood and ethanol sample into the capped cuvette and then covering them with parafilm before allowing them to incubate. The samples were then read in the spectrophotometer in the same cuvettes so that the oxygen had little chance to enter the tube and cause oxidation. The improved procedure provided much more consistent results.

### **Future Direction**

In the future the small corrections in the lab procedure and the fact that new samples will be obtained, and hopefully completely dry samples, shows promise in obtaining much more accurate results than those obtained this year. Plus, the new procedure will be done on the old samples which mean that more trials will be done on each sample giving us more statistically sound data.

### **Acknowledgements**

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### **References**

- <sup>1</sup>Chatonnet, P. & Dubourdieu, D. (1998). Comparative study of the characteristics of American white oak and European oak for the production of barrels used in barrel aging of wines. *American Journal of Enology and Viticulture*, 49 (1), 79-85.
- <sup>2</sup>Puech, J.L., Feuillat, F. & Mosedale J.R. (1999). The tannins of oak heartwood: Structures, properties, and their influence on wine flavor. *American Journal of Enology and Viticulture*, 50 (4), 469-478.
- <sup>3</sup>Quinn, M.K. & Singleton, V.L. (1985). Isolation and identification of ellagitannins from white oak wood and an estimation of their roles in wine. *American Journal of Enology and Viticulture*, 36 (2), 148-155.
- <sup>4</sup>Viriot, C., Scalbert, A., Lapierre C. & Moutounet, M. (1993). Ellagitannin and lignins in aging of spirits in oak barrels. *Journal of Agriculture and Food Chemistry*, 41, 1872-1879.
- <sup>5</sup>Vivas, N. & Glories, Y. (1996). Role of oak wood ellagitannins in the oxidation process of red wines during aging. *American Journal of Enology and Viticulture*, 47, (1) 103-107.

### **Appendix**

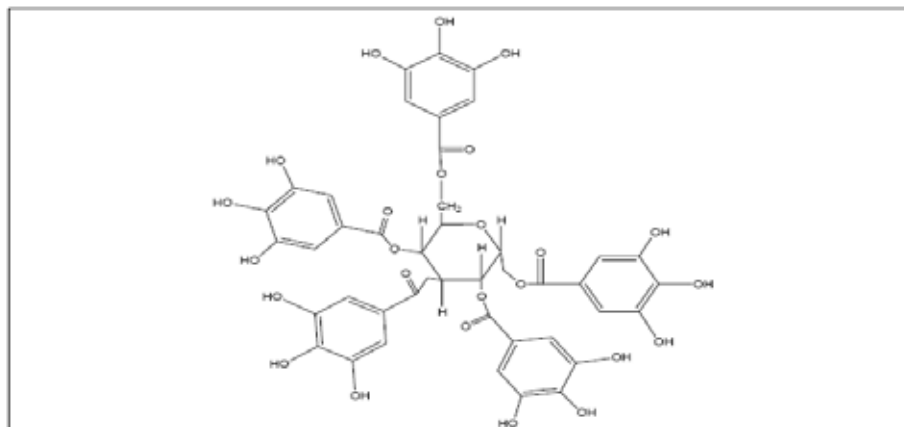


Figure 1: General Ellagitannin Structure

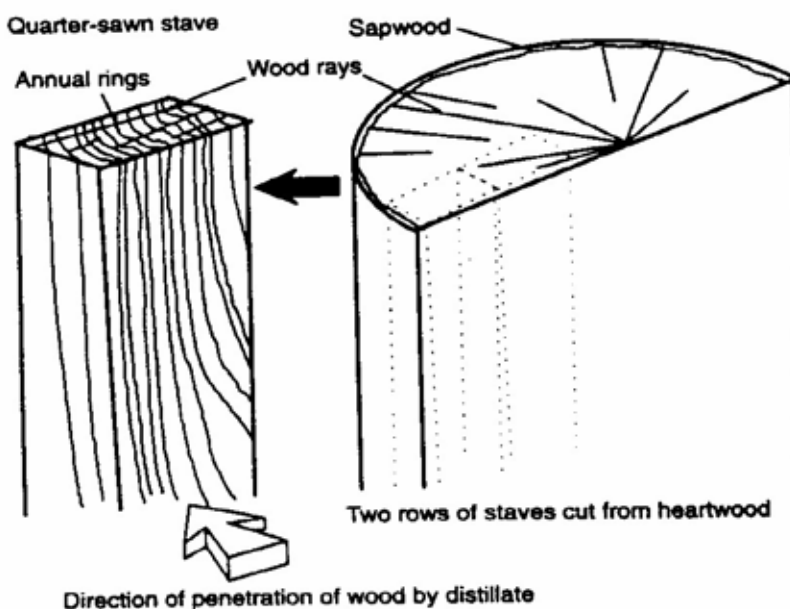


Figure 2: Cross-section of the interior of a American White Oak Tree

Table 1 Absorbance Results for High Sample at 1303 Feet Elevation at 760nm

Soak (min)	Trial A	Trial B	Trial C	Mean	SD
1	0.038	0.043	0.036	0.039	0.004
2	0.028	0.138	0.042	0.069	0.060
3	0.027	0.045	0.036	0.036	0.009
4	0.03	0.048	0.05	0.043	0.011
5	0.034	0.062	0.068	0.055	0.018

20	0.043	0.082	0.078	0.068	0.021
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Table 2 Absorbance Results for High Sample at 1299 Feet Elevation at 760nm

Soak (min)	Trial A	Trial B	Trial C	Mean	SD
1	0.022	0.039	0.035	0.032	0.009
2	0.032	0.042	0.064	0.046	0.016
3	0.04	0.058	0.052	0.050	0.009
4	0.056	0.041	0.05	0.049	0.008
5	0.033	0.036	0.04	0.036	0.004
20	0.065	0.05	0.061	0.059	0.008

Table 3 Absorbance Results for High Sample at 1294 Feet Elevation at 760nm

Soak (min)	Trial A	Trial B	Trial C	Mean	SD
1	0.045	0.023	0.088	0.052	0.033
2	0.065	0.128	0.018	0.070	0.055
3	0.023	0.05	0.052	0.042	0.016
4	0.048	0.06	0.036	0.048	0.012
5	0.042	0.067	0.035	0.048	0.017
20	0.055	0.041	0.04	0.045	0.008

Table 4 Absorbance Results for Low Sample at 949 Feet Elevation at 760nm

Soak (min)	Trial A	Trial B	Trial C	Trial D	Mean	SD
1	0.022	0.033	0.042	0.028	0.031	0.008
2	0.051	0.034	0.024	0.027	0.034	0.012
3	0.049	0.047	0.048	0.031	0.044	0.009
4	0.048	0.057	0.054	0.035	0.049	0.010
5	0.04	0.051	0.073	0.033	0.049	0.017
20	0.053	0.053	0.044	0.043	0.048	0.006

Table 5 Absorbance Results for Low Sample at 740 Feet Elevation at 760nm

Soak (min)	Trial A	Trial B	Trial C	Mean	SD
1	0.031	0.069	0.029	0.043	0.023
2	0.027	0.079	0.031	0.046	0.029
3	0.033	0.033	0.049	0.038	0.009
4	0.048	0.044	0.033	0.042	0.008
5	0.078	0.031	0.035	0.048	0.026
20	0.037	0.041	0.076	0.051	0.021

Table 6 Absorbance Results for Low Sample at 709 Feet Elevation at 760nm

Soak (min)	Trial A	Trial B	Trial C	Mean	SD
1	0.054	0.043	0.052	0.050	0.006
2	0.056	0.037	0.042	0.045	0.010
3	0.047	0.035	0.04	0.041	0.006
4	0.038	0.035	0.042	0.038	0.004
5	0.042	0.041	0.065	0.049	0.014
20	0.062	0.071	0.067	0.067	0.005

Table 6 Absorbance Results for Low Sample at 709 Feet Elevation at 760nm

Soak (min)	Trial A	Trial B	Trial C	Mean	SD	P-Values
Soak (min)	Average of Low Samples	SD of Low Samples	Average of High Samples	SD of High Samples		
1	0.042	0.0135		0.041	0.0193	0.4277
2	0.042	0.0152		0.062	0.0432	0.1049
3	0.045	0.0097		0.043	0.0120	0.3432
4	0.044	0.0084		0.047	0.0094	0.2742
5	0.047	0.0156		0.046	0.0149	0.4694
20	0.055	0.0161		0.057	0.0156	0.3500
	1	0.044	0.048	0.056	0.049	0.006
	2	0.041	0.054	0.038	0.044	0.009
	3	0.048	0.055	0.064	0.056	0.008
	4	0.058	0.043	0.039	0.047	0.010
	5	0.037	0.048	0.035	0.040	0.007
	20	0.037	0.04	0.085	0.054	0.027

Table 7 Statistical Analysis of High and Low Elevation Samples

**A Study Using Flow Cytometric Phosphatidylserine Translocation to Detect Apoptosis in the  
Earthworm *Eisenia hortensis* In Vitro**

**Timothy Nacarelli and Sheryl L. Fuller-Espie, Ph.D.**

**Faculty Advisor: Sheryl L. Fuller-Espie, Ph.D., DIC, Associate Professor of Biology**

**Abstract**

Research on the invertebrate *Eisenia hortensis*, also known as the European nightcrawler, was completed through the detection of phosphatidylserine translocation via apoptosis induction of the earthworm coelomocytes *in vitro* by the apoptotic inducers camptothecin, etoposide, actinomycin D, cycloheximide, and dexamethasone. The objective of the research studies employed flow cytometry for detection of phosphatidylserine translocation, which occurs in the event of early apoptosis, using annexin V conjugated to the fluorochrome phycoerythrin (annexin V PE). Late apoptosis and cell necrosis was also determinable by 7-amino-actinomycin D (7-AAD), a nucleic acid dye, from which the viability of a cell was assessed. It was hypothesized that *E. hortensis* possess an apoptotic pathway which was exploited via an apoptotic inducer that would cause significant phosphatidylserine translocation through the detection by annexin V PE. From the apoptotic inducers tested and statistically analyzed by a student's *t*-test ( $p \leq 0.05$ ), actinomycin D exhibited itself as the most prevalent and significant inducer which resulted in phosphatidylserine translocation in predominantly hyaline amoebocytes. When gating on the hyaline amoebocytes from the total amount of earthworms tested within the individual extrusion assays that responded to actinomycin D as an apoptotic inducer, statistical significance was yielded from 50% of the earthworms in assays 2 and 3. When gating on the hyaline amoebocytes from the total amount of earthworm gradient samples tested within the batch extrusion assays that responded to actinomycin D as an apoptotic inducer, statistical significance was yielded from 75% of the earthworm gradient samples in assay 4, which includes bands 2 and 3 of the two gradients tested, and 20% of the earthworm gradient

samples in assay 5, which includes the 3<sup>rd</sup> band from the two gradients tested at the temperatures ranging from 20°C, 30°C, and 37°C with times ranging from 4, 8, and 24 hr.

## Introduction

The invertebrate species that was the subject of my research was the European nightcrawler known as *Eisenia hortensis*. This type of earthworm exhibits an innate immunity as its primary defense which protects against impurities and foreign entities contributed from the environment.<sup>2</sup> The innate immunity is comprised of different types of cells which are extruded from the earthworm's dorsal pores in abundant amounts which then are used for research studies. From the innate immunity, cells are particularly significant for recognizing antigens from a known foreign entity via recognition receptors through its antigenic nonspecific defense receptors. These receptors are known as pattern recognition receptors which are present on the surface of antigen presenting cells. An example of a pattern recognition receptor is a conserved toll-like receptor which is a ligand binding receptor from which cell-signaling pathways are initiated. These cells consist of hyaline amoebocytes, also known as large coelomocytes, granular amoebocytes, also known as small coelomocytes, and eleocytes, also known as chloragocytes. These ecologically important cells are dissimilar in function and morphology. The hyaline amoebocytes involve phagocytic activity, the granular amoebocytes use natural killer-like activity, and eleocytes use lytic functions.

Flow cytometric and microscopic assessments *in vitro* have been completed on the different invertebrate earthworms *Lumbricus terrestris*, *Eisenia fetida*, and *Octolasion tyrtaeum*.<sup>3</sup> This was through examining their extruded entities such as their coelomocytes and comparing the morphology and viability between the three different species of earthworms. Through flow cytometry, the coelomocytes from the different earthworms were tested through a neutral red uptake which assessed the viability and integrity of the coelomocytes cells. The neutral red dye was accessible to the cell through the cells being membrane-compromised from which accumulates intracellularly in the lysosomes where the difference in the pH causes a red staining of the lysosomes. From the cell viability staining, it was evident that the *L. terrestris*

had the most red dye uptake and the *E. fetida* had taken up the least from an incubation of two hours. From previous classifications of the quality of the cell populations, the microscopic assessments showed that the *E. fetida* had the smallest coelomocytes while the *L. terrestris* had the largest. The amount of red dye taken up by the membrane-compromised cells was proportional to the amount and size of cells within a given sample which is logical because of the quality of cells of the *L. terrestris* were larger in size and in a more copious amount. The earthworm with the most populated coelomocytes and granulated cells give evidence of a more significant lysosome cell content which helped validate the further neutral red uptake. This clarified that the neutral red uptake was most significant in the *L. terrestris* and least in the *E. fetida*. This study had shown that invertebrate earthworm coelomocytes can be used in *in vitro* experiments to show cell death or morphological changes via membrane-compromised cell changes and staining techniques.

Apoptosis has been studied in the invertebrate *Caenorhabditis elegans* which is described as programmed cell death.<sup>1</sup> Apoptosis within *C. elegans* functions as a part of normal development at the same points in the cell lineage. During this process the cell shrinks, the nucleus becomes condensed, the DNA is fragmented, the membrane blebs, and apoptotic bodies form which may include organelles, DNA fragments, or cytoplasm. This event is triggered from activation of a cascade protein, otherwise known as a “suicide” protein, from which the apoptosis pathway is activated where nuclease and protease enzymes degrade DNA and protein within the cell. Apoptosis is also described as a cellular defense mechanism involving a cascade of cellular signaling pathways.<sup>9</sup> The cells undergoing apoptosis are attributed by morphological changes from the nuclease and protease activation. Among the amoebocytes of the *E. hortensis*, the hyaline amoebocytes are morphologically larger than the granular amoebocytes and comprise of 42% of the cell population; therefore, the morphological changes of the hyaline amoebocytes would be more prominent from apoptotic induction. The innate immunity of the *E. hortensis* is also characterized by phagocytosis or natural killer-like activity. Phagocytic cells, such as the hyaline amoebocytes, engulf and digest foreign entities whereas natural killer-like cells, such as the granular



amoebocytes, release perforins, proteases, or chemokines when activated which targets a cell for destruction.

Apoptosis, being essential for cellular homeostasis, was also induced and tested on the budding yeast *S. cerevisiae*; where formic acid served as the inducer which caused phosphatidylserine translocation *in vitro*.<sup>5</sup> Detection of phosphatidylserine translocation was done so through annexin V FITC using a confocal microscope. Propidium iodide, a nucleic acid dye, was also used for detection of cell necrosis or late apoptosis where if the cell membrane was permeated enough, the propidium iodide dye would enter the cell and attach to any double-stranded nucleic acids. In *S. cerevisiae*, apoptosis was noted through condensation of chromatin, fragmentation of DNA, reactive oxygen species production, externalization of phosphatidylserine, and mitochondrion destruction. As a result of apoptosis, formic acid had interrupted the electron transport of the mitochondria within the budding yeast. During apoptosis, a cell is subject to loss of membrane phospholipid symmetry which is targeted towards the phosphatidylserine being externalized relative to the membrane surface. Phosphatidylserine relative to the outside of the cell membrane is important to a cell because it is involved in removal of cells undergoing apoptosis by macrophages.<sup>6</sup> This recognition is used in the same manner through flow cytometry detections using annexin V FITC. Annexin V only binds to phosphatidylserine translocated cells whereas cells that do not have phosphatidylserine externalized, such as normal cells, would not be stained with the annexin V which gives annexin V its selective nature. B cells from a Burkitt lymphoma cell line were cultured under apoptosis inducing conditions which involved an incubation at 37°C, 5% CO<sub>2</sub>. These cells were then examined via a flow cytometer after being tagged with annexin V FITC. From the incubation, the only cells which demonstrated early apoptotic morphology changes and DNA fragmentation were those that were labeled by annexin V FITC. This showed that annexin V FITC binding was dependent upon the morphology of the B cells incubated.

The apoptotic inducer actinomycin D is an antineoplastic antibiotic which was used as a chemotherapy drug but exhibited highly toxic effects to cells by damaging genetic material. Actinomycin D inhibits transcription by preventing RNA polymerase activity. Molecularly, actinomycin D binds to the

DNA at the transcription initiation complex thus causing RNA polymerase to be inhibited along with the elongation process. Actinomycin D was significant in accelerating the rate of apoptosis in HeLa cells through infection with a mutated stomatitis virus.<sup>7</sup> The M protein of the vesicular stomatitis virus is known to naturally cause apoptosis in HeLa cells. Preliminary results showed that a mutated stomatitis virus that was deficient in M protein had not caused apoptosis in HeLa cells whereas the wild-type stomatitis virus caused apoptosis in HeLa cells. This experiment used a mutated stomatitis virus which was M protein deficient and was incubated in the presence of HeLa cells with the apoptotic inducer actinomycin D. From this incubation up to 30 hours at 37°C, 5% CO<sub>2</sub>, 5 µg of actinomycin D per mL caused the mutated stomatitis virus, deficient for the M protein, to still undergo apoptosis through inhibiting the mRNA of HeLa cells while not inhibiting the RNA synthesis of the stomatitis virus. This showed that actinomycin D was significant enough to compensate for the mutation of the stomatitis virus that infected the HeLa cells.

The apoptosis pathway has been demonstrated in the invertebrate *Drosophila melanogaster* which was manipulated through the inhibition of the CED-4/Apaf-1-related killer (ARK) homologue, an essential gene for apoptosis.<sup>4</sup> This experiment used the technique of RNA interference to scrutinize the apoptotic signaling pathway of the *D. melanogaster in vitro*. Apoptosis was inhibited within *D. melanogaster* cells from inhibition of the ARK homologue. The apoptotic inducers actinomycin D and cycloheximide were used at 6 and 8 hour incubation times which caused phosphatidylserine translocation and apoptotic attributes of the *D. melanogaster* cells. When the ARK homologue was inhibited, apoptosis was inhibited when incubated with actinomycin D and cycloheximide; however for the control sample where ARK was not inhibited, phosphatidylserine translocation from incubation with actinomycin D and cycloheximide resulted. This was distinguishable through annexin V FITC and propidium iodide staining of the *D. melanogaster* cell samples which were analyzed on the flow cytometer.

Similarly, flow cytometric methodologies utilizing annexin V PE, for detection of phosphatidylserine translocation for early apoptotic events, and 7-AAD, for detection of late apoptotic

cells by binding to DNA, were applied to the *E. hortensis* model *in vitro*. Flow cytometric phosphatidylserine translocation detections for early apoptotic cells were quantified by the percent annexin V PE tagged cells of the hyaline or granular amoebocytes from the selected apoptotic inducers tested which constituted camptothecin, etoposide, actinomycin D, cycloheximide, or dexamethasone. This also tested the apoptotic and cell signal transduction pathways of *E. hortensis* as a response to an apoptotic inducer.

## Materials and Methods

### *Animal Husbandry*

The specie of earthworm used was the *Eisenia hortensis* (Vermitechnology Unlimited), also known as the European night crawler, because of their size and ability to extrude an abundant amount of coelomocytes along with the simplistic nature of the maintenance and how they are handled. Their environment consisted of wood chips and shredded paper, which have been autoclaved, in a dark condition at 20°C and nutritional intake involved Gerber's baby food, specifically rice and wheat powder. The earthworms were cleaned before experimental procedures and extrusion of coelomocytes which involved placing the earthworms in a Petri dish which comprised of moist filter paper consisting of 1X Fungizone (2.5µL/ml; Fisher Scientific) for the duration of 1 day in order to decontaminate the earthworms. When completed with the experimental use and extrusion of the earthworms, they were either euthanized by freezing at -20°C in a freezer or returned to their habitat.

### *Coelomocyte Extrusion*

Individual or batches of earthworms were placed in a Petri dish for 1 min which contained 5 ml of ice cold extrusion buffer. Within this particular buffer was 71.2 mM NaCl, 5 % v/v ethanol, 50.4 mM guaiacol-glyceryl-ether, 5 mM EGTA, pH 7.3.<sup>8</sup> The association of this buffer with the earthworm caused a stimulation where the earthworm released its coelomocytes rapidly via the dorsal pores of the coelomic cavity. The coelomocyte cells extruded were then treated with 1 ml Accumax, which was an enzyme

cocktail containing trypsin, collagenase and DNase (Innovative Cell Technology), at room temperature for the duration of 5 min. After the 5 min incubation, 7 ml of cold phosphate buffered saline (PBS), which contained 0.2 M potassium phosphate, 1.5 M sodium chloride, and had a pH of 7.2, was added to the cells for the dilution of the Accumax enzyme. Then the coelomocyte cells were centrifuged at 150g at the temperature of 4°C for the duration of 5 min. Within the hood, the supernatant within the conical tubes, which now contains a pellet, was poured off and the pellet was flicked in the conical tube.

The cells were then resuspended in 1 mL of Super Dulbeccos Modified Eagle Medium (SDMEM) which contained 1X non-essential amino acids, 1X L-glutamine (Gibco), 1X streptomycin/penicillin/amphotericin B, 10 µL/mL tetracycline, 5 µL/mL chloramphenicol (Fluka Biochemika), HEPES buffer (15 mM), 10% fetal calf serum, 10 µL/mL kanamycin (Shelton Scientific), and 100 µL/mL ampicillin (Shelton Scientific). The earthworm cells were enumerated via hemacytometry where 7 µL of the cell resuspension was placed under the coverslip of the hemacytometer via a pipette. The cells were then counted and given a quality score that was ranging between 1 and 10, where 1 was a high amount of eleocytes and 10 was a low amount of eleocytes in a given sample. It was preferred that the selected samples would have a high quality score by having low amounts of eleocytes. Relative to the amount of cells counted from the hemacytometer, the total amount of cells from a sample was determined by multiplying the number of cells in a 5 X 5 square area by a dilution factor of 10<sup>4</sup>.

#### *Flow Cytometric Phosphatidylserine Translocation Assays*

From the extrusion process, the earthworm cells were harvested into a 96 well plate in duplicates or triplicates. Hydrogen peroxide (1%) and saponin were used as the single positive controls for annexin V PE and 7-AAD, respectively, for compensation purposes for the flow cytometer. The untreated cells incubated with annexin V PE and 7-AAD was the spontaneous apoptosis control which served as the background when comparing to the other samples that were incubated with an inducer. This comparison was also made during the statistical analysis via student's *t* tests. The apoptotic inducers of choice were

incubated for a designated incubation time and temperature where after the designated incubation period 5  $\mu$ L of annexin V PE and 7-AAD were added to the appropriate wells from which were given an incubation of 15 min at room temperature. Since the fluorescent reagents were sensitive to light, both reagents and the 96 well plate were protected from light at all times.

Before being run on the flow cytometer, the cells that contained annexin V PE were placed in a predetermined amount of a working solution of 1X annexin V PE binding buffer, where the amount of 1X annexin V PE binding buffer used was dependent upon the amount of the cell sample. Annexin V PE binding buffer was as a 10X stock solution which comprised of Hepes (0.1 M), NaCl (1.4 M), and CaCl<sub>2</sub> (25 mM). The 1X annexin V PE binding buffer provided a sufficient amount of calcium to help stabilize binding within a cell solution because annexin V PE binding was dependent of calcium phospholipid-binding protein. The cells that didn't contain annexin V PE were placed in FACS flow (sodium chloride, disodium EDTA, potassium chloride, potassium phosphate (monobasic), sodium phosphate (dibasic) and preservatives, BD Biosciences). The samples were then ready to be run on the flow cytometer from which the samples were covered by tin foil with the sample being vortexed before being run on the flow cytometer.

All assays used a "ready-to-use apoptosis inducer set" by BioVision™. This kit comprised of the apoptotic inducers actinomycin D (10 mM), camptothecin (2 mM), cycloheximide (100 mM), dexamethasone (10 mM), and etoposide (100 mM) which were all stored at -20°C. Basing that the inducers were dissolved in DMSO, the untreated cells of the assays were treated with DMSO at the designated dilution to control for effects of the DMSO inducer solvent. Other reagents used within the assays were purchased from BD Pharmingen™ which comprised of annexin V PE, which was used for phosphatidylserine translocation detection through binding to early apoptotic cells and was detected by the FL-2 detector on the flow cytometer, and 7-aminoactinomycin D (7-AAD), which was a nucleic acid dye that binds to nonviable cells or late apoptotic cells and was detected by the FL-3 detector on the flow cytometer. Both of these reagents were stored at 4°C while being covered from any light. All assays used flow cytometry which was employed on the FACS Calibur flow cytometer where Listmode data used

CellQuest Software (BD BioScience). The flow cytometer parameters used consisted of a forward light scatter (FSC) and side light scatter (SSC), which were set on a linear scale, and FL-2 and FL-3 detectors, which were set on a log scale. The earthworm cells that were collected were based on a FSC versus SSC two dimensional dot plot where the hyaline and granular amoebocyte subpopulations were gated for analysis. Annexin V PE was based on the FL-2 detector and 7-AAD was based on the FL-3 detector. Analysis comprised of a histogram which was based upon the FL-2 or FL-3 detector where M2 on the histogram was positive for FL-2 or FL-3. For phosphatidylserine translocation, M2 of the FL-2 histogram was positive for those cells that had cells that were tagged by annexin V PE.

#### *Percoll Gradient*

When using a Percoll gradient within a particular assay, the pellets of two different conical tubes upon centrifugation from the extrusion process were combined by the supernatants being poured out of the conical tubes then the pellets being flicked where one of the pellets was resuspended in 2.5 mL of PBS which was transferred to the a different pellet. Then the Percoll gradient was created where 15%, 30%, 45%, and 60% Percoll solutions were made using 1X PBS. The 15% Percoll gradient was created through addition of 2.1 mL of Percoll to 11.9 mL of PBS, 30% was created through the addition of 4.2 mL of Percoll to 9.8 mL of PBS, 45% was created through the addition of 6.3 mL of Percoll to 7.7 mL of PBS, and lastly 60% was created through the addition of 8.4 mL of Percoll to 5.6 mL of PBS.

These Percoll solutions were added to a 14 mL culture tube at 3 mL increments via a Pasteur pipette starting with 15%, then 30%, 45%, and 60%. Then the cells are added very slowly and cautiously to the top of the Percoll gradient. The Percoll gradient technique was a way of purifying the cells via density bands where the third band was typically desired. Then the Percoll gradients were centrifuged at 800g for 10 min at 4°C. After centrifugation, the 3<sup>rd</sup> band was extracted where 2 mL of that band was added to another conical tube. Then 7 mL of PBS was added to the conical tube which was centrifuged at 150g for 5 min at 4°C. From centrifugation, the supernatant was poured out of the conical tube and the cells were resuspended in 1 mL of SDMEM for hemacytometry enumeration. Percoll gradient assays

were more concerned with phosphatidylserine translocation with early apoptotic detections via annexin V PE binding than late apoptosis and cell necrosis; therefore, 7-AAD was excluded from these assays.

### *Statistical Analysis*

Statistical analysis comprised of quantifying the amount of hyaline or granular amoebocytes that had taken up annexin V PE via phosphatidylserine translocation and was used in a student's *t* test through comparing the samples of the annexin V PE spontaneous apoptosis control with cells that were treated with the apoptotic inducer and annexin V PE. Only those samples with  $p \leq 0.05$  were considered statistically significant which yielded a 95% level of confidence.

## **Results**

Assay 1 utilized the individual earthworm extrusion process where the earthworm cells were harvested into a 96 well plate in duplicates. This assay tested phosphatidylserine translocation detection with camptothecin (0.002 mM) and etoposide (0.1 mM) from a dilution of 1:1000 at the incubation of 16 hr at 20°C, 5% CO<sub>2</sub>. It appeared that from the amount of annexin V PE positive cells, the dilution of 1:1000 of the inducers was not effective enough to provide statistically significant results from incubation with camptothecin and etoposide. This showed that the inducers were not concentrated enough to cause apoptosis with distinct phosphatidylserine translocation in comparison to the annexin V PE spontaneous apoptosis control. Another aspect to the results involved the cleanliness and viability of the cells whereas the cells could have yielded better results if the concentration of annexin V PE binding was lower along with 7-AAD binding.

Assay 2 utilized the individual earthworm extrusion process in the same manner as assay 1 with the same incubation period except phosphatidylserine translocation detection used camptothecin (0.008 mM), etoposide (0.4 mM), actinomycin D (0.04 mM), and cycloheximide (0.4 mM) in duplicates from a dilution of 1:250. From the student's *t* test, camptothecin exerted a significant effect upon the hyaline amoebocytes of 25% of the earthworms, actinomycin D exerted a significant effect upon 50% of the earthworms for the hyaline amoebocytes and 25% of the earthworms for the granular amoebocytes, and

cycloheximide exerted a significant effect upon the hyaline amoebocytes of 25% of the earthworms.

Shown in **Figure 1** is a graph of the response of the inducers on the hyaline amoebocytes from one of the earthworms. This was measured according to phosphatidylserine translocation via percent annexin V PE binding. It appears that from the response of the granular and hyaline amoebocytes of one of the earthworms, the dilution of 1:250 of the inducers was effective enough to provide significant results from a select amount of the inducers. It also appears that the hyaline amoebocytes were more affected by the inducers than the granular amoebocytes according to student's *t* test analyses.

Assay 3 used the individual earthworm extrusion process where phosphatidylserine translocation detection used camptothecin (0.008 mM), etoposide (0.4 mM), actinomycin D (0.04 mM), and cycloheximide (0.4 mM) in duplicates at a 5 hr incubation at 30°C, 5% CO<sub>2</sub>. The hyaline amoebocytes of 50% of the earthworms resulted in statistically significant phosphatidylserine translocation from incubation with actinomycin D and 25% for cycloheximide. **Figure 2** is a graph of the hyaline amoebocytes which shows the percent annexin V PE binding from phosphatidylserine translocated cells. From previous assays, a trend was becoming more prevalent which was the fact that the hyaline amoebocytes were affected more so than the granular amoebocytes where the hypothesis remains certain that there was a morphological and biochemical/molecular influence upon cells that are affected by the a particular inducer. From this assay there was still room for improvement in terms of viability and heterogeneity of the cells through the spont-apoptosis control having a high background of phosphatidylserine translocated cells.

Assay 4 utilized batch extrusion of earthworms with the use of a Percoll gradient and apoptosis induction via etoposide (0.4 mM), actinomycin D (0.04 mM), cycloheximide (0.4 mM), and dexamethasone (0.04 mM) from a 1:250 dilution in triplicates at a 8 hr incubation at 30°C, 5% CO<sub>2</sub>. After centrifugation of the Percoll gradients, the 2<sup>nd</sup> and 3<sup>rd</sup> bands were extracted individually from both Percoll gradients which resulted in four different samples of cells being tested for apoptotic analysis. From the student's *t* test determinations, actinomycin D, cycloheximide, and dexamethasone were significant from the 3<sup>rd</sup> band of the second gradient hyaline amoebocytes. Actinomycin D and dexamethasone were also



significant from the 3<sup>rd</sup> band of the second gradient granular amoebocytes. Actinomycin D and cycloheximide were significant from the 2<sup>nd</sup> band of the second gradient hyaline amoebocytes and actinomycin D was also significant from the 2<sup>nd</sup> band of the first gradient hyaline amoebocytes. **Figure 3** shows a graph of the 3<sup>rd</sup> band extracted from the second gradient hyaline amoebocytes from which actinomycin D, cycloheximide, and dexamethasone were statistically significant. Another attribute of this graph is that the phosphatidylserine translocated cell concentrations were notably lower than the earthworm's samples of the other assays that did not have the Percoll gradient technique integrated into it. This shows that the cells were significantly cleaner via use of the Percoll gradient and batch extrusion of earthworms.

Assay 5 analyzed the 3<sup>rd</sup> band of Percoll gradients at varying times and temperatures while testing actinomycin D (0.04 mM) and dexamethasone (0.04 mM) from a 1:250 dilution. The incubation times were at 4, 8, and 24 hr with temperatures that were ranging from 20°C, 30°C, and 37°C with all of the temperatures being at 5% CO<sub>2</sub>. **Figure 4** shows pictures of the Percoll gradients where the 3<sup>rd</sup> band was extracted and used under the designated incubation times and temperatures with actinomycin D and dexamethasone. This assay also used an additional step of fixing the cells with paraformaldehyde basing that the cells were used under a range of different temperatures. From student's *t* test determinations, actinomycin D was significant for the hyaline amoebocytes of gradients 1 and 2 at the incubation of 24 hr at 30°C, 5% CO<sub>2</sub>. The only samples that actinomycin D and dexamethasone were both significant for was the granular amoebocytes of gradient 1 for 8 hr at 30°C, 5% CO<sub>2</sub>. **Figure 5A** shows a graph of the hyaline amoebocytes from gradient 1 which was incubated with actinomycin D and dexamethasone for 24 hr at 30°C, 5% CO<sub>2</sub>. **Figure 5B** shows a graphic from the flow cytometer which is referring to **Figure 5A** where the annexin V PE spont-apoptosis control cells are indicated in green and the actinomycin D is on top of it indicated in purple. M2 signifies the region of percent annexin V PE tagged cells which qualitatively shows a shift in actinomycin D more so than the annexin V PE spont-apoptosis control cells. **Figure 6** also shows a flow cytometry graphic which shows the different incubation temperatures of 20° C, 30° C, and 37° C under the incubation time of 8 hr. The sample tested under these temperatures was

the annexin V PE spont-apoptosis control from which the inducer cells are compared to. In the graphic, M2 signifies the percent annexin V PE tagged cells that exhibited phosphatidylserine translocation. As you can see, the blue line, indicating 37° C, had shown the most phosphatidylserine translocation while 20° C, indicated in green, had shown the least. This shows that the cell's viability is affected by temperature for phosphatidylserine translocation.

### **Conclusion**

Through the various assays completed, actinomycin D proved to be the most significant inducer used at the dilution of 1:250 (concentration of 0.04 mM) through inducing apoptosis with the greatest amount of phosphatidylserine translocation detected by annexin V PE in conjunction with 7-AAD. The optimal incubation time and temperature used for apoptotic induction with the various inducers was for 8 hr at 30°C, 5% CO<sub>2</sub>. This was proven through statistical data analysis upon the amount of hyaline or granular amoebocytes that were tagged via annexin V PE. Also the student's *t* test ( $p \leq 0.05$ ) had shown that the most significant inducer through having the most significant *p* values was actinomycin D, an inhibitor of RNA polymerase activity through binding to DNA at the transcription initiation complex. Another distinguishable trend was that the hyaline amoebocytes were more affected in terms of phosphatidylserine translocation via annexin V PE detection than the granular amoebocytes. An overall significant difference in the viability of the cells was distinguishable when the Percoll gradient was used. Most importantly, the annexin V PE spont-apoptosis control cells had become more viable through the purification of the cells via density bands of the Percoll gradient technique. Although using extrusion of batches of earthworms with the Percoll gradient technique may yield cleaner cells, the risk of alloreactivity was increased. Alloreactivity involves different earthworm cells recognizing each other as foreign and subsequently rejecting each other resulting in cell death or an altered response to an apoptotic inducer.

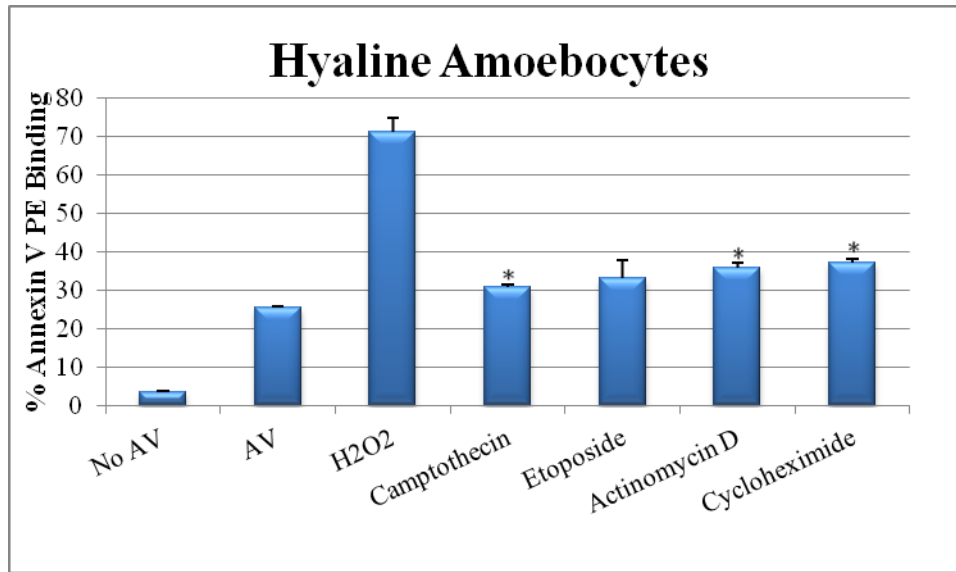
### **Future Directions**

Future directions entail investigating the production of reactive oxygen species (ROS) and changes in mitochondrial membrane potential ( $\Delta\Psi_m$ ) induced by pathogen-associated molecular patterns (PAMPs) in *E. hortensis* coelomocytes. The PAMPs that will be used for the induction of ROS and  $\Delta\Psi_m$  include zymosan, lipopolysaccharides (LPS), peptidoglycan, and bacterial flagellin. PAMPs are known to activate cell-signaling pathways of innate immunity using pattern recognition receptors (PRRs). The sensitivity of earthworm leukocytes will be investigated from the effects of different forms of stress which will be detected by dihydrorhodamine 123 (DHR 123) for ROS production, or JC-1 for  $\Delta\Psi_m$ . These studies will investigate the conservation of the host defense mechanism in invertebrates using the *E. hortensis* model.

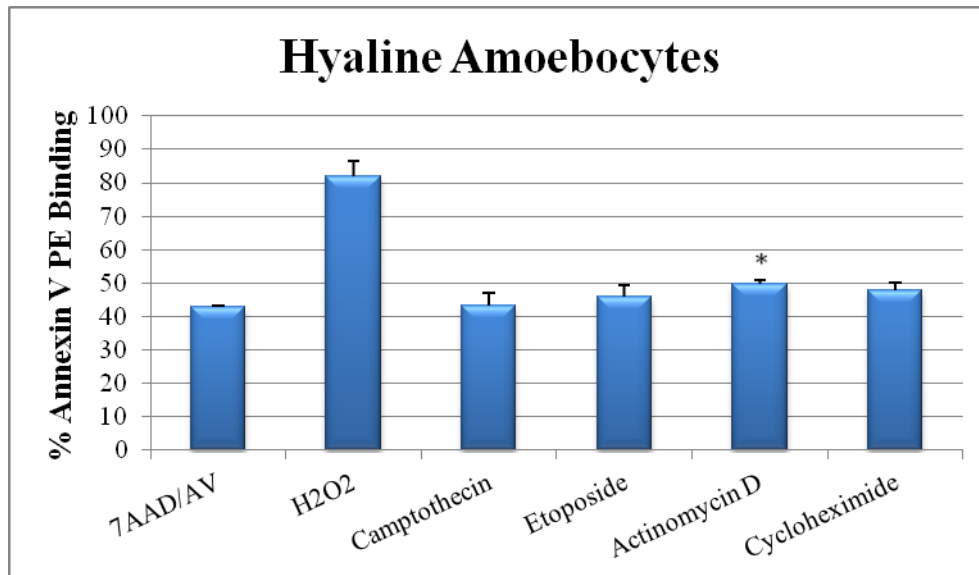
## References

- <sup>1</sup> Campbell, N. & Reece, J. (2005). Biology. San Francisco: Pearson Benjamin Cummings Publishing, 427-428.
- <sup>2</sup> Cooper, E. (2006). Role of TOLL-like receptors in adjuvant–augmented immune therapies by T. Seya. *Evidence-based Complementary and Alternative Medicine*, 3(1), 133-137.
- <sup>3</sup> Diogene, J., Dufour, M., Poirier, G., & Nadeau, D. (1997). Extrusion of earthworm coelomocytes: comparison of the cell populations recovered from the species *Lumbricus terrestris*, *Eisenia fetida* and *Octolasion tyrtaeum*. *Laboratory Animals Journal*, 31, 326-336.
- <sup>4</sup> Droin, N., Green, D., Ricci, J., & Zimmermann, K. (2002). The role of ARK in stress induced apoptosis in *Drosophila* cells. *Journal of Cell Biology*, 156(6), 1077-1087
- <sup>5</sup> Du, L., Su, Y., Sun, D., Wang, J., Zhuang, X., Zhu, W., et al. (2008). Formic acid induces yca1p-independent apoptosis-like cell death in the yeast *Saccharomyces cerevisiae*. *Wiley Interscience Journal*, 8(4), 531-539.

- <sup>6</sup> Koopman, G., Kuijten, G., Reutelingsperger, C., Keehnen, R., Pals, S., & Oers, M. (1994). Annexin V for flow cytometric detection of phosphatidylserine expression on B cells undergoing apoptosis. *Blood Journal*, 84, 1415-1420.
- <sup>7</sup> Kopecky, S. & Lyles, D. (2003). Contrasting effects of matrix protein on apoptosis in HeLa and BHK cells infected with vesicular stomatitis virus are due to inhibition of host gene expression. *Journal of Virology*, 77(8), 4658-4669.
- <sup>8</sup> Patel, M., Francis, J., Cooper, E.L. & Fuller-Espie, S.L. (2007) Development of a flow cytometric, non-radioactive cytotoxicity assay in *Eisenia fetida*: An *in vitro* system designed to analyze immunosuppression of natural killer-like coelomocytes in response to 7, 12 dimethylbenz[a]anthracene (DMBA). *European Journal of Soil Biology*, 43(1), 597-103.
- <sup>9</sup> Shors, T. (2009). *Understanding viruses*. Massachusetts: Jones and Bartlett Publishers, 153-156.

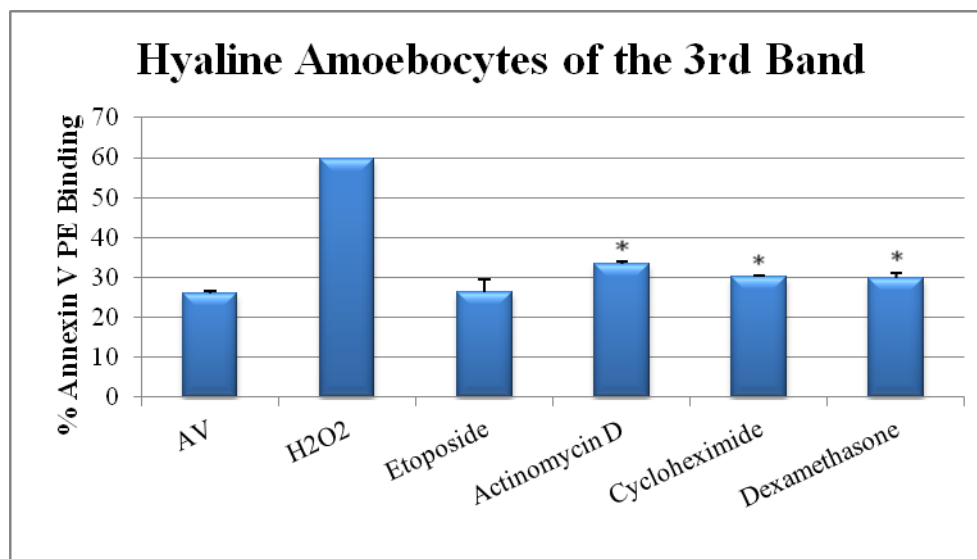


**Figure 1: Assay 2 hyaline amoebocytes undergo apoptosis by inducers camptothecin (0.008 mM), etoposide (0.4 mM), actinomycin D (0.04 mM), and cycloheximide (0.4 mM).** The hyaline amoebocytes were incubated for 16 hr at 20°C, 5% CO<sub>2</sub>, in the presence or absence of apoptosis inducers as indicated. From the quantitative data extracted from the flow cytometer for the cells that exhibited phosphatidylserine translocation via tagging by annexin V PE, the values were used in a student's *t* test to yield a significant *p* value. Those inducers that were compared to the spont-apoptosis control cells of annexin V PE untreated cells that yielded a significant *p* value are indicated by an asterisk. It appears that camptothecin, actinomycin D, and cycloheximide were the inducers that proved to be significant from a considerable increase in percent annexin V PE tagged cells.

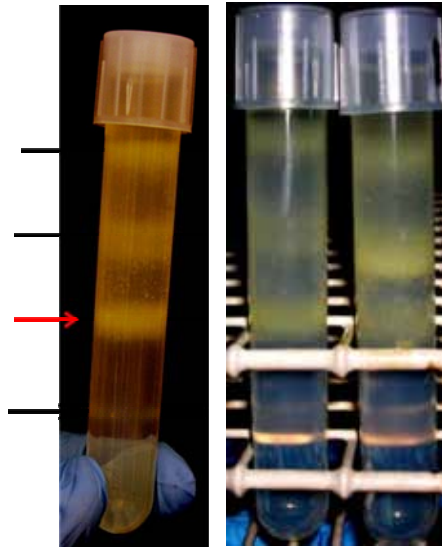


**Figure 2: Assay 3 hyaline amoebocytes undergo apoptosis by the inducers camptothecin (0.008 mM), etoposide (0.4 mM), actinomycin D (0.04 mM), and cycloheximide (0.4 mM).** The hyaline amoebocytes were incubated for 5 hr at 30°C, 5% CO<sub>2</sub>, in the presence or absence of apoptosis inducers as indicated. From flow cytometric analysis, percent annexin V PE tagged cells were recorded from which were used in a student's *t* test to yield a significant *p* value. Those inducers that were compared to the spont-apoptosis control cells of annexin V PE untreated cells that yielded a significant *p* value are

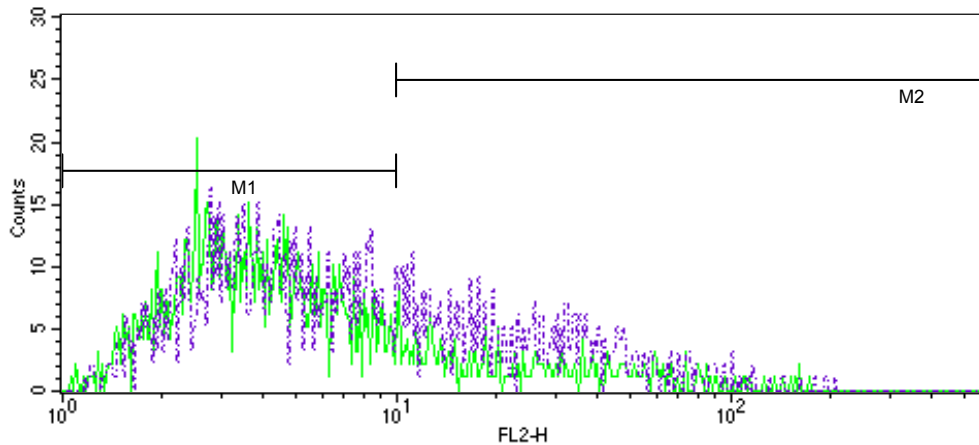
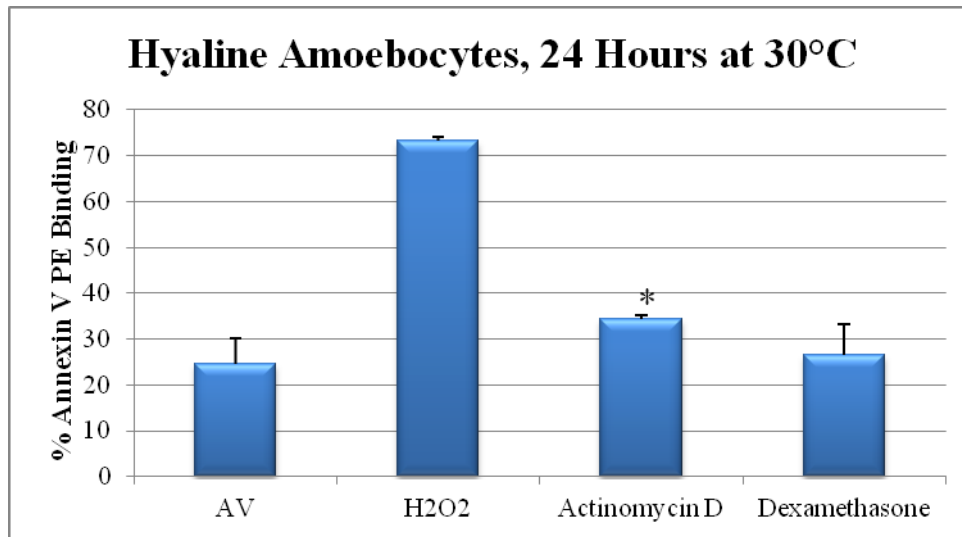
indicated by an asterisk. Actinomycin D was the only inducer that yielded a significant p value for this particular earthworm.



**Figure 3: Assay 4 hyaline amoebocytes of the 3<sup>rd</sup> band extracted from the second gradient tested with etoposide (0.4 mM), actinomycin D (0.04 mM), cycloheximide (0.4 mM), and dexamethasone (0.04 mM).** The hyaline amoebocytes were incubated for 8 hr at 30°C, 5% CO<sub>2</sub>, in the presence or absence of apoptosis inducers as indicated. From the quantitative data extracted from the flow cytometer for the cells that exhibited phosphatidylserine translocation via tagging by annexin V PE, the values were used in a student's *t* test to yield a significant p value. Those inducers that were compared to the spont-apoptosis control cells of annexin V PE untreated cells that yielded a significant p value are indicated by an asterisk. The hyaline amoebocytes appear to be impacted from the inducers actinomycin D, cycloheximide, and dexamethasone from which the cells appear to be generally cleaner from the use of the Percoll gradient.

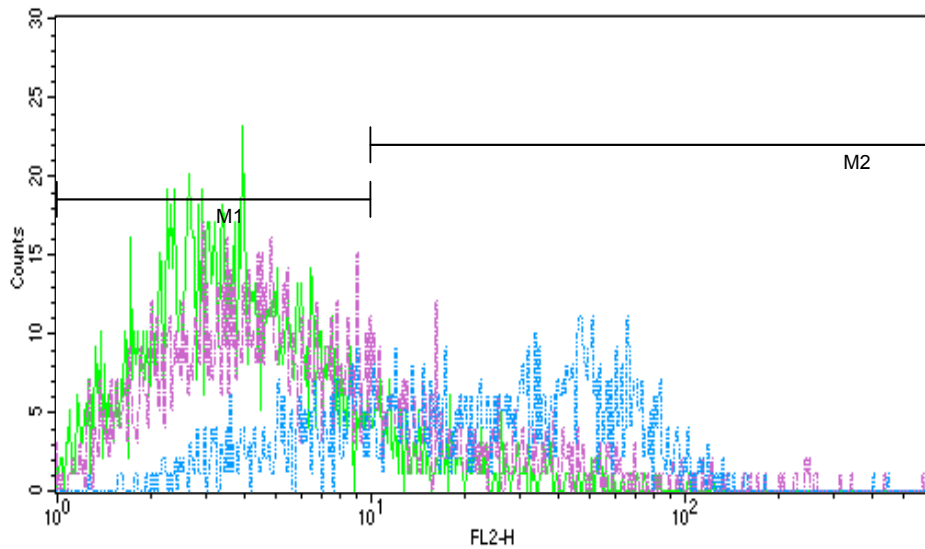


**Figure 4: Assay 5 Percoll Gradients.** Indicated by a red arrow in the picture on the left shows the 3<sup>rd</sup> band that was extracted, incubated with actinomycin D or dexamethasone, and used for flow cytometric analysis. The picture on the right shows both gradients 1 and 2 from which the 3<sup>rd</sup> band was extracted and tested on the flow cytometer by incubation with actinomycin D and dexamethasone at different times and temperatures.



**Figure 5A and B:** Assay 5 graph of hyaline amoebocytes of gradient 1 tested with actinomycin D (0.04 mM) and dexamethasone (0.04 mM) at the incubation of 24 hr at 30° C, 5% CO<sub>2</sub>. Picture B is a flow cytometry graphic overlay of the annexin V PE spont-apoptosis control with the significant inducer actinomycin D on top. Figure 5A shows gradient 1 of the batches of earthworms where the 3<sup>rd</sup> band was extracted and tested with actinomycin D and dexamethasone. From this graph, actinomycin D proved to be significant from a student's *t* test yielding a significant p value. Figure 5B is a flow cytometer graphic of figure 5A with the annexin V PE spont-apoptosis control cells, indicated in green, which has an overlay of actinomycin D, indicated in purple, on top. M2 signifies the region of percent annexin V PE tagged cells. From this graphic you can see the shift of the actinomycin D into the M2 region more so than the annexin V PE spont-apoptosis control background cells, thus making the cells treated with actinomycin D statistically significant.





**Figure 6: Flow cytometry graphic showing the different incubation temperatures of the annexin V PE spont-apoptosis control cells at the incubation time of 8 hr.** This flow cytometry graphic shows the different incubation temperatures of the annexin V PE spont-apoptosis control cells at the incubation time of 8 hr. M2 signifies the region of percent annexin V PE tagged cells that exhibited phosphatidylserine translocation. Indicated in green is the 20° C incubation, purple is the 30° C incubation, and blue is the 37° C incubation. From the graph you can see that the cells that had the most phosphatidylserine translocation was the cells incubated at 37° C. This shows that the cells can be dependent upon temperature for phosphatidylserine translocation, along with the inducers used.

## 16s rRNA Expression and Growth Characteristics of *Halosimplex carlsbadense*

Dana Lewis and Heather Stanley  
Biological Sciences  
Faculty Advisor: David A. Dunbar, Ph.D.

### Abstract

*Halosimplex carlsbadense* is a halophilic archaeon that was isolated from a 250 million year old salt crystal from the Salado formation in New Mexico. This rod shaped, gram-negative, obligate aerobe lacks the ability to grow on complex media. Previous growth studies have shown that *H. carlsbadense* is unable to use carbohydrates, amino-acids, fats or nucleic acids as a source for energy production. The inability to use these molecules as nutrients suggest two possibilities; either that *H. carlsbadense* possesses novel catabolic pathways or, that it lacks membrane transport enzymes necessary to utilize such substrates. A detailed growth curve analysis was performed in order to gain more insight into the basic biology of this organism and to compare the growth characteristics of *H. carlsbadense* to that of other halophilic microorganisms. *H. carlsbadense* was grown in a defined glycerol-acetate medium containing 25% NaCl with a pH of 7.4. Results from these studies indicate optimal growth characteristics similar to that of other members of the Halobacteriaceae family. A growth curve was generated using the same glycerol-acetate medium but with varying salt concentrations in order to determine which concentration led to optimum growth. In addition to the unique biochemistry of *H. carlsbadense*, this organism displays unique molecular characteristics. *H. carlsbadense* has two divergent 16S rRNA genes B and C. Reverse-transcriptase (RT)-PCR experiments were performed demonstrating expression of both genes B and C. Interestingly, under ideal salt conditions, gene B is preferentially expressed but under altered salt conditions gene C is preferentially expressed.

**Keywords:** Archaea, Halophiles, 16s rRNA

### 1. Introduction

Halobacteriaceae reside in the domain Archaea and are obligate extreme halophiles. Currently, the family of Halobacteriaceae consists of 18 genera and 49 validly described published species since 2004 (Robinson et al. 2004). Members of this family of halophiles thrive in a variety of hypersaline environments (Ventosa 2004). At least 1.5 M NaCl is required for growth, in which 2.0-4.5 M NaCl promotes optimal growth.

In addition to providing opportunities to gain fundamental knowledge about the microbial world, extreme halophiles, in general, offer a largely untapped resource for identifying novel genes for use in biotechnology. This is because of their unique adaptations and evolution that allow them to thrive in high salt conditions. High salt requires microbes to minimize water loss and osmotic stress. Halophilic microbes accomplish this by concentrating their intracellular solutes and by adaptations to their enzymes (Boetius & Joye 2009). Some have even suggested that most extant forms of life evolved from halophilic microbes on Earth, and that the earliest living cells may have been halophilic in nature (Stoeckenius 1978). Thus, the more we learn about the genetics and biochemistry of halophilic microbes, the more we might learn about the evolution of life on Earth during life's early, formative years.

*H. carlsbadense* is a halophilic archaeon that was isolated from a 250 million year old salt crystal from the Salado formation in New Mexico (Vreeland et al. 2002). It has been identified as a gram-negative obligate aerobe that produces primarily rod shaped cells, and it lacks the ability to grow on complex media, with the only carbon compound that supports the growth of this halophile being pyruvate. It is also incapable of growing on any organic compounds such as amino acids, methanol, nucleotides, formaldehyde, fatty acids, vitamins, proteins, or Krebs cycle intermediates, which would seem to suggest that either this organism possesses novel catabolic pathways, or that it lacks the membrane transport enzymes that are needed to utilize such substrates (Vreeland et al. 2002).

Taxonomic evidence based on phenotype, lipid patterns and small ribosomal subunit sequences seem to indicate that the organism belongs to a deep branch in the line of Haloarcula and Halorhabdus and supports creation of a new genus and species within the halophilic archaea. Another interesting feature of this microbe is that it contains two putative divergent 16S rRNA genes named B and C. Genes B and C

are 93.8% similar to one another, which is the highest level of 16S rRNA sequence divergence reported thus far at ~7% within one prokaryotic microorganism (Boucher et al. 2004). Boucher et al. (2004) have suggested that gene A is a chimeric PCR amplification artifact between genes B & C, arguing that the *H. carlsbadense* genome consists of copies of genes B & C but not of A. However, *H. carlsbadense* is similar to that of *Haloarcula marismortui* in that both have been shown to contain several divergent small subunit rRNA genes, two of which are nearly identical in sequence and a third one showing a 5% sequence divergence from the first two genes (Lopez-Lopez et al. 2007; Baliga et al. 2004; Dennis et al. 1998). Recently, it has been shown that *H. marismortui* conditionally expresses its divergent ribosome genes dependent on culture temperature conditions (Lopez-Lopez et al. 2007).

Our present study with *H. carlsbadense* demonstrated that both disparate small subunit genes B & C are expressed. Furthermore, we show that during exponential growth under optimal growth conditions, small subunit gene B is preferentially expressed but under altered salt conditions, small subunit gene C is preferentially expressed. Thus, our study is the second example of an extreme halophile capable of conditionally expressing ribosome genes dependant on culture conditions.

## **2. Materials and Methodology**

### **2.1 media preparation**

The media to grow *H. carlsbadense* in is very specific due to its requirements to grow in extreme salt conditions. To create the media for growing *H. carlsbadense*, the following components were dissolved in 300 mLs of deionized water: 2.08 mLs glycerol, 2.5 grams Sodium (Na) Pyruvate, 4.0 grams Potassium Chloride (KCl), 0.5 grams Potassium Phosphate ( $K_2HPO_4$ ), 0.1 grams Ammonium Sulfate ( $(NH_4)_2SO_4$ ), and 20 grams Magnesium Sulfate ( $MgSO_4$ ). Sodium Chloride (NaCl) was added to 700 mLs of deionized water making a final solution comprised of 7%, 11% or 25% NaCl in what would be a final volume of 1000 mLs of deionized water. The two solutions were then combined, bringing the total volume of the media prepared to 1000mL or 1L, and the pH of the entire solution was brought to 7.4 with 10 M Sodium Hydroxide (NaOH). The solution was then autoclaved for sterility. The NaCl used for these studies was from Morton solar water softener salt crystals that were 99.5% pure.

## 2.2 culture purity determination

Microscopic examination was performed in order to ensure culture purity. Stationary phase cultures grown in media containing 25% NaCl were prepared as wet mounts and visualized at 100X magnification using a Nikon Eclipse E400 microscope.

## 2.3 growth curve analysis

Baffled flasks were inoculated with 1.0 mL of a *H. carlsbadense* culture (strain 2-9-1). The strain 2-9-1 *H. carlsbadense* was obtained from Dr. Russell Vreeland at West Chester University. The flask was then filled one-third of the way up with 25% NaCl *H. carlsbadense* prepared media and incubated at 37°C and at 225 rpm. This culture remained in the shaking incubator for about 7-10 days, or until the first sight of the culture turning a pink color, which indicated the culture has reached exponential growth. 1 mL of this culture that was in exponential growth was added to 250 mL flasks along with prepared *H. carlsbadense* media of different NaCl concentrations and incubated at temperatures of 27°C, 37°C, 47°C, and 57°C in a shaking incubator (model # 1400 from New Brunswick Scientific) at 225 rpm. Triplicate samples were inoculated per temperature, each sample holding either 7% NaCl media, 11% NaCl media, or 25% NaCl media. This way, optimum temperature and salt conditions could be determined simultaneously. Optical Density (OD) readings at 600 nm were taken after inoculation daily for 10 days using a Nanodrop® Spectrophotometer, model ND-1000. This instrument allowed us to conduct spectrophotometric analysis while only using 1.5 µL of sample at a time. When conducting OD readings, the spectrophotometer was initiated and blanked against deionized water. 1.5 µL of the culture was removed from baffled flasks in the shaking incubators and then measured by the Nanodrop® spectrophotometer. If the culture had an OD reading over 1.2, a 1:4 dilution was performed using sterile media and read again to give accurate readings.

## 2.4 culture growth

We were given plates containing *E. coli* colonies that were transformed with *H. carlsbadense* from Penn State University Berks campus. The plates obtained from Penn State were prepared using blue white

colony selection. This was accomplished by adding X-GAL and IPTG to the agar solution used to make the plates. IPTG is an inducer of the Lac operon and is present in pUC19, which was the vector used to clone the dsDNA that came from the 16S rRNA. Alkaline phosphatase along with EcoR1 was used to originally cut the pUC19 plasmid as well as the source DNA. X-GAL in the medium turns blue when it is hydrolyzed by the cloned pUC19 vector. Therefore, if the colonies remain white, it means that the Lac Z' gene of the Lac operon was never fully synthesized meaning the DNA of interest was synthesized instead. Ampicillin was also added to the plates as a selectable marker for colony growth. These plates were re-streaked onto new agar plates made up of Luria Broth and ampicillin. Only the white colonies from the original plates were chosen to be re-streaked since they contained the recombinant DNA. These plates were incubated at 37° C for 15-24 hours upside down. The *E. coli* cells grew readily on the Luria Broth and ampicillin plates. The pUC19 vector used when transforming the *E. coli* cells is resistant to ampicillin thus enabling us to use ampicillin in the plates as an aid to ensure transformation was taking place. Blue white colony selection was also used to ensure the growing cells were recombinant meaning they contained the DNA of interest and were expressing it. The plates, after being streaked, were placed in a 37°C incubator for 15-24 hours. Once removed the plates could be stored in the -5°C refrigerator or used immediately for liquid culture preparation.

The liquid cultures were grown in either Luria broth and ampicillin or Magnificent Broth© and ampicillin. This depended on whether the purification process was to be done manually or by the MacConnell Mini-Prep™ machine, respectively. 5 mL sterile Falcon tubes received 2 mL of either Luria broth, or Magnificent Broth©, and 2 µL of ampicillin. The ampicillin was prepared by adding 25.0 milligrams of ampicillin to 1.0 milliliter of deionized water. The pH of the dilute ampicillin solution was then brought to 8.0 using 0.2 M hydrochloric acid (HCl). White colonies from the re-streaked plates were added to the labeled Falcon tubes one at a time. This was done using a metal inoculating loop that was sterilized by flame between each sample and before use. The Falcon tubes were then placed in a rotating incubator at 225rpm and 37°C for 15-24 hours. Growth in the Falcon tubes following the incubation period was determined by the presence of a cloudy appearance to the liquid. Only the cultures positive

for growth were saved and used for further experiments. The liquid cultures could then be either stored in the -20°C freezer or used immediately in DNA extraction experiments.

## 2.5 DNA extraction

The DNA of interest was embedded in the cloned pUC19 vectors, which were transformed into *E. coli* cells. Two methods were used for plasmid DNA extraction. The first and more efficient procedure was done using the MacConnell Mini-Prep 96™ machine. The mini-prep machine was first prepped with a rinse and bleach cycle to sterilize the machine prior to use. With using the miniprep procedure we were able to load the liquid culture samples into the wells of the cassettes used with the machine and run the installed program for plasmid DNA extraction. Each well of the cassette had an applicator comb and a lysis tablet inserted in it. The applicator comb had lysis buffer absorbed into the foam pad and the lysis tablets contained lysis enzymes. Each well received 1.5 mL of liquid culture sample. The plasmid DNA is separated from all other components of the liquid cultures through the precast agarose gels located in front of each well. The buffer used in the machine contains 20mM EDTA and is at a pH of 8.0. The agarose medium and the bacterial growth are also at a pH of 8.0. Electroelution is performed within the Mini-Prep and filters out the buffer containing the isolated plasmid DNA from each well. This process took about 2 hours and yielded about 20 µLs of isolated plasmid DNA per loaded well. These samples could then be stored in the -20°C freezer or used immediately for DNA purification. This process was done if the cultures were grown in the Magnificent Broth©.

If the cultures were grown in Luria broth, the manual procedure was performed. To begin, the liquid cultures are obtained and loaded into 1.5 mL microcentrifuge tubes. The tubes are then centrifuged for about 1 minute at maximum speed. The supernatant can then be decanted off into a waste beaker and the pellet is resuspended in 250 µL of cell resuspension solution. 250 µL of cell lysis solution was then added and the tubes were inverted about four times to ensure the samples were mixed and the pellet was dislodged and suspended in solution. Next, 10µL of alkaline protease solution was added and the sample was inverted again to ensure mixture. The tubes were then incubated at room temperature for about 5 minutes. 350µL of neutralization solution was then added and the tubes were inverted again to mix the

solution. The samples were then centrifuged at maximum speed for 10 minutes at room temperature. Separate, sterile collection tubes were obtained and the filter column was placed in the collection tubes. The clear supernatant from the last centrifugation step was then added to the filter columns that were resting in the collection tubes. These collection tubes were then left to incubate at room temperature to ensure absorption of the sample lysate in the filter column. The collection tubes with the filter columns inserted were then placed in the centrifuge and spun for 1 minute at maximum speed. The flow through from each of the collection tubes was then discarded and the filter column was reinserted. Next, 750  $\mu\text{L}$  of wash solution, which contained a high concentration of 96% ethanol, was added to the filter columns. The collection tubes with the columns inserted were then centrifuged again for 1 minute at maximum speed. The flow through was discarded and 250  $\mu\text{L}$  of wash solution was added to the filter columns for a second washing cycle. The collection tubes were then centrifuged again for two minutes and the flow through was once again discarded. The filter column was then placed in a new, sterile collection tube and 50  $\mu\text{L}$  of nuclease free water was added to the filter column. The columns inserted in the collection tubes were then left to incubate at room temperature for about 5 minutes. The collection tubes with the filter columns were then centrifuged for 1 minute at maximum speed and the remaining liquid in the collection tubes was the isolated and purified plasmid DNA. The end result was the same as the mini-prep results in that it yielded plasmid DNA ready for use in a restriction digest, or PCR. The amount obtained in the manual DNA isolation and purification process was about 20  $\mu\text{L}$  per 1.5 mL of sample. The samples from this manual procedure were either stored in the  $-20^{\circ}\text{C}$  freezer or used immediately for further experiments.

## 2.6 restriction digests

Restriction digests were done to ensure the presence of plasmid DNA containing the 16S rRNA of interest. This was done by obtaining the purified plasmid DNA, which was obtained through Mini-Prep or manual procedures, and incubating 8  $\mu\text{L}$  of the samples in a water bath set at  $37^{\circ}\text{C}$  for 12-24 hours with 1  $\mu\text{L}$  of EcoR1, and 1  $\mu\text{L}$  of 10X buffer solution.



After the samples incubated in the water bath for the appropriate amount of time, 1  $\mu$ L of Promega brand 6X blue/orange loading dye was added to each of the samples. A 1.5% agarose gel with Invitrogen brand SYBR Safe DNA gel dye was prepared to run the samples. The SYBR Safe DNA gel dye contained a 10,000X concentrate in dimethyl sulfoxide (DMSO). TAE buffer was used to prepare and run the gel. The samples were loaded into each of the wells in the gel and an image was taken showing the presence of various bands indicating the plasmid DNA representing 16S rRNA was present.

### 2.7 determination of expression of rRNA genes

Total RNA was extracted from *H. carlsbadense* using procedures previously outlined (Nieuwlandt et al. 1995). Approximately 0.5  $\mu$ g of total RNA was treated with 5 units of RNAase free DNAase, extracted with phenol/chloroform/isoamyl alcohol and ethanol precipitated. The RNA was reverse transcribed using 200 units of Superscript II reverse transcriptase (Gibco Pharmaceutical) and an oligonucleotide primer to position 1263-1286 (R) (5'CCGAATCTTCATGAGGGCGAGTTTT3') of both ribosome genes B & C. Reverse transcription reactions were done according to Gibco Pharmaceutical recommendations. PCR was performed on an aliquot of the reaction using the oligonucleotide used for reverse transcription and a forward primer oligonucleotide complementary to position 1020-1040 (5'TGAGGCATCCTGTAAAGTCA3') of both genes B & C. The PCR conditions were: 95°C for 4 minutes (one cycle), then 95°C for 30 seconds, 55°C for 30 seconds, 72°C for 30 seconds (thirty cycles). The PCR products, approximately 275 base pairs, were cloned using the Invitrogen TOPO TA-Cloning kit for Sequencing.

DNA sequencing reactions on selected plasmids containing amplified gene inserts were conducted using the SequiTherm EXCEL II DNA Sequencing Kit-LC by Epicentre Biotechnologies. An IRD700-labeled M13 forward primer and an IRD800-labeled M13 reverse primer were used in the process. The PCR conditions were: 95°C for 2 minutes (one cycle), then 95°C for 30 seconds, 50°C for 30 seconds, 72°C for 45 seconds (thirty cycles) followed by 72°C for 5 minutes using a Biorad I Cycler PCR machine. DNA sequence data analysis was performed using a LICOR 4300 Automated DNA sequencing machine.

### 3. Results

### 3.1 culture purity determination

To ensure culture purity for growth and gene expression studies microscopic analysis was performed using a Nikon Eclipse E400 microscope (Figure 1). Using phase contrast microscopy allowed us to gain an image of the samples used without damaging them with dyes used in staining procedures. Figure 1 indicates *H. carlsbadense* to be a rod-shaped microbe as previously indicated by Vreeland et al (2002). Our results also confirm the work of Vreeland et al (2002) in that this microbe is 0.95  $\mu\text{m}$  in width and 50  $\mu\text{m}$  in length. This is seen in figure 1.

### 3.2 growth curves of *H. carlsbadense*

It was earlier reported that *H. carlsbadense*'s optimal temperature growth conditions were approximately 37°C with no growth occurring above 60°C. Additionally, as reported earlier, a NaCl concentration of approximately 25% was considered optimal under various temperature growth conditions (Vreeland et. al, 2002). To understand in greater detail the salt conditions and temperature requirements that support growth of *H. carlsbadense* for our ribosome gene expression experiments, we first grew *H. carlsbadense* under several different NaCl concentrations at 37°C. We found that growth occurred at a much higher rate when *H. carlsbadense* was grown with a 25% NaCl concentration versus being grown at the same temperature but with lower NaCl concentration. However, we also found that there was very little difference in the growth patterns of *H. carlsbadense* when grown at 37°C with 11% NaCl or in 7% NaCl. These results support the work of Vreeland et al. (2002) where they demonstrated ideal salt concentration for *H. carlsbadense* growth was 25% salt. Our findings are all seen in figure 2.

To determine if temperature made any sort of difference as to the growth characteristics of *H. carlsbadense*, we also conducted growth curves with samples being grown at 47°C, 57°C, and 27°C with 7%, 11%, and 25% NaCl. This data is not shown due to the fact that there was minimal growth for all of the samples with the most growth occurring with 25% NaCl in all cases. This indicated to us that 37°C and 25% NaCl are the optimal growth conditions.

### 3.3 differential ribosomal gene expression

To determine gene expression differences of the two 16S rRNA genes, B and C, under various growth conditions, RT-PCR was performed followed by cloning and sequencing PCR amplified products. Only genes B and C were studied as previous reports have indicated that these two genes are not chimera where as gene A may be (Boucher et al. 2004). RT-PCR was performed with primers that border a region in which both genes had 19 nucleotide sequence differences. The amplified DNA products were then resolved on a 3% agarose gel shown in figure 3.

Figure 3 shows the results obtained from RNA isolated from *H. carlsbadense* under ideal growth conditions of 25% salt and 37°C as reported by Vreeland et al. (2002). One major issue that most RNA isolation methods lack is the ability to completely remove genomic DNA contamination from the RNA. For this reason, we treated the RNA samples with DNase in order to reduce any contamination. However, amplification was seen when total RNA samples were not treated with DNase, indicating that DNase treatment is essential to remove residual genomic DNA contamination.

Amplified RT-PCR products were cloned into bacterial plasmids using a TA-Cloning Kit by Invitrogen Corporation. After bacterial transformations using the procedure outlined with the Invitrogen TA-Cloning Kit, bacteria colonies containing plasmids with cloned inserts were expanded by growing cultures in LB broth in the presence of the drug ampicillin. Plasmids from overnight cultures were then purified using standard procedures, digested with the restriction endonuclease EcoRI and resolved on a 2% agarose gel (data not shown). Plasmids containing inserts were sequenced using a Li-COR 4300 automated DNA sequencing machine.

Table 1 depicts our gene expression results when *H. carlsbadense* was grown at 37°C under various salt concentrations. Table 1A indicates that under growth conditions for *H. carlsbadense* of 25% NaCl and 37°C, 22 clones from our RT-PCR experiments matched gene B. No clones matched that of gene C, thus suggesting that 16S rRNA gene B is the preferentially expressed gene under what has previously been determined to be ideal culture conditions for this organism. Table 2 shows that at an elevated temperature of 47°C with optimal NaCl concentration of 25%, most clones sequenced represent Gene B.

Our results continue to clearly show that 16S rRNA gene C is predominantly expressed at suboptimal salt growth conditions (Tables 1 and 2). To show that our data regarding ribosomal gene expression in various salt concentrations was significant and not random, a two-factor ANOVA without replication was performed.

#### 4. Discussion

Our gene expression studies have clearly demonstrated that both 16S rRNA genes B and C of *H. carlsbadense* are expressed. These results represent a second example in which disparate small subunit ribosomal RNA genes were demonstrated to be differentially expressed in a microbial species, the first being *H. marismortui* (Lopez-Lopez, 2007). Traditionally, small subunit ribosomal RNA gene sequences that differ by greater than 2% are thought to be sequences from separate microbial species. Furthermore, Whitman et al. (2001) suggests that sequence similarity less than 93-95% are considered evidence for separate genera. Clearly, our work demonstrates that a microbial genome can contain two disparate 16S rRNA gene sequences that are not only found in the genome of this microorganism, but are differentially expressed. If other microbes are similar to *H. carlsbadense* in possessing more than one unique ribosome gene, then the actual correct microbial species number and microbial genera estimated from 16S rRNA analysis could presumably be much lower than currently thought.

Our ribosome gene expression studies with *H. carlsbadense* grown under both ideal and altered salt growth conditions yielded interesting results. Our data indicates that gene B is predominantly expressed under optimal salt concentration of 25% NaCl at 37°C as well as when the temperature is increased or decreased. However, Gene C was the predominantly expressed small subunit ribosome gene under several sub-optimal salt growth conditions and at all temperatures. These results suggest that the differential expression of multiple 16S rRNA genes may help to form ribosomes that are functionally optimal at different salt conditions, which could be a way that the microbe evolved to adapt to different salt concentrations in its environment.

It might also be reasonable to propose the idea that other ribosomal genes could be expressed differentially under varying salt concentrations. A typical cell would not be able to withstand the high salt

concentrations that a halophile thrives in because halophiles have adapted to these conditions by accumulating high salt concentrations within the cell in order to maintain an osmotic balance (Ventosa, 2005). Therefore, their intracellular proteins have to be able to adapt to a variety of changing salt environments. If a halophile were exposed to a lower salt concentration, this protein arrangement might not be as efficient as it would be in a higher salt concentration. Therefore it is not unreasonable to assume that perhaps different sets of ribosomal genes would be expressed under altered environmental conditions.

Future experiments are aimed at performing qPCR experiments to measure precise expression levels of 16S rRNA genes B and C under different salt conditions. We also plan on studying which 16S rRNA genes are involved in the transition between lag and exponential phase growth, and the transition between exponential phase and stationary phase growth to understand which genes might be involved in these critical growth phase transitions in *H. carlsbadense*. qPCR experiments have thus far proved to be problematic with the current *H. carlsbadense* strain used for these studies because genes B and C are similar enough in sequence that we were not able to distinguish between them by qPCR. In order to conduct qPCR expression studies, we plan on creating mutant *H. carlsbadense* strains in which the strain lacks either gene B or gene C. To do so, we will use a methodology similar to that used to construct mutant strains of *H. marismortui* for qPCR studies (Tu et al. 2005).

## 5. Acknowledgements

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## 6. Bibliography

1. Alberts, B., Bray, D., Hopkin, K., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. 2004. Essential Cell Biology: 2<sup>nd</sup> Edition. Garland Science, 378-379.

2. Baliga, N.S., Bonneau, R., Facciotti, M.T., Pan, M., Glusman, G., Deutsch, E.W., Shannon, P., Chiu, Y., Weng, R.S., Gan, R.R., Hung, P., Date, S.V., Marcotte, E., Hood, L. and Ng, W.V. 2004. Genome sequence of *Haloarcula marismortui*: a halophilic archaeon. *Genome Res.* 14(11):, 2221-2234.
3. Boetius, A & Joye, S. 2009. Thriving in Salt. *Science.* 324: 1523-1525.
4. Boucher, Y., Douady, C.J., Sharma, A.K., Kamekura, M., Doolittle, W.F. 2004. Intragenomic heterogeneity and intergenomic recombination among haloarchaeal rRNA genes. *Journal of Bacteriology.* 186: 3980-3990.
5. Franzman, P.D., Stackebrandt, E., Sanderson, K., Volkman, J.K., Cameron, Stevenson, P.L., McKeen & Burton, H.R. 1988. *Halobacterium lacusprofundi* sp. Nov., a halophilic bacterium isolate from Deep Lake, Antarctica. *Syst. Appl. Microbiol.* 11:20-27.
6. Hazen, R.M., & Roedder, E. 10 May 2001. How old are bacteria from the Permian age? *Nature* 411:155.
7. Hutcheon, G. Vasisht, N., & Bolhuis, A. 20 June 2005. Characteristic of a highly stable  $\alpha$ -amylase from the halophilic archaeon *Haloarcula hispanica*. *Extremophiles* 9:6.
8. Kennedy, B.M., Torgersen, T., & van Soest, M.C. 28 February 2002. Multiple atmospheric noble gas components in hydrocarbon reservoirs: A study of the Northwest Shelf, Delaware Basin, SE New Mexico. *Geochimica et Cosmochimica Acta* 66(11): 2807-2822.
9. López-López A., Benlloch S., Bonfá M., Rodríguez-Valera F., Mira A. 2007. Intragenomic 16S rDNA divergence in *Haloarcula marismortui* is an adaptation to different temperatures. *Journal of Molecular Evolution.* 65(6):687-96.
10. Mullakhanbhaik, M.H. & Larsen, H. 1975. *Halobacterium volcanii* spec. nov., a Dead Sea halobacterium with a moderate salt requirement. *Arch. Microbiol.* 104:201-214.
11. Müller, M., & Klösgen, R.B., 19 October 2004. The Tat pathway in bacteria and chloroplasts, *Molecular Membrane Biology* 22(1-2): 113-121.

12. Mylvaganam, S., Dennis, P.P. 1992. Sequence heterogeneity between the two genes encoding 16S rRNA from the Halophilic Archaeobacterium *Haloarcula marismortui*. *Genetics Society of America*. 130: 399-410.
13. Nicastrò, A.J., Vreeland, R.H., & Rosenzweig, W.D. 10 May 2002. Limits imposed by radiation on the long-term survival of trapped bacterial spores: beta radiation. *International Journal of Radiation Biology* 78(10):891-901.
14. Oren, A. 2002. *Halophilic microorganisms and their environments*. Kluwer Academic Publishers, Dordrecht, The Netherlands, 211.
15. Powers, D.W., Vreeland, R.H., & Rosenzweig, W.D. 10 May 2001. Reply: How old are bacteria from the Permian age? *Nature* 411:155-156.
16. Robinson, J.L., Pyzyra, B., Atrasz, R.G., Henderson, C.A., Morrill, K.L., Burd, A.M., DeSoucy, E., Fogelman, R.E., Naylor, J.B., Steele, S.M., Elliott, D.R., Leyva, K.J. & Shand, R.F. 2004. Growth kinetics of extremely halophilic archaea (family halobacteriaceae) as revealed by arrhenius plots. *Journal of Bacteriology*. 187: 923-929.
17. Ross, J.R.P., Ross, C.A. 6 March 2007. *Science and Technology: Permian Period*. Britannica. Retrieved 1 December 2009 from <http://www.britannica.com/EBchecked/topic/452280/Permian-Period>
18. Soliman, G.S.H., & Truper, H.G. 1982. *Halobacterium pharaonis* sp. nov., a new, extremely haloalkaliphilic archaeobacterium with low magnesium requirement. *Zentbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. 1 Orig.* 3: 318-329.
19. Stoeckenius, W. 1978. *Speculations about the evolution of halobacteria and of chemiosmotic mechanisms in light transducing membrane structure, function, and evolution* (ed D. W. Deamer). Academic Press, New York, 122-139.
20. Tang, C.M. 25 January 2007. *Geography and Travel: Permian Basin*. Britannica. Retrieved 1 December 2009 from <http://www.britannica.com/EBchecked/topic/452277/Permian-Basin>

21. Tortora, G.J., Funke, B.R., & Case, C.L. 2004. *Microbiology: An Introduction* 2<sup>nd</sup> Edition. Pearson, 66-67.
22. Tu, D, Blaha, G, Moore, P.B., Steitz, T.A. 2005. Gene replacement in *Haloarcula marismortui*: construction of a strain with two of its three chromosomal rRNA operons deleted. *Extremophiles*. 9: 427-435.
23. Ventosa, A (Ed.), 2004. How old are these cells? In *Halophilic microorganisms*. Springer. Heidelberg, Germany, 97-89.
24. Vreeland, R.H., Jones, J., Monson, A., Rosenzweig, W.D., Lowenstein, T.K., Timofeeff, M., Satterfield, C., Cho, B.C., Park, J.S., Wallace, A., & Grant, W.D. 6 December 2006. Isolation of Live Cretaceous (121-112 Million Years Old) Halophilic Archaea from Primary Salt Crystals. *Geomicrobiology Journal* 24:275 – 282.
25. Vreeland, R.H., Rosenzweig, W.D., & Powers, D.W. 19 October 2000. Isolation of a 250 million-year-old halotolerant bacterium from a primary salt crystal. *Nature* 407:897-900.
26. Whitman, W.B., Boone, D.R., Koga, Y, Keswani, J. 2001. Taxonomy of methanogenic archaea. In: Boone D.R., Castenholz, R.W. (eds) *Bergey's manual of systematic bacteriology*, 2<sup>nd</sup> edn, vol 1. Springer, Berlin Heidelberg New York,, pp 211-213.
27. Winter, J.A., Panayiotis, C., Morroll, S., & Bunting, K.A. 22 August 2009. The crystal structure of *Haloferax volcanii* proliferating cell nuclear antigen reveals unique surface charge characteristics due to halophilic adaptation. *BMC Structural Biology* 9:55.
28. Woo, P.C.Y., Lau, S.K.P., Teng, J.L.L., Tse, H., & Yuen, K.-Y. 11 June 2008. Then and now: use of 16S rDNA gene sequencing for bacterial identification and discovery of novel bacteria in clinical microbiology laboratories. *Clinical Microbiology and Infection Disease* 14:908-934.



Figure 1

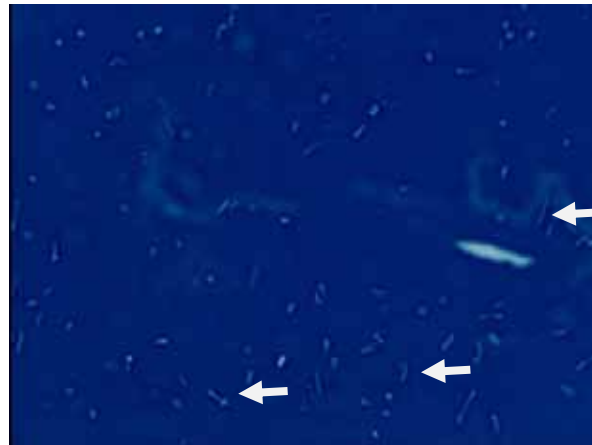


Figure 1. This is a picture of a wet mount of *H. carlsbadense* culture. *H. carlsbadense* is a rod-shaped gram negative prokaryote. The white arrows indicate the presence of some of the *H. carlsbadense* cells in this image.

Figure 2

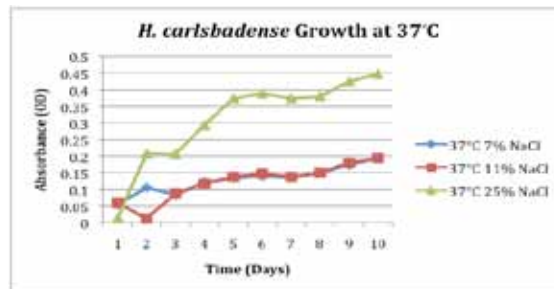


Figure 2. In this figure, you can see that the growth of the samples began to plateau starting around day 5 for the samples with 7% or 11% NaCl. The sample that was being grown at the same temperature, but with 25% NaCl continued to grow exponentially up to day 10. The sample also had a visible pink color, unlike the other two, indicating that growth of *H. carlsbadense* had taken place and reached maximum growth.

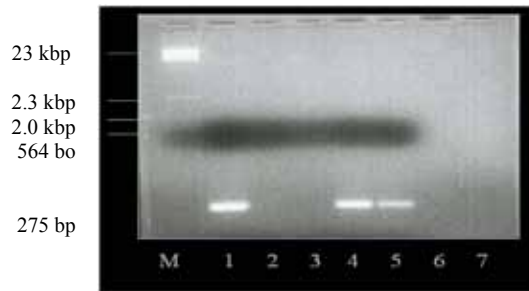
**Figure 3**

Figure 3. Lane 1: Genomic DNA (275 bp in size). Lane 2: Primers alone. Lane 3: Total RNA treated with both RNase and DNase. Lane 4: Total RNA treated with RNase but not with DNase. Lane 5: Total RNA treated with DNase but not with RNase.

**Table 1**

NaCl	Gene B*	Gene C**
<b>7%</b>	3	20
<b>11%</b>	3	18
<b>15%</b>	5	20
<b>25%</b>	22	0

Table 1. Differential expression of 16S rRNA genes at 37°C. A number of plasmid inserts containing genes B or C with *H. carlsbadense* cultured at 37°C and under different salt conditions. A two-factor independent ANOVA gave *p* values of < 0.05 (\*) for gene B and < 0.01 (\*\*) for gene C, respectively.

**Table 2**

<b>NaCl</b>	<b>Gene B*</b>	<b>Gene C**</b>
<b>7%</b>	5	19
<b>11%</b>	6	17
<b>25%</b>	20	2

Table 2. Differential expression of 16S rRNA genes at 47°C. A number of plasmid inserts containing genes B or C with *H. carlsbadense* cultured at 47°C and under different salt conditions. A two-factor independent ANOVA gave *p* values of < 0.05 (\*) for gene B and <0.01 (\*\*) for gene C, respectively.

**An *In Vitro* Study Investigating Apoptosis Induction of Coelomocytes in the Earthworm *Eisenia hortensis* using a DNA Fragmentation Assay**

Erin L. Blake and Sheryl L. Fuller-Espie, Ph. D.

Faculty Advisor: Sheryl L. Fuller-Espie, Ph. D., DIC, Associate Professor of Biology

**Abstract**

The aim of this study was to evaluate the effects of *in vitro* exposure to various apoptotic inducers on coelomocytes obtained from the earthworm *Eisenia hortensis*, also known as the European nightcrawler. Specifically this study focused on DNA fragmentation as a resultant of an induction of apoptosis. Results from this study indicate that earthworm coelomocytes have the ability to induce apoptosis at a time of distress caused by the addition of hydrogen peroxide. Apoptotic inducers such as dexamethasone, camptothecin, actinomycin D, etoposide, and cycloheximide have all been proven to induce apoptosis in other species. It is hypothesized that if these inducers can induce apoptosis in other species such as vertebrates then they might also induce an apoptotic pathway in an invertebrate such as the earthworm *E. hortensis*. Seven assays were conducted testing all five of the apoptotic inducers exposing the cells to the cytotoxic drugs at different time intervals. Apoptotic DNA was isolated and run on an agarose gel to observe the pattern of DNA laddering. Following gel electrophoresis and staining of the agarose gel the DNA Markers were visible as 2000, 1500, 1000, 750, 500, 300, 150, and 50 base pair fragments. From the seven assays, about 60% showed that camptothecin and dexamethasone were the predominant inducers due to the appearance of DNA laddering in the gel.

Unexpected DNA laddering appeared within our negative control in multiple assays forcing the idea that there is another entity causing the induction of apoptosis within the healthy coelomocytes. The phenomenon of allorecognition could be this underlying cause of the false induction of apoptosis. This event occurs between different earthworm cells causing the cells to recognize and subsequently reject each other, therefore resulting in cell death. To solve this problem individual earthworms were extruded

separately by not coming into contact with another earthworm. To test this hypothesis an assay was conducted with cells from individual earthworms that had not come into contact with other earthworm cells as well as a mixture of pooled earthworm cells to simulate conditions in an alloreactive response. Through this we could then show how viable the cells are separately compared to pooled together to prove if there is any alloreactivity between the cells. Unfortunately the results of this assay were inconclusive.

### **Introduction**

Invertebrates are some of the most abundant creatures on earth and have been around for millions of years living in every type of habitat. Many choose to study invertebrates based upon this fact enabling scientists to explore the level of conservation of different cellular processes such as apoptosis between vertebrates, invertebrates and even plant species. *E. hortensis*, also known as the European nightcrawler, is an invertebrate that belongs to the phylum *Annelida*. These worms have an innate form of immunity and an ability to extrude a copious amount of coelomocytes, which are white blood cell equivalents.<sup>17</sup> Coelomocytes play a key role in the defense mechanisms that are part of the immune system. These coelomocytes, which provide much ecological importance, are the earthworm's protection against microbes and foreign entities found within the soil in which they live in. Coelomocytes are immune cells that are obtained through the dorsal pores of the coelomic cavity and are divided into three different groups: the hyaline amoebocytes that are phagocytic, the granular amoebocytes that establish NK-like activity, and the eleocytes that display lytic activity.<sup>19</sup> These cells can undergo many different cellular responses to help maintain the health of the earthworm such as the cellular response known as apoptosis.

Apoptosis, or programmed cell death, is a critical factor promoting many biochemical events in different organisms such as plants, fungi, bacteria, vertebrates and invertebrates. This specific cellular response also plays a very important role in the physiological and pathological growth of humans. The main objective of this innate cellular response is to remove cell debris that may be infected with foreign particles such as viruses, promote tissue development, maintain homeostasis, and to promote cell defenses for the immune system. For example, cells that undergo apoptosis during embryonic development help

separate individual toes and fingers during the growth of the embryo. These structures are sculpted through the event of apoptosis when cells that are no longer needed between them die.<sup>2</sup> Apoptosis is illustrated by morphological events within a cell including cell shrinkage, chromatin condensation, deterioration of mitochondria, DNA fragmentation, and enzyme activation.<sup>6</sup> DNA fragmentation is a resultant of apoptosis due to the activation of cellular proteases, including caspases and nucleases, which results in the degradation of nuclear DNA to nucleosome-sized fragments.<sup>18</sup>

Apoptosis has been closely examined in many vertebrates and in some invertebrates such as the marine worm *Themiste petricola* (Sipuncula). In this specific study apoptosis was induced by adding a low concentration (100mM) of hydrogen peroxide to earthworm coelomocytes for incubation periods ranging from 30min to 5 hr. Hydrogen peroxide is known to induce apoptosis, but there are many other factors that may enhance programmed cell death. These factors include temperature, environmental pollutants such as heavy metals, infection by a parasite, and the exposure to cytotoxic drugs. There are many cytotoxic drugs that are known to induce apoptosis in vertebrates, but they have yet to be proven to induce apoptosis in invertebrates. These drugs include actinomycin D (10mM), camptothecin (2mM), cycloheximide (100mM), dexamethasone (10mM), and etoposide (100mM).

Camptothecin which is a known apoptosis inducer inhibits the topoisomerase-I enzyme activity of deoxyribonucleic acid.<sup>16</sup> The significance of the topoisomerase-I enzyme is that it facilitates the breaking and reunion of the double-stranded DNA which when inhibited can lead to apoptotic characteristics. Camptothecin, in this manner, specifically causes breaks in the double-stranded DNA during synthesis or replication of the DNA.<sup>11</sup> Molecularly the camptothecin results in a complex which involves DNA and topoisomerase-I where 3'-OH is covalently attached to topoisomerase-I, which results in a double-stranded break in the DNA.<sup>13</sup> This can be exemplified through condensation of the chromatin involved, blebbing of the plasma membrane, cytoplasmic shrinking, and most significantly, DNA fragmentation.

The chemical actinomycin D is known to be an apoptosis inducer through inhibition of the ribonucleic acid and protein synthesis of the cell it is affecting.<sup>1,12</sup> Actinomycin D has a selective nature in which it targets proliferating cells and induces destruction of that particular cell. This cytotoxic attribute

in turn leads to denaturation of the deoxyribonucleic acid. This has been seen to affect vertebrate cells, specifically cells of a rat *in vivo*.<sup>15</sup> Nonproliferating liver cells of a rat were tested with actinomycin D which led to the cytotoxic impact and inhibition of ribonucleic acid synthesis involving DNA-dependent RNA polymerase. Although the main attribute of actinomycin D is to inhibit RNA synthesis, it mainly affects the DNA through its cytotoxic nature.

Cycloheximide is an apoptosis inducer through inhibiting protein synthesis within the cytoplasm in eukaryotes. This involves deleterious effects in relation to inhibition of the cytoplasmic protein synthesis with a particular cell of a eukaryote. The inhibition of the cytoplasmic protein synthesis is relative to the ribosomes within the cytoplasm.<sup>5</sup> Cycloheximide specifically inhibits the processes of elongation, initiation, and termination involving protein synthesis of a living cell while increasing tumor necrosis factor alpha. This inhibition contributes to DNA denaturation along with inhibition of cellular respiration, amino acid uptake, pyrimidine nucleotide synthesis, and ion adsorption.<sup>3</sup> Cycloheximide has been used within plants where these processes exhibited, particularly protein synthesis inhibition had occurred which implicated the ripening of pears.<sup>14</sup>

Dexamethasone is another apoptosis inducer also known as a glucocorticoid. The significance of dexamethasone being a glucocorticoid is that it contributes to activation of the apoptosis pathway which was tested *in vivo*. Attributes of this mechanism involved retardation of certain cell types. Cell types that can be affected are immune cells such as T helper cells which involve the decrease in anti-apoptotic proteins such as BCL-2 and BCL-X. For example, studies have shown that treating rats *in vivo* with dexamethasone causes decreases in BCL-2 and BCL-X proteins in T cells.<sup>8</sup> This also showed that dexamethasone-treated cells had altered caspase activity in T helper cells. In contrast, our investigational study with the *E. hortensis* will analyze the effects of dexamethasone on coelomocytes *in vitro*.

Etoposide exerts its effects by inhibiting DNA topoisomerase II which is essential for protection against tumor cells. It was considered an antitumor agent that was induced from a DNA damage event which was tested through preclinical and clinical studies that involved cancerous cells.<sup>20</sup> Through etoposide inhibiting topoisomerase II, apoptosis is induced with an association with different tumorigenic

cell lines. This can be involved with activation of p53 activity from the result of DNA damage. DNA damage was proven through DNA chip technology which showed that there was a significant change in the gene expression of the DNA that was damaged.<sup>20</sup>

Hydrogen peroxide is the final apoptotic inducer that will be used to observe programmed cell death in coelomocytes. This inducer will also serve as the positive control in all assays due to the fact that hydrogen peroxide is known to cause programmed cell death in many cells including coelomocytes obtained from marine worms. Hydrogen peroxide is believed to induce its effects on cells through the depolarization of the mitochondrion.<sup>6</sup> Once coelomocytes are exposed to hydrogen peroxide, the effects can be analyzed through DNA agarose gel electrophoresis. DNA obtained from treated coelomocytes are exposed to gel electrophoresis and analyzed for the appearance of DNA fragmentation.

DNA that has been extracted from apoptotic cells is exposed to gel electrophoresis where a certain pattern known as “DNA laddering” is demonstrated. This pattern exhibits the endonucleolytic cleavage (cutting both strands) of DNA during programmed cell death where the DNA is cleaved between nucleosomes in 200 bp intervals.<sup>9</sup> This cleavage of genomic DNA occurs at internucleosomal sites on the DNA double helix. Recent studies have used DNA fragmentation to detect the initiation of apoptosis in the event that cells are exposed to certain apoptotic inducers including camptothecin, cycloheximide, and etoposide. Specifically this experiment used Jurkat and HL-60 cells that were exposed to cycloheximide, camptothecin, or etoposide for an incubation period of 4-8 hr.<sup>10</sup> Results from this study showed the pattern of DNA laddering within a gel indicating the induction of apoptosis due to the apoptotic inducers that were added to the cells. The control (lane C) in this gel does not appear to contain any DNA which is due to the picture not showing the wells of the gel where the high molecular weight DNA is located showing that DNA fragmentation is not occurring in the negative control. These results show that these apoptotic inducers can initiate apoptosis in vertebrates but the question is can the cytotoxic drugs also induce apoptosis in invertebrates such as the earthworm *E. hortensis*.

## **Methods**

### *Animal Habitat*



*E. hortensis*, also known as the European nightcrawler (Vermitechnology Unlimited) is the model earthworm for all assays being conducted. Earthworms were stored in the dark in plastic containers containing moistened autoclaved wood shavings and shredded paper towels. They were fed Gerber baby food cereal every few days as their bedding material was changed. Earthworm coelomocytes were obtained through an extrusion process where the earthworms were either returned to their habitat intact or euthanized by freezing at  $-20^{\circ}\text{C}$ .

#### *Extrusion of coelomocytes*

To begin all assays, earthworm coelomocytes were first obtained through a method known as the extrusion process. This process entails the ejection of coelomocytes from the coelomic cavity where the cells exit through the dorsal pores on the body of the earthworm, once the worm has become irritated with a buffer solution. Earthworms were placed into Petri dishes that contained saturated filter paper with a 1:100 solution of Fungizone ( $2.5\mu\text{g/ml}$ ; Fisher Scientific) for an overnight incubation period in the dark. The purpose of Fungizone was to eliminate any possible fungi contamination to the coelomocytes due to wastes caused by the earthworms and habitat material.

The following morning, either individual earthworms or batches of earthworms were submerged in 5ml ice cold extrusion buffer (71.2 mM NaCl, 5 % v/v ethanol, 50.4 mM guaiacol-glyceryl-ether, 5 mM EGTA, pH 7.3) to obtain coelomocytes. If the earthworms were not responding to the extrusion buffer (meaning they were not releasing their cells), another method was used that involved electric shocking the earthworms with a 9-V battery. Once the earthworms appeared to be done extruding, the cells were removed and placed into a 15ml conical tube containing 1ml of Accumax which is an enzyme cocktail containing trypsin, collagenase and DNase (Innovative Cell Technology). Cells were then incubated at room temperature for 5 minutes to prevent them from clumping together. After the 5 min incubation period, 7ml of ice cold phosphate buffered saline (PBS) (0.2M potassium phosphate, 1.5 M sodium chloride, pH 7.2) was added to the cells to dilute the Accumax enzyme and the cells were then stored on ice. The cells were then centrifuged at  $150\times g$ ,  $4^{\circ}\text{C}$ , for 5 minutes to pellet all intact cells from the solution. The supernatant was then poured completely off the pellet and the pellet was flicked to

loosen the cells. Cells were then resuspended in 1ml Super Dulbeccos Modified Eagle Medium (SDMEM) which contained 10% fetal calf serum, 1x nonessential amino acids, 1x L-glutamine (Gibco), 1x streptomycin/penicillin/amphotericin B, 100 µg/ml ampicillin (Shelton Scientific), 10 µg/ml kanamycin (Shelton Scientific), 10 µg/ml tetracycline, 5 µg/ml chloramphenicol (Fluka Biochemika), and 15mM HEPES buffer. The quality and quantity of the cells was determined by using hemacytometry and an inverted phase-contrast microscopy. The cells were chosen based upon the quality score ranging from poor to superior (1~10) based upon the proportion of eleocytes. Cells were also chosen based upon their quantity score where the highest yielding batch of earthworms was chosen.

#### *Suicide Track™ DNA Ladder Isolation Kit Protocol*

The Suicide Track™ DNA isolation kit was purchased through Calbiochem®. After the cells were enumerated on the hemacytometer, the highest quality of cells were chosen following the dilution of the cells to the desired concentration by using the equation of total cells divided by the desired concentration of cells giving you the amount of SDMEM in ml to add to your cells. The desired concentration of cells needed for these assays ranged from  $0.5 \times 10^6$  to  $1 \times 10^6$  cells/ ml<sup>-1</sup>. The concentrations of the chosen cells were altered to achieve the desired amount of cells that will be placed into each well within a 12-well plate. To all twelve wells 1ml of cells was added. Once the cells were added to the plate they were then stored in the 20°C, 5% CO<sub>2</sub> humidified incubator for a short recovery time. Apoptotic inducers were then added to the appropriate wells at a 1:250 dilution from their original concentrations. These apoptotic inducers were purchased through BioVision™ as a Ready-to-use Apoptosis Inducer Set which included actinomycin D (40M), camptothecin (8M), cycloheximide (400M), dexamethasone (40M), and etoposide (400M). Hydrogen peroxide (30%) (Fisher Scientific) was used as a positive control at a 1% concentration. Another positive control used with this assay was provided by the Suicide Track™ DNA Ladder Isolation Kit that contained  $1 \times 10^6$  HL60 cells that were treated with 0.5mg/ml actinomycin D for 19 hours. This sample was defrosted and processed in the same manner as the other samples beginning with the isolation of total DNA. A negative control was also used where cells were either not treated with any type of drug or they were treated with DMSO (Peirce). Cells were

then exposed to the inducers by adding 1ml of the diluted solution (SDMEM & inducer) to each labeled well. Once all the inducers were added the cells were then placed back into the 20°C, 5% CO<sub>2</sub> humidified incubator for an O/N incubation period.

The next day, the cells were removed from the 12-well plate and placed into a 1.5ml Eppendorf tube being sure to remove all cells from the plate due to the fact that they often stick to the corners and bottom of the plate. Cells were then centrifuged at 1000xg for 5 min at room temperature to pellet all intact cells. The supernatant was then poured off of each tube. Procedure 2 found in the Suicide Track™ DNA isolation kit was then followed to isolate total DNA. Cells were gently resuspended in 55µl of solution #1 (lysis buffer) following the addition of 20µl of solution #2 (RNase A) where the cells were then incubated at 37°C for 1 hr. After 1 hr. 25µl of solution #3 (proteinase K) was added to the cells where they were then incubated for 1 hr at 50°C in a waterbath. Cells were removed from the waterbath and 500µl of resuspension buffer was added to the cells. To precipitate the DNA, 2µl of Pellet Paint® was added as a co-precipitant. Following this was the addition of 60µl of 3M (0.3M final) sodium acetate (pH 5.2) being sure to mix the solution briefly. Then 662µl of 2-propanol was added to the cells where at this time cells were frozen and stored at -80°C to start the assay again another day. When freezing the DNA and beginning the assay another day the samples were removed from the freezer and placed on ice to allow time for them to defrost. Once samples were defrosted, they were centrifuged at 15,000-16,000xg for 5 min where a pink pellet formed at the bottom of the tube. The supernatant was removed with a pipet tip. Once the supernatant was removed, the DNA pellet was rinsed with 500µl of 70% ethanol, then centrifuged again at 15,000-16,000xg for 5 min. The supernatant was removed again with a pipet tip, then 500µl of 100% ethanol was added and sample was centrifuged at 15,000-16,000xg for 5 min. The supernatant was removed with a pipet tip and samples were allowed to completely air dry in an inverted fashion on the benchtop at room temperature. When samples appeared to be completely dried, they were resuspended in 50µl of resuspension buffer and placed on ice until they were ready to be exposed to DNA gel electrophoresis.

*An Alternative Method for the Isolation of Total Apoptotic DNA*

A new protocol was produced for isolating apoptotic DNA which entailed the creation of all solutions to be used within all of the remaining assays. This new protocol was produced due to the fact that the Suicide Track™ DNA Ladder Isolation Kit could only carry out 25 extractions therefore all the solutions in this kit were used. The new protocol followed the same guidelines found in Hermann *et al.* (1994) with the main goal of isolating apoptotic DNA fragments induced by IL-2 deprivation.<sup>12</sup> Once coelomocytes were obtained through the extrusion process they were counted via hemacytometry and given a quality score where the best yielding cells were chosen. Cells were then treated with either the apoptotic inducers, H<sub>2</sub>O<sub>2</sub> (positive control), or DMSO (negative control) and placed into a V-bottom 96-well plate. The cells were then incubated at different incubation periods ranging from an overnight incubation period to an 8hr incubation period in a 30°C, 5% CO<sub>2</sub> humidified incubator. After the incubation period, the plate was then spun down at 1000rpm for 10mins at 4°C. Following the centrifugation of the cells the plate was then “flicked” into the sink to remove all supernatant from the wells without disturbing the cells. The plate was then vortexed to resuspend the pellet in each well. Using a multichannel pipettor 40µl of lysis buffer (1% NP-40, 20mM EDTA, 50mM Tris-HCL pH 7.5, and dH<sub>2</sub>O) was then added into each well. Like cells were then pooled together (e.g. all lysis buffer within the negative control wells are placed into one eppendorf tube). Once all the cells were removed from the plate, cells were then spun in the microcentrifuge at 1600xg for 5mins to pellet any cell debris. The supernatant was then transferred to a new eppendorf tube. Another 40µl of lysis buffer was then added to the original eppendorf tube containing the pellet. Cells were then microcentrifuged again at 1600xg for 5mins and the supernatant was then pooled with the other supernatant. The pellet was then discarded and 50µl of 5% SDS (final concentration of 1% SDS) was added to the supernatant. At this time the cells were frozen and stored at -80°C. The cells were then removed from the freezer and placed on ice to allow time for them to defrost. Once cells were defrosted RNase A (Fermentas Life Sciences) was diluted to a 1:100 dilution and was added to each sample for a final concentration of 5 µg/ µl. Cells were then incubated in a waterbath for 2hr at 56°C. Then Proteinase K (20mg/ml) was added to each sample with a final concentration of 2.5 µg/ µl and incubated for 2hrs. at 37°C. Cells were then removed from the

incubator and ½ vol. of 10M Ammonium Acetate (NH<sub>4</sub>OAc) was added to each sample and mixed with a pipette. Finally, 2.5 vol. of 100% ethanol was added to the samples to facilitate nucleic acid precipitation. The cells were then washed with 70% ethanol by spinning the tubes in the microcentrifuge at 16,000xg (16,110Xg) for 15mins. to pellet all cells. The supernatant was then poured off and the pellet was dried. To each pellet 21µl of TE buffer (10mM Tris-Cl, 1mM EDTA, pH 7.5) was added (Bio-Rad) where the samples were then vortex followed by a quick spin in the microcentrifuge to bring down solution. Samples were then incubated at 37°C for ~5mins. to allow the pellet to completely dissolve into solution. They were then removed from the waterbath and vortexed again followed by another spin in the microcentrifuge to bring down any insoluble material. For the DNA double-staining method, the loading dye was prepared by placing 99µl loading dye + 1µl SYBR® safe gel stain into separate eppendorf tube then adding 4µl of this mixture to each sample. DNA molecular weight markers were prepared (Fisher Scientific) by placing 10µl MW marker + 2µl SYBR® safe gel stain into a separate eppendorf tube. Cells were placed on ice followed by preparation of the agarose gel.

#### *DNA Gel Electrophoresis*

For the DNA gel electrophoresis section, 10X Tris-borate EDTA (TBE) loading buffer (Promega) was used to run all gels and was also used to create all gels. TBE loading buffer was diluted to a 1X concentration by mixing 900ml of dH<sub>2</sub>O with 100ml of TBE in a 1000ml Erlenmeyer flask which was then covered and stored on the lab bench at room temperature. Agarose gels (0.75% - 1.5%) were created by combining 50ml of 1X TBE buffer with the desired amount of High Strength Analytical Grade Agarose (Bio-Rad) in a 250ml Erlenmeyer flask. This solution was heated until the agarose was completely dissolved in the TBE buffer. The solution was then cooled to the touch and 10µl of 10,000X SYBR® safe DNA gel stain (Invitrogen) was added to the gel. After adding the gel stain the solution was swirled gently to distribute gel stain throughout the entire solution. The gel was then poured into a prepared electrophoresis chamber and a gel comb was positioned to form sample wells in the gel. After the gel had completely solidified the comb was removed and the gel was placed into the gel buffer tank. Once the gel was correctly placed into the tank, enough TBE buffer was added so the surface of the gel

was completely covered. The DNA samples were subjected to a pulse spin to bring down any condensation in the tube then, 21µl was transferred into a fresh Eppendorf tube. To these tubes 4µl of 6X gel loading buffer was added being sure to fully dissolve the pink pellet into the solution, and the samples were loaded onto the gel being sure to note what each well contains. The DNA molecular weight markers were subjected to a pulse spin and 5µl was loaded onto the gel. Once all samples were loaded onto the gel the lid was assembled and the leads were attached allowing the DNA to migrate toward the positive lead (red/anodic). The gel was run at ~120 volts until the dye front was 1-2cm from the bottom of the gel. The gel was removed from chamber and photographed using a Gel-Document System (Bio-Rad).

## **Results**

Results from the first couple of assays concerning the apoptotic inducers were inconclusive due to the fact that the wells appeared to be lacking DNA. **Figure 1** shows that there was no sign of DNA laddering within the wells containing the negative controls or the treated cells. This finding is most likely due to the loss of the pellet during the ethanol washing stage. The reasoning behind this is that the pellet may have been too small to see with the naked eye. A solution to this problem is to raise the amount of cells needed for the assay from  $0.5 \times 10^6$  cells to  $1 \times 10^6$  cells which may result in a larger pellet.

The lack of DNA during gel electrophoresis continued to become a problem but as the concentration of the cells was increased results became more promising due to the appearance of DNA fragmentation within the wells unlike all the other assays that had been conducted. **Figure 2** and **Figure 3** displays these results by illustrating the DNA laddering pattern within cells that were treated with the apoptotic inducers. **Figure 2** shows unexpected DNA laddering pattern in the negative control. This was an extremely unexpected event due to the fact that these cells are assumed to be healthy. The only explanation for this phenomenon is that the tubes could have been mislabeled or mixed up when adding the samples to the well, or there is a lot of spontaneous apoptosis occurring. Reasoning behind this conclusion is based upon the results of the hydrogen peroxide. The well that contained the cells treated with hydrogen peroxide appeared to have little DNA due to the fact that there is no visible DNA laddering pattern occurring. In fact there appears to be no sign of DNA in the high molecular weight portion of the

gel therefore forcing the idea that there just wasn't enough DNA in the sample or that it was really the negative control. The DNA ladders did not appear on the gel which is most likely due to a low concentration. **Figure 2** also shows that high molecular weight appears to be stuck in the wells meaning the pellet is not being completely dissolved and distributed in the TE buffer. This might be avoided by pipetting the solution gently a few times before adding the DNA sample into the gel. For the next assay samples will be kept labeled at all times to ensure they do not get mixed up.

Overall, 3 of the inducers seemed to have induced some form of apoptotic pathway on the earthworm coelomocytes due to the appearance of DNA laddering in the gel (**Figure 4**). These inducers included dexamethasone, cycloheximide, and camptothecin. Actinomycin D however did not induce any DNA laddering where the issue of a low concentration of DNA is not a factor due to the high molecular weight band around 1000bp. Reasoning why it didn't induce apoptosis could be due to a mistake in the dilution process resulting in the cells not receiving enough of the drug. It is apparent that the negative control is somehow becoming contaminated in all of these assays due to the fact that the negative control is once again displaying DNA laddering within the gel (**Figure 4**), therefore we cannot conclude if the inducers are having any effect. This phenomenon pushes the idea that there is another entity causing the induction of apoptosis on the healthy coelomocytes. One factor that could be causing this problem could be allorecognition between the different earthworm cells causing the cells to recognize and subsequently reject each other, therefore resulting in cell death. Earthworm cells are polymorphic because they are not produced through an inbred population, therefore earthworm cells possess polymorphism. To solve this problem individual earthworms could be extruded separately. By not pooling the earthworm coelomocytes together this would eliminate any form of allorecognition between different earthworms and we could then focus on the affects of the cytotoxic drugs.

## **Conclusion**

Among the five apoptotic inducers, dexamethasone and camptothecin were the two predominant inducers. Throughout the assays that actually worked dexamethasone and camptothecin appeared to induce an apoptotic pathway resulting in the pattern of DNA laddering. Even though these inducers

appeared to have worked well it is difficult to conclude if the results really show an apoptotic pathway being induced via the cytotoxic drugs or if the DNA is being degraded in another manner due to another entity. All assays conducted have resulted with a negative control containing DNA laddering therefore it is not certain that the apoptotic inducers are in fact inducing an apoptotic pathway. All reactivity could be one of the reasons why there is DNA laddering in the negative control therefore having a greater impact on the cells than we might think. To solve this issue earthworms will not be extruded in batches in any future assays. Instead individual earthworms will be extruded separately avoiding any exposure with other earthworm cells. Based upon the unexpected laddering found in the negative control it is also believed that the ethanol in the extrusion buffer could be inducing apoptosis in earthworm coelomocytes.<sup>7</sup>

### **Future Directions**

In future studies various extrusion methods could be tested focusing on individual coelomocyte populations via flow cytometry. Specifically the TUNEL assay (Terminal deoxynucleotide transferase dUTP Nick End Labeling) will be used to identify DNA fragmentation of apoptotic cells. The TUNEL assay does this by targeting the 3'OH groups found on the broken ends of damaged DNA.<sup>4</sup> Breaks in the DNA allow the attachment of terminal deoxynucleotidyl transferase (TdT) at the 3'OH site on the DNA strand resulting in the addition of deoxyribonucleotides. To the same location another structure is added known as a deoxythymidine analog 5-bromo-2'-deoxyuridine 5'-triphosphate (BrdUTP) that serves as a label for the break sites on the DNA strand. When analyzed on the flow cytometer a anti-BrdU antibody is used to identify the breaks on the DNA stand. One of the major advantages of this form of analysis is to identify and quantify different cells populations undergoing various stages of apoptosis. Data can then be associated with the different treatments that the cells received allowing us to conclude which extrusion method is the best and does not kill the cells in the process. Once the best extrusion method is chosen, then the apoptotic inducers can be truly tested.

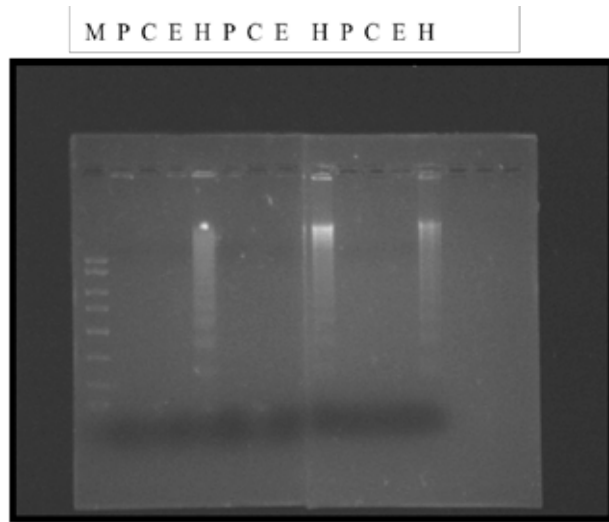


## References

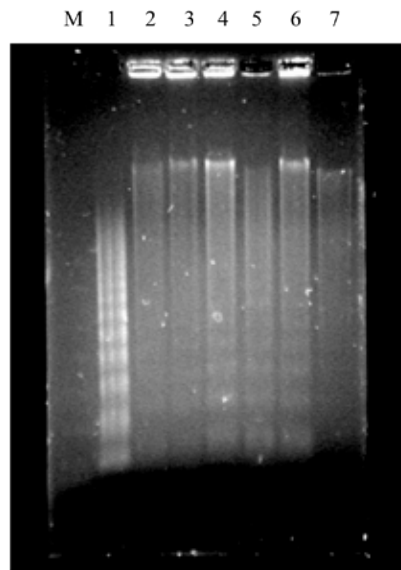
- <sup>1</sup>Abdelhaleem, M. (2003). The actinomycin D-induced apoptosis in BCR-ABL-positive K562 cells is associated with cytoplasmic translocation and cleavage of RNA helicase A. *Anticancer Research*, 23, 485-490.
- <sup>2</sup>Alberts, B., Bray, D., Hopkin, K., Johnson, A., Lewis, J., & Raff, M. (2004). *Essential Cell Biology* (p. 626). New York: Garland Science.
- <sup>3</sup>Alessenko, A., Boikov, P., Filippova, G., Khrenov, A., Loginov, S., & Makarieva, E. (1997). Mechanisms of cycloheximide-induced apoptosis in liver cells. *Federation of European Biochemical Societies*, 416, 113-116.
- <sup>4</sup>Anzar, M., Liwei, H., Buhr, M., Kroetsch, T. & Pauls, K. (2002). Sperm apoptosis in fresh and cryopreserved bull semen detected by flow cytometry and its relationship with fertility. *Biology of Reproduction*, 66, 354-360.
- <sup>5</sup>Baliga, S., Pronczuk, A., & Munro, H. (1969). Mechanism of cycloheximide inhibition of protein synthesis in a cell-free system prepared from rat liver. *Journal of Biological Chemistry*, 244, 4480- 4489.
- <sup>6</sup>Blanco, G., Bustamante, J., Garcia, M., & Hajos, S. (2005). Hydrogen peroxide induces apoptotic-like cell death in coelomocytes of *Themiste petricola* (Sipuncula). *Biological Bulletin*, 209, 168–183.
- <sup>7</sup>Castaneda, F., & Rosin-Steiner, S. (2006). Low concentration of ethanol induced apoptosis in HepG2 cells: role of various signal transduction pathway. *International Journal of Medical Sciences*, 3(4), 160-167.
- <sup>8</sup>Chrysis, D., Ritzen, E., & Savendahl, L. (2003). Growth retardation induced by dexamethasone is associated increased apoptosis of the growth plate chondrocytes. *Journal of Endocrinology*, 176, 331–337.
- <sup>9</sup>Collins, J., Schandl, C., Young, K., Vesely, J., & Willingham, M. (1997). Major DNA fragmentation is a late event in apoptosis. *The Journal of Histochemistry & Cytochemistry*, 45(7), 923–934.

- <sup>10</sup>DiBartolomeis, S., & Mon' e, J. (2003). Apoptosis: a four-week laboratory investigation for advanced molecular and cellular biology students. *Cell Biology Education*, 2, 275–295.
- <sup>11</sup>Eng, K., Faucette, L., Johnson, R. & Sternglaur, R. (1988). Evidence that DNA topoisomerase I is necessary for the cytotoxic effects of camptothecin. *Molecular Pharmacology*, 34,755-760.
- <sup>12</sup>Hermann, M., Lorenz, H., Voll, R., Grünke, M., Woith, W. & Kalden, J. (1994). A rapid and simple method for the isolation of apoptotic DNA fragments. *Nucleic Acids Research*, 22, 5506-5507.
- <sup>13</sup>Hsiang, H., Lihou, M. & Liu, L. (1989). Arrest of replication forks by drug-stabilized topoisomerase I-DNA cleavable complexes as a mechanism of cell killing by camptothecin. *Cancer Research*, 49, 5077-5082.
- <sup>14</sup>MacDonald I. & Ellis, R. (1969) Does cycloheximide inhibit protein synthesis specifically in plant tissues. *Nature*, 222, 791-792.
- <sup>15</sup>Merits, I. (1963). Actinomycin D inhibition of ribonucleic acid synthesis in rat liver. *Biochemistry and Biophysical Research Communications*, 10, 254-259.
- <sup>16</sup>Morris, E. & Geller, H. (1996). Induction of neuronal apoptosis by camptothecin, an inhibitor of DNA topoisomerase-I: evidence for cell cycle-independent toxicity. *The Journal of Cell Biology*, 134(3), 757-770.
- <sup>17</sup>Roch, P. (1996) A definition of cytolytic responses in invertebrates. *Advances in Comparative and Environmental Physiology*, Invertebrate Immune Responses: Cells and Molecular Products, E.L. Cooper, ed Springer-Verlag, Berlin, Heidelberg, 23, 116-150.
- <sup>18</sup>Shors, T. (2009). *Understanding viruses* (p. 153). Massachusetts: Jones and Bartlett Publishers.
- <sup>19</sup>Tahseen, Q. (2009). Coelomocytes: Biology and possible immune functions in invertebrates with special remarks on nematodes. *International Journal of Zoology*, 90(6):1308-1320.
- <sup>20</sup>Wang, Y., Rea, T., Bian, J., Gray, S, & Sun, Y. (1999). Identification of the genes responsive to etoposide-induced apoptosis: application of DNA chip technology. *Federation of European Biochemical Societies*, 445, 269-273.

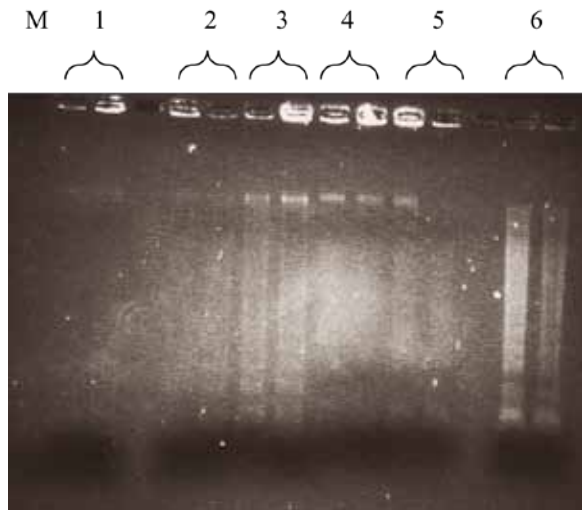
Appendix



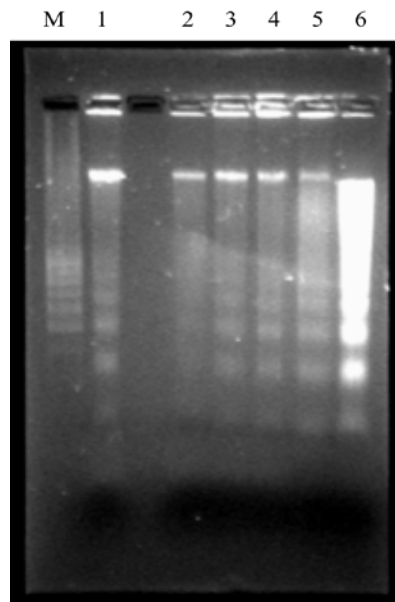
**Figure 1: Earthworm coelomocytes were treated with various inducers for an O/N incubation period and DNA was isolated and run on 0.75% agarose gels.** Lane M (molecular weight markers in bp: 2,000; 1,500; 1,000; 750; 500; 300; 150 and 50), Lanes P (untreated batched cells), Lanes C (batched cells treated with camptothecin), Lanes E (batched cells treated with etoposide), and Lanes H (batched cells treated with hydrogen peroxide).



**Figure 2: Earthworm coelomocytes that were exposed to various apoptotic inducers where the DNA was isolated and run on a 1.2% agarose gel.** Lane M (molecular weight markers in bp: 2,000; 1,500; 1,000; 750; 500; 300; 150 and 50), Lane 1 (HL-60 cells treated with actinomycin D), Lane 2 (untreated batched cells in the presence of DMSO), Lane 3 (batched cells treated with cycloheximide), Lane 4 (batched cells treated with etoposide), Lane 5 (batched cells treated with camptothecin), Lane 6 (batched cells treated with dexamethasone), and Lane 7 (batched cells treated with hydrogen peroxide).



**Figure 3: Coelomocytes obtained from the extrusion of batched earthworms then treated with various apoptotic inducers and the DNA was isolated and run on a 1.2% agarose gel.** Lane M (molecular weight markers in bp: 2,000; 1,500; 1,000; 750; 500; 300; 150 and 50), Lanes 1 (batched untreated cells in the presence of DMSO), Lanes 2 (batched cells treated with cycloheximide), Lanes 3 (batched cells treated with dexamethasone), Lanes 4 (batched cells treated with actinomycin D), Lanes 5 (batched cells treated with camptothecin), and Lanes 6 (batched cells treated with hydrogen peroxide).



**Figure 4: Effect of apoptotic inducers on earthworm coelomocytes where apoptotic DNA was isolated and run on a 1.5% agarose gel.** Lane M (Molecular weight markers in bp: 1,000; 900; 800; 700; 600; 500; 400; 300; 200; 100; 50 and 25), Lane 1 (batched untreated cells in the presence of DMOS), Lane 2 (batched cells treated with actinomycin D), Lane 3 (batched cells treated with cycloheximide), Lane 4 (batched cells treated with dexamethasone), Lane 5 (batched cells treated with camptothecin), and Lane 6 (batched cells treated with hydrogen peroxide).

# Humanities

**Mental Constructs: Deinstitutionalized Slavery in Morrison's *A Mercy***

Author: Katherine Sullivan

Faculty Mentor: Michelle Filling, Ph.D.

Abstract: A close inspection of Toni Morrison's most recent novel *A Mercy* reveals slavery as more than the institution at the heart of the Civil War. It is possible for a person to be a slave to madness, love, or material possessions and such a loss of power can happen regardless of gender or race. All forms of slavery strip the individual of identity; wild and desperate attempts to regain control of oneself can have devastating consequences. The idea of power in regard to slavery and mercy, respectively, is also examined in an attempt to understand the role such relationships play in the various manifestations of slavery.

The world does not wait for us to grow. It shapes us and can transform us as fundamentally as the shifting of the seasons and the changing of the tides but it will not hesitate to pull us away before we reach absolution. Self-identity is a difficult concept; it is taxing to create and nurture it. Slavery is an institution that denied millions the opportunity to form their own identities. Aside from the physical torment and losses, slavery left deep psychological wounds that rendered many unable to feel free even after they had been liberated. Slavery, however, is not just a power construct that exists between two races or even between two people. An individual can enslave themselves; they can be held captive by emotions or dreams without even being aware of their confinement. In Toni Morrison's most recent novel *A Mercy* there is institutional slavery, but there are also prisons of a different kind. A person can be a slave to love, to madness, or to material possessions, and the extent to which they can or cannot exercise power has no bearing—no one is immune to mental imprisonment.

Many relationships have a built-in power disparity: parent/child, teacher/student, and boss/employee. One party is understood to have control over the other. Such is not meant to be the case in romantic relationships; however, the ideal is rarely the norm. Every day we have reason to believe that

“love may exist in starkly unequal power relations”<sup>3</sup> and may endanger people in regards to their individuality and freedom of self-expression. In *A Mercy* Florens is accused of being a slave to love. She is already a slave in the sense that she is an African-American girl who is owned by a white man, so she has the concept of slavery ingrained in her existence. This does not help her any in realizing her situation regarding her obsessive and singular love for the blacksmith. She is so enamored she defines herself only in terms of her relationship with him: “when I see you and fall into you I know I am live.”<sup>2</sup> Love essentially swallows Florens whole, burying her under the delusion that she can place responsibility for her entire being in the hands of another, one she barely knows. The most dangerous aspect of the situation is Florens’ inability to realize that the blacksmith does not want all she is giving him. She is unable to reconcile the fact that he may actually care about a person other than her.

Florens harbors the damaging thought that she was given up because her mother preferred her little brother. She wants to be owned by someone because she is so haunted by being disowned as a child. Malaik, a child being cared for by the blacksmith, reawakens in her that jealousy of her brother and fear that she is being abandoned. Lashing out at him is part of releasing a pain long-buried, a hurt that she likely cannot even fully process. The blacksmith, horrified at her actions, scathingly accuses her: “You are a slave...your head is empty and your body is wild...no constraint. No mind...a slave by choice.”<sup>2</sup> Florens is confused and horrified. Her only concept of slavery is that of history’s institution where blacks are subject to the whims of whites—she acquiesces to her love that yes, she is a slave because she became one when she was sold to Jacob Vaark. But she is human because of her devotion to him. The blacksmith disagrees that Florens’ obsessive adoration makes her less of a human and more of a slave; she loves blindly and with her body rather than her mind. Florens exhibits more distress over the loss of his love for her than over his cruel assertions that she is animalistic. She cannot tolerate the loss of identity that goes hand-in-hand with the loss of his affections—he is her only reference for both freedom and life. Cut free from him, she has no basis on which to build herself. Ironically, it is far more painful for Florens to be free of the slavery of love. She loved entirely at her own expense, confining herself to a prison of her own

design. She was incapable of realizing what she did to herself because she would not think to associate something as beautiful as her love for the blacksmith with the dark reality of slavery.

It is important to note that the wildness in question was believed by Florens to already be nesting in her before she reached the blacksmith; he was merely the catalyst for its release. Her hope is that the blacksmith will tell her of her worth, of the life she hosts that is not dark and violent. When he does the exact opposite, accusing her of being savage rather than comforting her lost sense of self, she asserts her new reality: “I am become wilderness.”<sup>2</sup> This is a moment of empowerment rather than deference because although she takes the words of her former lover, she follows them with the emphatic “...but I am also Florens. In full. Unforgiven. Unforgiving.”<sup>2</sup> She is asserting her identity for the first time and is absolutely unashamed. The wildness was planted and encouraged by slavery, fueled by hatred and compliance, but its ferocity is what allows Florens to pull through without losing her mind. This quality of turning a negative outcome to her advantage will help her move forward.

Florens is fortunate enough to have her slavery pointed out to her before her self-identity becomes irretrievable. She is unaware of her position, but she is the only one who fails to notice. What would befall an enslaved person if no one, including themselves, managed to realize the enslavement? What force can slip so quietly into a person’s life that it takes control without challenge or even acknowledgement? Mental illness can be that silent master—sometimes it is so subtle the person does not even realize they are sick, much less that they are suddenly at the mercy of something beyond their control.

Sorrow suffers from such an ailment. The trauma she lives through on the ship leaves deep psychological scars; however, she does not view herself as ill or disordered. Twin, a manifestation of Sorrow’s confusion, loneliness, and fear after the shipwreck, is to Sorrow merely a new friend who looks like her. She sees nothing foreboding or intrusive about Twin’s presence. For one reason or another, though, Sorrow keeps Twin’s existence a secret. She must know that she will remain better protected if



she keeps to herself. As this is the case, no one else has any idea of the extent of the damage to Sorrow's mind. They regard her as "mongrelized," daft, and aimless but do not know how far the roots of psychological trauma reach. People are too put off by Sorrow's melancholy attitude and frequent disappearances to attempt connecting with her. As a result, she is severely isolated. The existence of Twin feeds into this isolation, as Twin tells her when it is alright to speak and when she must stay away from people. Sorrow is being controlled by a force beyond her understanding; she believes Twin is merely a friend and would not have the knowledge or the resources to deduce the truth about her mental state. Sorrow cannot become any more than what people expect of her and her identity centers on the opinions of those around her. They do not offer her any chance to change, nor do they seem to anticipate it.

The birth of Sorrow's daughter fundamentally transforms her—Twin disappears and Sorrow renames herself "Complete." But has the wilderness disappeared with the birth of her daughter or has it just been rerouted? Now determined to do something singly and well, it would not be surprising if Sorrow became more set on fulfilling a mission than being a mother, if her daughter became not the ends but the means to which Sorrow could feel as if she has found an identity, as if she has completed something she chose. Trouble lies in the fact that she never did choose the child; she was impregnated by a stranger and possibly against her will. Similarly to Florens, Sorrow is trying to claim something that did not originate as her own. The situations of both women were born of powerlessness and now they are attempting to wrench some control out of the pieces they have left. The disconcerting fact is that power cannot keep them safe.

We want to believe that those who have power are safe, spared from the pain of violence, loss, or insanity. Jacob Vaark is supposed to be "safe" because he is white. He has established dominance over a plot of land he inherited and the slaves who work it for him. He fails to recognize that "he is enslaved to an idea of prosperity that costs him his life."<sup>1</sup> Jacob becomes so consumed with the gaining of material possessions that he can think of nothing else. He is entirely transformed by greed. When he speaks to Peter Downes and gets wind of the lucrative sugar enterprise, he is suddenly no longer a man who wishes

not to deal in slavery. However, he justifies it to himself by asserting that as long as he is not actually whipping slaves in Barbados, he is not doing anyone harm. Jacob distances himself from the far-reaching consequences of his actions and thinks only about what he will gain from them. He seems more pacified than happy to have his grand home finally built.

His quest for possessions becomes a mission he cannot separate himself from. In response to Rebekka saying they do not need another house, Jacob asserts “Need is not the reason...what a man leaves behind is what a man is...I will have it.”<sup>2</sup> He no longer thinks of his character in terms of his actions, emotions, or behaviors. Instead he believes the only legacy he can leave behind is locked in material items. Jacob needs something tangible, something he can touch, something he can withhold from others, just as Florens needs to feel wanted and Sorrow relies on Twin. He feels he can only identify himself by what he has. He is feverish with desire and like Florens and Sorrow, he does not see what he is becoming. It is difficult for him to tell that he is rendering himself a slave.

Even when Jacob falls ill he does not stop his desperate rush towards material gain. He demands to be put in his new house, to die there even though he was never able to live in it. He is rendered completely impotent. He is not saved by his status as a white landowner or by the money he manages to accumulate. The power society offers him does not save him from becoming beholden to materialism. He is meant to be above his slaves, but he falls victim to the same fate.

The truth is that no one can be spared from the various forms of mental and physical slavery because they are too far-reaching, intrusive, and sometimes difficult to realize. Slavery as a construct impairs self-identity. Florens feels her identity lies in the blacksmith, Sorrow in Twin, and Jacob in the legacy of wealth he can leave behind. They are all inundated with wildness. Florens decides to move on with it and attempt to make it hers even though it was bestowed upon her by others. Sorrow suffers its stigma as she is called a mongrel and then realigns it into tenacity regarding her daughter. Jacob grows

sick with and dies with it. No one moves forward without scars. The human mind is complex enough to be at once an incredible asset and a domineering curse. There are some things it holds onto forever.

#### References

- <sup>1</sup>Frykholm, Amy "A Mercy." *Christian Century* 126.4 (2009): 46-47. Academic Search Premier. EBSCO. Web. 28 Oct. 2009. <<http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=36634868&site=ehost-live>>.
- <sup>2</sup> Morrison, Toni. *A Mercy*. New York: Alfred A. Knopf, 2008. Print.
- <sup>3</sup> Rushdy, Ashraf H.A. "The Iron Fettered Weight of All Civilization: The Project of Barbara Chase-Riboud's Narratives of Slavery." *Callaloo* 32.3 (Summer 2009): 758-772. Project Muse. Web. 30 Sept 2009. <<http://muse.jhu.edu.ezproxy.library.cabrini.edu/journals/callaloo/v032/32.3.rushdy.html>>.

**It's God's World After All:  
An Analysis of Milton's Interpretation of God in *Paradise Lost***

Author: Matt Slutz

Faculty Mentor: Marilyn Johnson, Ph.D.

In John Milton's *Paradise Lost*, entrepreneurship and legalese have never been more popular among the spiritual beings as they are in this epic. God has both an MBA and law degree as he reigns supreme in heaven for eternity. Milton develops an interpretation of God that relates to our modern view of a family business owner. The creator of the business takes less of a hands-on approach by delegating power to His Son and the archangels Raphael and Michael. A disgruntled employee, Satan, decides to rebel against God when he learns that God appointed His Son to a leadership position in the organization of heavenly hosts. This event generates incidents that allow the reader to observe the character development of God as a businessman and lawyer when He handles the situation in heaven and the dissolution of his franchise called Eden.

Although it may seem that God acts behind the scenes, He takes full responsibility for His creation, yet instills in them free will, which enables the sentient creation to choose either to love and obey Him or not. The free will that God's employees possess leads to a disruption in his business plan, which causes Him to utilize a legalistic attitude to solve the problems. Milton's appraisal of God is complex and one can best comprehend God's actions in the epic, *Paradise Lost*, by closely reading God's language and the way He interacts with others.

We encounter God in Book III when He explains His new outlook for the future because of Satan's inglorious exit from heaven. The reader first learns of God's attitude in Book I when Satan gives his reasons for leaving heaven. God addresses his stockholders, who are the faithful angels, regarding His plan for creation and the salvation that awaits this new creation. Isabel G. MacCaffrey suggests that "the famous Dialogue in Heaven – occurs during the suspension of action in the first half of Book III, and it inevitably provides the main axis for the book" (59). God's words and decisions will propel the direction of the plot since it is His choice as to what to do next regarding heaven and the universe. Milton shapes

God's words so that He sounds like a strict CEO and pragmatic business leader who is aware of His surroundings and knows how to handle complex situations.

In Book III, Milton writes of an imagined board meeting with God and the angels to justify God's actions and thoughts for the future. God restructures the family business when the Son volunteers to save humanity. God the Father officially appoints the Son second in command. God is exact and He accurately describes the sentiments of the fallen angels as well as forecasting Satan's revenge. God explains the purpose of free will and incorporates His assessment of the events to come. Everyone in God's business possesses free will, which means they have the choice to either obey God or to follow Satan and live in darkness. God points out that when Satan disrupts creation, the Son will have the responsibility to save humanity from sin and death, which will overrun creation. The Son acts as the field manager and Saviour who will personally know creation as well as know every thought and feeling of humanity. Before the Son achieves this ultimate victory, a war between heaven and hell solidifies the destiny of the universe and moves the plot of the epic.

Milton is not linear in his revelation of the creation process since the creation story takes place in Book VII and the reader already meets Adam and Eve in Book IV. It is in Book V that we see that God genuinely cares for His creation and will try anything just short of changing human history by reclaiming free will. God tells Raphael to be "friend with friend / Converse with Adam... advise him of his happy state" (V. 229-234). Milton now changes his tone toward heaven and depicts a marvelous image of Raphael leaving heaven in his perfect state. Milton writes, "The gate self – opened wide / On golden hinges turning as by work / Divine the sov'reign architect had framed" (V. 254-256). Milton is slowly representing a heaven that is open, free, and harmonious as well as an authoritative God who is becoming a more positive leader. Evil, however, lurks in Paradise as Satan devises a plan to corrupt God's creation, which Milton reveals in Book IV and in Book VI, which is a war against God that actually occurs before the creation of the world.

Satan, not finished with his grievances toward the family business in heaven, decides to incite an all out war with heaven. God watches from a distance as his angels encounter the fallen angels of hell in

a wild desperate battle that features incredible fighting methods until the Son of God personally ends the war. Milton, throughout the battles, includes God's comments on the situation as he evaluates the lack of progress made by his powerful angels (VI. 680 – 718). These sentiments give the reader the perception that Milton's God is a cold omnipotent being that one does not recognize as our God. Milton renders a composition of the Old Testament God who is severe and standoffish when it comes to personal interaction. It is not until we observe God's response to His Son's decisive victory in the brief but telling war of heaven and hell that we begin to understand God's transformation.

The war is crucial to God's plan for salvation and the Son's involvement with humanity, thus prompting God's great praise of His Son. Milton begins to shape a new tone for God's personality in that God is less severe by being open minded and focused on His creation of the earth. MacCaffrey suggests that "we are to read the speeches of the Son as His Father's spoken thoughts, His Word in a literal sense that is also a spiritual sense" (71). The events of the war between heaven and hell is a turning point for Milton's God because God as a character in the poem begins to accept the fate of creation realizing that His omnipotence is not a tool for altering the future. He tells Abdiel, "Servant of God, well done, well hast thou fought / The better fight..." (VI. 29-30). God's response to Abdiel is a critical point in God's character development in the poem since God becomes more personable and acts like a father figure (VI. 29-55). God's language and the rank of the Son in heaven leads to the idea that "for were He like the Son of orthodox trinitarianism, inseparable from God in substance and essence, indeed cosubstantial and coequal with Him, what we observe in Books III and VI would be a ritual dialogue, not a trial of merit and service" (Revard 251). This attitude translates to God's treatment of the Son when He asks His Son to end the war by forcefully driving Satan and the rest of the army out of heaven. Additionally, God is more supportive of the Son when He returns from his glorious conquest.

Milton continues God's new *modus operandi* in Book VII as we read the creation story as told by Milton. After the tremendous war of heaven and hell, God creates the Earth, which is a franchise of his heavenly kingdom. We see God's character becoming more amiable as He further shares His power with the Son during the creation of the world. God employs the Son to create the world, thus, "His word, the

filial Godhead, gave effect” (VII. 175). God delegates His power and provides the Son with the means to fulfill God’s Word, which will become flesh when the Son enters the world to save humanity later in history (Revard 285 -287). Milton, through Raphael, retells God’s feelings toward the Son as they prepare to create the world. Raphael says, “The Son.../ Girt with omnipotence, with radiance crowned / Of majesty divine.../ And all his Father in him shone” (VII. 192-196). After Milton’s vivid account of the creation of the world, God bonds with the Son on the seventh day, thus giving the reader further insight into God’s character.

Yet in Book VIII God’s character development becomes static when He converses with Adam, His new creation, concerning the preservation of Eden and the rules of the world. For a time, Milton’s version of God is stiff and narrow-minded; however, God relents and acknowledges Adam’s request for a suitable mate (VIII. 357- 499). At this time, Milton’s God becomes the lawgiver, the One who instructs Adam not to eat of the Tree of Knowledge. If Adam does go against God’s Will, Adam will face a tough prosecution by God who practiced His legalistic tone in Book III.

Adam and Eve finally succumb to the temptation of Satan by eating the fruit of the Tree of Knowledge, thus fulfilling the events outlined earlier in the epic. God acts as a tough prosecutor when he addresses Adam and Eve, but relies on the Son to deliver the sentence that awaits the fallen Adam and Eve. Beginning at line 103 of Book X, God combines His opening argument with his cross-examination of Adam and Eve. Although God knows everything, He still asks Adam why he ate from the tree, and then God explains to Adam the nature of his sin in order to avoid future incidents that may lead Adam to disobey God. God then questions Eve in a brief exchange that consists of God asking her if she ate from the tree and Eve’s simple response of “The Serpent me beguiled and I did eat” (X. 157-162).

Subsequently, God begins His closing argument, which contains his cursing of the serpent, imposing pain during childbirth, and forcing Adam to work the land for survival. This may seem like God is sentencing Adam and Eve, but the new way of life for Adam and Eve is more of a consequence of their actions and not the ultimate sentence.

God's explains His punishing sentence in Books XI and XII by means of the archangel Michael who relates to Adam the future of the world. Adam and Eve appeal to God with sincere contrite hearts so that God will not sentence them with immediate death (XI. 22-44). God listens to their prayers and spares Adam and Eve from immediate death (XI. 45 – 71, 84-98). God then develops laws that are a guide for humanity to live fruitful and purposeful lives. The laws God provides and His desire to offer grace to humanity demonstrate His longing to reconcile humanity to Himself in the form of Jesus, His Son (Revard 305). God banishes Adam and Eve from Paradise, but sends Michael to reveal salvation history to Adam in order to calm his mind and heart. Adam chooses to obey God a second time, but now it is not so easy since he has to practice his faith by doing good deeds, being modest, being virtuous, and having patience and love (XII. 270 – 284). God places Adam on probation by having him perform “community service.” It is a way to come back to God as well as to lead a productive life by being a manager of God's creation, the earth, and to try to establish God's kingdom on earth (XII. 285 – 306).

Over the course of *Paradise Lost*, Milton's God experiences a transformation from a tough CEO to a compassionate and interested father, and finally a determined lawyer/judge who acts with fairness and mercy. God's tone adjusts accordingly as we move from the crucial dialogues in Book III to His final instructions in Book XI when he tells Michael what to say to Adam. Milton's character development of God is atypical, but resembles normalcy when Michael speaks to Adam concerning the events of what we know as the Old Testament. The reader perceives God as detached early in the epic, not possessing feeling or emotion. Later God's relationship with the Son and the Son's growing responsibility softens God's demeanor as God comes into full acceptance of His own omnipotence. God wants to be involved with creation after Adam and Eve's fall, and He rededicates Himself to the family business, which is now under new management in the form of Jesus who will bring salvation to the world.



Works Cited

- Fish, Stanley Eugene. "Discovery as Form in Paradise Lost." *New Essays on Paraidse Lost*. Ed. Thomas Kranidas. Los Angeles: University of California Press, 1969. 1-14.
- Johnston, Ian. Lecture on Milton's Paradise Lost. English 200. Malaspina University-College. Nov. 1988. *Johnstonia*. Web. 16 Mar. 2010  
<<http://records.viu.ca/~johnstoi/Eng200/milton.htm>>.
- King, John N. *Milton and Religious Controversy*. Cambridge: Cambridge University Press, 2000.
- MacCaffrey, Isabel G. "The Theme of Paradise Lost, Book III." *New Essays on Paraidse Lost*. Ed. Thomas Kranidas. Los Angeles: University of California Press, 1969. 58-85.
- Milton, John. *Paradise Lost*. Ed. William Kerrigan, John Rumrich, and Stephen M Fallon. New York: The Modern Library - Random House, 2008.
- Revard, Stella Purce. *The War in Heaven*. Ithica: Cornell University Press, 1980.
- Shawcross, John T. "The Style and Genre of Paradise Lost." *New Essays on Paraidse Lost*. Ed. Thomas Kranidas. Los Angeles: University of California Press, 1969. 15-33.

**“Las reglas de la lectura en ‘La noche boca arriba’ de Julio Cortázar”**

Author: Vera Recupido

Faculty Mentor: Raquel Green, Ph.D.

Abstract: This literary analysis was written as part of the requirements for a Survey of Latin American Literature II course in the fall 2009. The paper examines how Cortázar challenges the reader's initial assumptions about what constitutes reality in the narrative and invites him to dismantle the text in order to recognize the limitations he puts on his own imagination. At the end of the story, the reader understands that most of his assumptions were incorrect and that the exercise has served him to read a complex story that defies a single interpretation. The paper was presented during the Foreign Language Symposium at Arcadia University and at Cabrini College's Undergraduate Research Symposium in April 2010.

En su cuento “La noche boca arriba”, Julio Cortázar presenta a sus lectores con diferentes maneras de leer el texto. El cuentista propone dos o más lecturas posibles -una lineal y secuencial y otra superimpuesta, que desbarata la estructura temporal cronológica de la narrativa tradicional y lleva hacia lo que más tarde la crítica habría de definir como deconstrucción de un texto. El lector se ve forzado a desmontar el cuento para entenderlo.

La historia comienza con un accidente de motocicleta y la hospitalización posterior de un hombre del siglo XX. Cuando lo drogan para una operación, el lector ya no puede confiar en el narrador porque éste ahora reporta sobre un mundo donde el personaje está atrapado en un sueño provocado por la anestesia y la fiebre. En esta secuencia el personaje es parte de la tribu moteca y está escapando para no caer en manos de los aztecas durante la guerra florida. Al irse armando el cuento, las secuencias en que el personaje penetra en la trama del sueño cobran más importancia y llegan a ser más vívidas. Al final, el moteca termina siendo víctima de un sacrificio humano para los dioses aztecas. Este momento narrativo converge con el momento de la operación del hombre moderno. Cuando el cuento termina, el reconocimiento de cuál es la realidad y cuál es el sueño es algo que unen al lector y al protagonista.

El relato empieza a las nueve menos diez en la mañana, con la salida en motocicleta de un hombre moderno. El primer párrafo tiene una secuencia que es muy fácil seguir porque Cortázar describe

muchos vínculos con un mundo moderno –el hotel, la motocicleta, la joyería, los edificios, el centro, la serie de comercios –que indican una realidad con la que el lector puede identificarse. El momento de quiebre se da con el accidente. Después de desmayarse el protagonista, el narrador resalta ante todo el dolor físico del herido. Cuando el herido vuelve en sí, “sentía gusto a sal y sangre, le dolía una rodilla y cuando lo alzaron gritó, porque no podía soportar la presión en el brazo derecho” (Méndez-Faith 298). La ambulancia lleva al protagonista al hospital, y la enfermera lo droga para una operación. Hasta ahora, el lector piensa que ésta es la realidad principal.

Pero, sin aviso alguno, otra secuencia se superpone al tiempo cronológico del relato. El lector abandona el hospital y entra en la guerra florida, la práctica de los aztecas para obtener víctimas y luego sacrificarlas a sus dioses. El hombre, un miembro de la tribu moteca, está huyendo de los guerreros para no ser sacrificado. Cortázar define esta realidad como un sueño porque el lector se puede identificar con esto. En el sueño, no hay una percepción del tiempo cronológico, pero los sentidos del hombre son más intensos. El narrador menciona con insistencia el sentido del olfato: “Como sueño era curioso, porque estaba lleno de olores y él nunca soñaba olores” (línea 61); “Lo que más lo torturaba era el olor” (línea 70); “No se oía nada, pero el miedo seguía allí como el olor, ese incienso dulzor de la guerra florida” (línea 81) (Méndez-Faith 298). Al hacer uso de los sentidos, Cortázar describe una realidad más visceral y el lector debe cuestionarse si esto es un sueño debido a la fiebre o si el personaje está verdaderamente corriendo de los aztecas.

En la secuencia que se somete a un tiempo cronológico, el hombre moderno se despierta en la cama de hospital, pero esta vez es la tarde. Cortázar refuerza la suposición del lector que el hombre está soñando sobre la persecución porque se mencionan los analgésicos: “Vio llegar un carrito blanco que pusieron al lado de su cama, una enfermera rubia le frotó con alcohol la cara anterior del muslo, y le clavó una gruesa aguja conectada con un tubo que subía hasta un frasco lleno de líquido opalino” (Méndez-Faith 299). Sin embargo, al mismo tiempo, el autor hace un guiño al lector al mezclar otra vez las dos realidades: “Sintió sed, como si hubiera estado corriendo kilómetros” (Méndez-Faith 299). Finalmente la noche cae, y Cortázar invita otra vez al lector a entregarse a una narración libre de las limitaciones de un

orden cronológico: “La fiebre lo iba arrastrando blandamente a un estado donde las cosas tenían un relieve como de gemelos de teatro, eran reales y dulces y a la vez ligeramente repugnantes, como estar viendo una película aburrida y pensar que sin embargo en la calle es peor, y quedarse” (Méndez-Faith 299). Al efectuar los cambios de las reglas que rigen los dos mundos narrativos, Cortázar no sólo intenta confundir al lector sino invitarlo a ser parte de una historia activa; la lectura ahora depende completamente de él.

Al final de la segunda secuencia en el hospital, el hombre moderno se abandona y al cerrar sus ojos entra en el mundo en que está intentando escapar de los aztecas. Cuando se da cuenta de que se desvió de la calzada, el lector debe cuestionarse si el narrador está hablando de una acera en el mundo moderno o sólo el camino que el hombre tomaría para huir de los guerreros. Desde el momento que el autor menciona el puñal, podemos ver que la vida del hombre está en peligro. El moteca tiene el puñal y está anticipando lo que los aztecas van a hacer cuando lo capturen y, al mismo tiempo, el hombre moderno tiene que ir “bajo el bisturí.” Al llegar a esta secuencia del sueño, el narrador hace mención de la palabra “tiempo”, pero no es ya el tiempo cronológico sino que se habla de la vigencia de un tiempo sagrado. El lector comienza a no poder relacionarse porque no sabe qué es este “tiempo sagrado.” Al final de esta secuencia, el moteca ve las antorchas de los aztecas que están siguiéndolo. Nuevamente, las descripciones se transforman en muy intensas, se huele la guerra algo que una persona no experimenta típicamente durante un sueño. El lector entiende que el moteca es capturado por los guerreros.

Si el hombre moderno se siente seguro al despertarse porque puede escapar su pesadilla, el autor parece ofrecer otras pistas que nos fuerza a cuestionar la realidad del accidente:

Trataba de fijar el momento del accidente, y le dio rabia advertir que había ahí como un *hueco*, un vacío que no alcanzaba a rellenar. Entre el choque y el momento en que lo habían levantado del suelo, un desmayo o lo que fuera no le dejaba ver nada. Y al mismo tiempo tenía la sensación de que ese *hueco*, esa nada, había durado una eternidad. No, ni siquiera tiempo, más bien como si en ese hueco él hubiera pasado a través de algo o recorrido distancias inmensas. (Méndez-Faith 301)

Si el protagonista duda la realidad de su propio accidente, al lector no le queda otra opción que cuestionarla también.

Al comienzo de la tercera secuencia del sueño, el hombre vuelve en sí en la misma posición en que estaba durmiendo en el hospital. El narrador menciona otra vez el olor: “pero en cambio, el olor a humedad, a piedra rezumante de filtraciones” (Méndez-Faith 301). El hombre está atado por unas sogas a una losa de cemento, esperando su turno a ser sacrificado. Empieza a gritar y trata de liberarse de las cuerdas, pero cuando se termina el sueño, cuatro acólitos lo llevan a su muerte.

Al final del cuento, Cortazar combina la realidad y el sueño en un párrafo (en vez de separarlos como antes) para reforzar que las dos secuencias narrativas son paralelas. El párrafo comienza en el hospital, donde el hombre trata de olvidarse de su pesadilla:

En la mesa de noche, la botella de agua tenía algo de burbuja, de imagen traslúcida contra la sombra azulada de los ventanales. Jadeó buscando el alivio de los pulmones, el olvido de esas imágenes que seguían pegadas a sus párpados. Cada vez que cerraba los ojos las veía formarse instantáneamente, y se enderezaba aterrado pero gozando a la vez del saber que ahora estaba despierto, que la vigilia lo protegía, que pronto iba a amanecer, con el buen sueño profundo que se tiene a esa hora, sin imágenes, sin nada... (Méndez-Faith 302)

El autor cambia de la escena en el hospital a la escena en la mazmorra en una frase: “Hizo un último esfuerzo, con la mano sana esbozó un gesto hacia la botella de agua; no llegó a tomarla, sus dedos se cerraron en un vacío otra vez negro y el pasadizo seguía interminable, roca tras roca, con súbitas fulguraciones rojizas, y él boca arriba gimió apagadamente porque el techo iba a acabarse” (Méndez-Faith 302). Con este cambio, nuestro autor reitera el paralelo entre la realidad y el sueño febril del personaje.

En la última secuencia del sueño, el hombre intenta escapar la pesadilla pero no puede encontrarse en el hospital. Los acólitos lo están llevando, boca arriba, a su muerte, y él puede oler la sangre de los otros humanos sacrificados. Al final del cuento, el protagonista y el lector se encuentran con una sorpresa que todo este tiempo, la realidad ha sido un sueño y el sueño ha sido la realidad:

Alcanzó a cerrar otra vez los párpados, aunque ahora sabía que no iba a despertarse, que estaba despierto, que el sueño maravilloso había sido el otro, absurdo como todos los sueños; un sueño en que él había andado por extrañas avenidas de una ciudad asombrosa, con luces verdes y rojas que ardían sin llama ni humo, con un enorme insecto de metal que zumbaba bajo sus piernas.

(Méndez-Faith 303)

Julio Cortázar escribió “La noche boca arriba” para proponer una manera diferente de concebir la lectura. Haciendo uso del doble, “lector/autor”, “hombre moderno/moteca”, “presente/pasado”, “vigilia/sueño”, nos fuerza a cuestionar lo que es verdadero. Nosotros ponemos un límite en nuestra capacidad imaginativa y Cortázar nos desafía a cambiar completamente las reglas de juego de la lectura. El cuentista argentino nos hace pensar en el proceso de montar un cuento. Nos hace cuestionar la idea de ordenar la narración sólo siguiendo la secuencia del tiempo cronológico. Al final del cuento, se nos presenta la posibilidad de un moteca que, al borde de la muerte, se ve proyectado a un futuro donde también sufre un accidente. Al invertir todas las presuposiciones del lector, Cortázar lo invita a valorar el cuento como artificio que se construye.

#### Referencia

Cortázar, Julio. "La noche boca arriba." Compiled by Teresa Méndez-Faith. *Panoramas Literarios: América Hispana*. Boston: Houghton Mifflin Company, 2008. 297-303. Print.

## **“El desafío feminista en Chile y Guatemala”**

Author: Shannon Keough

Faculty Mentor: Raquel Green, Ph.D.

Abstract: This essay explores and contrasts the fight for women's rights in Chile and Guatemala. It includes the struggles with gender equality past and present, and the strides each country has made. This essay was written in the spring of 2010 as part of the requirements for a Latin American History and Civilization class.

En todos los países de Latinoamérica existe una sociedad extremadamente patriarcal que trata de limitar el papel de la mujer. Especialmente la sociedad quiere asegurarse que la mujeres se encarguen de las responsabilidades de la casa, es decir cocinar, limpiar y cuidar de los niños, mientras que las responsabilidades que son parte del trabajo y ganar dinero se reservan a los hombres. En algunos de los países, las mujeres han hecho avances en las áreas de política, educación y el trabajo, pero la igualdad no se ha logrado completamente. En otros países, las mujeres tienen poco poder en sus sociedades. Este trabajo de investigación tratará sobre las diferencias del proceso de afirmación femenina en Chile y Guatemala, los avances de las mujeres en estos países, y los problemas que aún se deben resolver para crear sociedades más justas.

Chile es uno de los países económicamente más exitosos en Latinoamérica. Sin embargo, las mujeres no se consideran iguales a los hombres en esta sociedad y no tienen muchos derechos (Van Gelderen i). Asombrosamente, las mujeres chilenas fueron muy avanzadas a fines del siglo XIX y el comienzo del siglo XX. El acceso a la educación universitaria para las mujeres latinoamericanas comenzó en Chile. Eloísa Díaz Inzunza recibió su título de médica en 1886 y, en 1887, ella fue la primera mujer chilena en obtener un título profesional. Para los años 20, 49 chilenas habían obtenido títulos médicos, 155 en odontología, y 130 en farmacia. Estos números fueron muy significantes durante esa época y motivaron a otros países a que empezaran la educación de las mujeres (Miller 48-51).

De 1973 hasta 1990, Chile estuvo bajo la dictadura militar del General Augusto Pinochet (Van Gelderen 1). Durante el gobierno de Pinochet, la política oficial limitaba el papel de la mujer a ser madre

y educadora, y si una mujer no aceptaba su papel se decía que rechazaba su identidad femenina. Es común en regímenes totalitarios equiparar la condición de la mujer con la maternidad (Miller 211). Esta idea deriva de las creencias del catolicismo también, y la mayoría de los chilenos son católicos. En los años 80 surgió un movimiento feminista en oposición al gobierno y en apoyo de la emancipación de las mujeres. El eslogan del movimiento era “Democracia en las calles y en el hogar”. Este movimiento desafió el poder patriarcal en la sociedad y la familia (Power 1).

En 2006, Michelle Bachelet fue elegida presidente de Chile. Ella representó el progreso de las mujeres en Chile. Bachelet fue la primera mujer electa presidente en Latinoamérica sin ser la viuda o esposa de una figura política prominente (Buckman 105). El objetivo más importante de Bachelet fue establecer la igualdad entre hombres y mujeres y promover justicia (Van Gelderen 1-2). Ella designó a mujeres a ocupar la mitad del Consejo de Ministros y presentó legislación que ordenó a todos los partidos políticos a elegir un 30% de mujeres en sus congresos (Buckman 105). Su gobierno también creó las leyes que aumentaron el cuidado y protección de las mujeres de bajos ingresos (Van Gelderen 2).

Hoy en día un 46.7 por ciento de las mujeres chilenas trabajan fuera del hogar. Este porcentaje es alto para Chile, pero bajo en comparación a otros países. Algunos estudiantes universitarios chilenos ahora estudian estos problemas de la desigualdad. El gobierno de concertación creó el Servicio Nacional de la Mujer (SERNAM), en el que la directora tiene un rango ministerial. De esta manera, con la ayuda de SERNAM, el gobierno se aseguró que la igualdad legal para las mujeres y los hombres estuviera respaldada por la Constitución (Power 1).

Aunque las mujeres chilenas han hecho algunos avances, todavía tienen mucho por delante. Por ejemplo, hay mucha discriminación en las oportunidades de empleos y las condiciones del trabajo son peores para las mujeres. Las mujeres reciben salarios significativamente menores que los hombres y ellas trabajan más horas. También, por lo general ellas son empleadas por tiempo parcial y no tienen contratos. En el lugar de trabajo, las mujeres no tienen protecciones contra los malos efectos del sol o productos químicos, y no se les permite comer o ir al baño por suficiente tiempo (Van Gelderen 3-4).



A diferencia de Chile, Guatemala es un país donde la mayoría es indígena o descendientes de los mayas. Debido a que la mayoría de los mayas viven en la pobreza y sufren más exclusión social, económica, política y cultural, es aun más difícil para las mujeres mayas obtener los derechos de igualdad en su sociedad. Desde que los conquistadores españoles llegaron a Guatemala en el siglo XVI, los mayas han sufrido periódicamente mucha discriminación, marginación y genocidio (Minority Rights Group International). Por ejemplo, hay mucha violencia hacia las mujeres guatemaltecas que investigadores norteamericanos han dado a llamar “femicides”, y como resultado de esta violencia muchas mujeres son asesinadas y los que cometen estos crímenes no sufren consecuencias. En 2005, se asesinaron 665 mujeres. Un “femicide” se caracteriza por el asesinato de mujeres solamente en base a su género y, frecuentemente, incluye la violación, la tortura y la mutilación (Center for Gender and Refugee Studies 8-9).

La inestabilidad en Guatemala duró hasta que el gobierno guatemalteco y la Unidad Revolucionaria Nacional Guatemalteca (URNG) firmaron acuerdos de paz en 1996. Estos acuerdos incluyen protecciones a los derechos humanos, desmilitarización, temas de justicia, los refugiados y las personas desplazadas, y los derechos indígenas. Además de esto, en 1996 se estableció una oficina para la defensa de los derechos mujeres indígenas (Minority Rights Group International). También, hubo un acuerdo para hacer frente a las desigualdades en base al género. En 2002 pasó una ley que reserva asientos para las mujeres en los Consejos a nivel municipal, provincial, regional y nacional. Estos acuerdos crearon el marco para el futuro de Guatemala, especialmente en el área de la igualdad entre hombres y mujeres (Women Fight for an Equal Voice 1).

Un ejemplo de una mujer muy fuerte en la lucha por los derechos indígenas en Guatemala es Rigoberta Menchú. Ella ganó el premio Nobel de la Paz en 1992 por sus esfuerzos como activista política para los derechos nativos y por ser autora de su autobiografía “I, Rigoberta Menchú” en 1982. Ella nació en un pueblo pequeño de Guatemala, llamado Chimel. La guerra civil guatemalteca ocurrió durante su vida temprana y ella perdió mucha de su familia. Menchú huyó a México y luego a Francia donde ella se expresó en contra de las injusticias que existían en Guatemala. Menchú es un símbolo importante para las

mujeres guatemaltecas porque defiende sus creencias aunque sea muy peligroso y no se define sólo por ser mujer (Minster 1).

Los estereotipos basados en el sexo del individuo, el acceso inadecuado a la educación e información, y la violencia dirigida a las mujeres siguen siendo problemas para las guatemaltecas (Women Fight for an Equal Voice 2). Según Ana García, en el área rural, se concentran los mayores niveles de analfabetismo ya que un 56 por ciento; de ocho niñas mayas que ingresan a la escuela sólo una termina su primaria. Es más, los libros, materiales educativos y las clases están fuertemente influenciadas por estereotipos sexistas (Ana García 1). Sin una educación adecuada, es muy difícil obtener un trabajo. Debido a esto, el trabajo de las mujeres se limita solamente a la casa.

En conclusión, las luchas de las mujeres chilenas y guatemaltecas son similares pero las chilenas han hecho más avances en el área de los derechos de las mujeres. En parte esto se debe a que las guatemaltecas deben luchar con los prejuicios contra los indígenas y en una sociedad marcadamente patriarcal. El factor más importante que separa el desafío en Chile y Guatemala es la proporción más grande de los indígenas en Guatemala comparado con Chile. En estos países, hay muchas organizaciones, como Oxfam y a Naciones Unidas, que trabajan para mejorar las vidas de las mujeres. Sin embargo, la contribución y el lugar de la mujer todavía son muy devaluados. El desafío feminista sigue en curso, pero no busca hacer a las mujeres mejores que los hombres sino obtener la igualdad con los hombres en una sociedad que todavía es injusta y no les da el lugar de respeto humano que las mujeres se merecen. Es importante que esta lucha continúe hasta lograr la igualdad entre los hombres y las mujeres. Pienso que la educación de todos los niños es importante para conseguir la igualdad entre los hombres y las mujeres. La lucha por la igualdad comienza con la educación ya que si las mujeres son iguales en las escuelas, ellas lograrán así obtener respeto y más tarde podrán tener el mismo acceso a las oportunidades de trabajo.

#### Bibliografía

Buckman, Robert T. *Latin America*, 2008. Harpers Ferry, W. Va.: Stryker-Post Publications, 2008. Print.

- García Ramos, Ana. "Situación de la mujer guatemalteca." *PeaceWomen.org*. Nov. 2002. Web. 10 Apr. 2010.
- Miller, Francesca. *Latin American Women and the Search for Social Justice*. Hanover: University of New England, 1991. Print.
- Minster, Christopher. "Biography of Rigoberta Menchu." *About.com*. Web. 13 Apr. 2010.
- Power, Margaret. "Gender and Chile's Split Culture: Continuing Contradictions in Women's Lives." *David Rockefeller Center for Latin American Studies*. 2004. Web. 11 Apr. 2010.
- Van Gelderen, Michael. "Fighting for Women's Rights in Chile : Supporting Women Workers and Promoting Women's Political Participation." *Oxfam.org*. Mar. 2008. Web. 11 Apr. 2010.
- "Guatemala's Femicides and the Ongoing Struggle for Women's Human Rights." *Center for Gender and Refugee Studies*. Sept. 2006. Web. 13 Apr. 2010.
- Minority Rights Group International, *World Directory of Minorities and Indigenous Peoples-- Guatemala: Overview*. July 2008. Web. 10 Apr. 2010.
- "Women Fight for an Equal Voice." *UN.org*. DPI, OSAGI. Oct. 2004. Web. 10 Apr. 2010.

**“Un autorretrato del reinado falso: La pasión ilícita de los Reyes Católicos por la unificación religiosa de España”**

Author: Benjamin Ferguson

Faculty Sponsor: Cynthia Halpern, Ph.D.

Abstract: *La Celestina* by Fernando de Rojas was written during the Middle Ages in Spain under the administration of the Catholic Kings, Ferdinand and Isabel. One of the major goals of this administration was to enhance the orthodoxy of Roman Catholicism in Spain and, to that end, the Spanish Inquisition was formed. Fernando de Rojas came from a *converso* family, one of Jewish descent who, in order to remain in Spain, converted to Christianity. This literary analysis attempts to bring to light that Fernando de Rojas relied on characterization throughout his work in order to reflect legitimate and significant people of the Spanish Inquisition.

Los Reyes Católicos, Fernando e Isabela, esperaban que España se uniera bajo la religión católica; la religión verdadera según los Reyes. La Inquisición empezó en el siglo XV con la meta de convertir a los judíos al catolicismo. Entre los miles de conversos estaba el autor de ascendencia judía Fernando de Rojas que escribió la obra *La Celestina*. Al convertirse al catolicismo, Rojas rechazó las ideas de la iglesia y de un país totalmente católico y también perdió su fe en Dios. El escepticismo y desaprobarción de Fernando de Rojas hacia los católicos se reflejan en *La Celestina* a través de los personajes principales; Calisto representa a los Reyes Católicos, la Celestina representa a la Inquisición y Tomás de Torquemada, el Inquisidor general que vigila la pureza de la fe católica de esta época. La pasión de los Reyes de unir a España bajo el catolicismo se refleja en la obra de Fernando de Rojas.

La pasión o la obsesión de una persona con algo la empuja a lograr su meta. Por ejemplo, Calisto, con su corazón lleno de pasión ardiente, desea el amor de Melibea y él desarrolla un plan para ganar su amor. De la misma manera, los Reyes Católicos tenían la obsesión de unir al país bajo una religión y por eso ellos forzaron la conversión de los judíos al catolicismo. A los que rechazaban su plan se los expulsaban, torturaban o mataban.

En el primer acto, Calisto sigue cortejando a Melibea con frases dulces que ganaría el corazón de cualquier otra mujer: frases como, ‘En esto veo, Melibea, la grandeza de Dios’ (Mujica 60) o ‘[S]i Dios me diese en el cielo la silla sobre sus santos, no lo tendría por tanta felicidad’ (Mujica 60). A pesar de la adoración de Calisto, ella niega su deseo y como consecuencia Calisto quiere pagar a una intermediaria para ayudarlo con su noviazgo; él no va a aceptar un rechazo y paga a Celestina para quitar el dolor que siente hacia Melibea.

De la misma forma que muchos artistas, como Velázquez, usan un espejo para pintar su autorretrato, Fernando de Rojas también se miraba en un espejo; un espejo que hace reflejar la época en sus obras. Sin embargo, en realidad eran los Reyes Católicos que querían la unidad de su país bajo una religión. Los Reyes siguieron forzando la conversión de muchos judíos españoles, con la ayuda del Inquisidor general Tomás de Torquemada. Según Rojas, en su obra el Inquisidor se representa por la alcahueta; la persona que hace el esfuerzo sucio de la Inquisición.

Después de unos pocos esfuerzos fracasados de Calisto de tratar de cortejar a Melibea, él consigue la ayuda de la Celestina. Celestina tiene gran fama de ser una persona con muchas profesiones que ayuda a los jóvenes a conseguir la atención de una mujer. Uno de los criados de Calisto, Pármeneo, le dice que ella es una ‘labradora, perfumera, maestra de hacer afeites y de hacer virgos, alcahueta y un poquito hechicera’ (Mujica 64). Examinando detalladamente sus profesiones, se nota que éstas son profesiones falsas; profesiones para atraer un amor ilícito. En el fondo de la fachada de la Celestina, Pármeneo sigue revelando la Celestina verdadera. Según él, ella tiene las posesiones de una bruja: ‘huesos de corazón de ciervo, lengua de víbora, cabezas de codornices’ (Mujica, 65) y más. Después de conocerla, Melibea ve inmediatamente la fachada falsa de ella y grita ‘¡Quemada seas, alcahueta falsa, hechicera, enemiga de honestidad, causadora de secretos yerros!’ (Mujica 71) A pesar de todas las advertencias de los criados de Calisto y el rechazo de Melibea, la Celestina por fin gana los deseos de Calisto. Contra sus mejores esfuerzos, Melibea empieza a enamorarse de Calisto y se involucra en un amor ilícito y apasionado.

Con la ganancia de la alcahueta, el patrón de la Inquisición ganó también. Tomás de Torquemada trataba de persuadir a los judíos que el catolicismo era la religión ideal y la única religión que llevaba a la salvación religiosa. Como la Celestina, Torquemada desarrollaba una fachada falsa de superioridad. Ciertamente muchos de los conversos veían la fachada falsa de Torquemada y de los Reyes también, como los criados Sempronio y Pármeneo ven el aspecto falso de la Celestina.

Como Melibea en la obra, al principio, los conversos rechazaban el esfuerzo de convertirse. El proceso de Melibea cayendo en un amor ilícito es muy despacio. Inicialmente no quiere hablar con la Celestina diciendo que ella, Melibea, es una mujer y de una familia con mucho honor. Le pregunta a la Celestina si debe sacrificarse para dar felicidad a Calisto; ‘¿Querrías condenar mi honestidad por dar vida a un loco?’ ‘Perder y destruir la casa y la honra de mi padre por ganar la de una vieja maldita como tú?’ (Mujica 71) Por fin, se ve su impaciencia cuando Melibea le pregunta a Celestina: ‘¿Y qué tanto tiempo ha?’ (Mujica 73) [¿Cómo está Calisto?]. Melibea se ve convertida por Celestina y ahora quiere rendirse a Calisto. Es seguro suponer que los judíos demostraban preocupaciones antes de convertirse también. Sin embargo, después de mucha persuasión, muchos de los judíos, incluyendo la familia de Fernando de Rojas, se convirtieron al catolicismo. Desafortunadamente, muchos de los judíos que siguieron rechazando la fe católica fueron torturados y asesinados.

No es solamente por los libros de historia que sabemos que los Reyes Católicos tuvieron éxito en unificar el país; también sabemos de su éxito por la obra de Rojas. En su obra Calisto y Melibea se atraían para celebrar un amor ilícito por la ayuda de la Celestina. Ambos éxitos, el de Calisto y el de los Reyes, tuvieron la ayuda de una alcahueta, ya que los Reyes contaban con la ayuda de Torquemada. A través de su obra *La Celestina*, Fernando de Rojas pudo expresar sus ideas verdaderas sobre la Iglesia y sus esfuerzos de lograr un país totalmente católico a través de sus personajes ficticios: un autor converso escribió un autorretrato de una época y de un reinado falso movido por la pasión ilícita de los Reyes de lograr la unificación religiosa de España.

Referencia

Rojas, Fernando de. "La Celestina." Compiled by Bárbara Mujica. *Texto y vida: Introducción a la literatura española*. New York: John Wiley and Sons, Inc., 2002. 60-86. Print.

***Through Sacrifice Comes Rebirth:  
Understanding that for Everything There is a Season  
in William Peter Blatty's The Exorcist***

Author: Cathy Matta

Faculty Mentor: Leonard Primiano, Ph.D.

As a novice to the study of both humanities and sciences, I am earnestly attentive to any concept assisting in my understanding of the two. The logic of a rising and setting sun appeals to me just as much as the fact that people throughout history have structured their days according to this natural feature. So when author William Peter Blatty, in his novel *the Exorcist*, offers a cyclical model for human existence, my attention is instantly and firmly seized. The book, which I read as part of my first year Honors Seminar, "The Search for Meaning," is about a young girl, Regan MacNeil, who suddenly develops an array of symptoms, leading her mother, Chris MacNeil, to believe her daughter is either mentally sick or possessed by demonic spirits. She calls in the help of Father Damien Karras, a Jesuit priest and psychiatrist, who aids another priest, Father Lancaster Merrin, in performing an exorcism on Regan. When the exorcism is approved by the Catholic bishop, the character Chris MacNeil comes across a book written by Father Merrin in which the priest gives a detailed account of the equilibrium inherently existent in human life. Essentially, he states that while life is composed of many transitory stages and events, every moment is pieced together to create an inescapable ebb and flow of human interactions, where good leads to bad, and misery stems from joy.

*The Exorcist* distinctively follows this naturally occurring curve of life, proving Father Merrin's ideal of an accurate and functional model for analyzing human existence. In order to understand the paradoxical relationship between the positive and negative experiences and emotions of the characters, Blatty presents their pleasures and failings, proving that through sacrifice comes rebirth. The quote from Father Merrin's book, "The day is swallowed up in the gloom of night, to be born out of it, as fresh as if it had never been quenched," concisely states what I mean when I say that through sacrifice comes rebirth.



Only when it seems all is lost can we rise triumphantly from the ashes, and conquer our failings, as, for example, Christians believe Jesus Christ did for all of humanity through his death and Resurrection. Each character in *The Exorcist* mirrors this important relationship between loss and renewed life, as each one experiences peace and rejuvenation out of painful or ill times. Chris MacNeil goes through her own personal hell when attempting to help her daughter, but at the end of the ordeal is given her new start. Father Dyer and Detective Kinderman also get a chance for happiness, as they pick up the pieces of their battered existence after a heart wrenching calamity within the book. And finally, Father Karras, through the “treatment” of Regan, ultimately shows what it means to illuminate an event of utter darkness.

The life of character Chris, as developed in the novel, is the most apparent example of Father Merrin’s view that essentially life is a wavering path of events. The book begins with this young actress preparing to perform in a horribly written scene. She leads a migratory life, living out of rented houses in different towns. Her thoughts allude to feelings of dissatisfaction with her life, asking herself, “Dammit, why don’t I stay? Buy the house? Start to live!” (18) Later on in the book, Chris is dealt some luck when she receives a letter from her agent, presenting her with the opportunity to direct a segment of an upcoming movie entitled *Hope* (28). Chris has always wanted to direct, and it seems that the opportunity has finally arisen. Unfortunately for Chris, shortly after receiving the letter, her daughter Regan begins behaving very out of character, indicating some form of illness. Regan’s demeanor has changed drastically, climaxing in her urinating on the carpet during her mother’s dinner party (83). Completely mortified, Chris realizes she must direct all her focus on her ailing daughter, and not on her dream of directing. This event begins a long period of sleepless nights and desperate pleas where Chris attempts to get Regan proper help and healing; the exorcism that ensues becomes the central focus of the book’s concluding chapters. While any average person would succumb to deep depression at the thought of a deeply afflicted child, in Chris’ situation Father Merrin’s passage serves as the light at the end of a tunnel and assists her in extrapolating meaning from this experience. While night may seem to “swallow up” day, morning allows for the day to begin again, “as if it had never been quenched.” The book concludes with Regan restored to her original self, the young cheerful girl her mother had feared was lost. The

challenging events of Chris' life as seen in *The Exorcist*, while taxing at times, are balanced out by the enormous joy of a daughter renewed. This motif of joy balancing out disappointment appears constantly throughout the novel.

Another balancing act of misfortune and pleasure can be viewed in a pair of interesting characters found in *The Exorcist*: Detective Kinderman and Jesuit priest Father Dyer. Although relatively minor characters, together they reveal every person's chance at renewal, and a chance to start over and begin life anew. Kinderman appears as a peculiar and worrisome man, who seems to be suffering from emphysema. Throughout the book, he alludes to his life full of sickness and loss. Father Dyer, dean of Georgetown University, is depicted as a jovial and wise man, as he consoles and advises other Jesuit priests. The disturbing death of Father Dyer's good friend Father Karras, who dies while assisting Father Merrin perform the exorcism of Regan, shatters the happy disposition of Father Dyer and adds yet another mysterious and evasive case to Detective Kinderman's career when he again is at a loss for the cause of death. Yet in spite of the grief and woe these characters are faced with, hope still arises. In Father Merrin's words, life "is bound together by a law of permanence, and though it is ever dying, it is every coming to life again" (325). The final scene of *The Exorcist* focuses in on these two characters, finding comfort in one another, developing a friendship when one is most needed, a place where hope and recovery can bloom. Again, balance is established, matching loss with companionship.

The final, most profound fluctuating system of events I would like to discuss is the life of character Father Karras, as I believe his life exemplifies a system of events where sacrifice is clearly seen as a tunnel to rebirth. As first encountered in the second chapter of *The Exorcist*, Father Karras leaves the impression of a despondent and pained man, wishing life had not left him unhappy and regretful (50-55). Through the course of the novel, Father Karras is faced with the death of his mother, an event which plagues him with guilt. When Chris approaches him, asking for his assistance in curing Regan, Father Karras agrees out of a sense of suffocating duty, another dissatisfying aspect of his life. For the remainder of the novel, Father Karras dedicates himself to Regan's cause, working non-stop. In working with Father Merrin to perform the exorcism, Father Karras witnesses a beautiful testimony to a simple

and sincere faith. They speak of doubts, despair, their efforts as priests, and Father Merrin's belief that good can be found in any situation. He says, "In some way...even Satan – Satan, in spite of himself – somehow serves to work out the will of God" (353). Father Merrin dies while fighting for his beliefs, seeking to release the evil from the poor innocent Regan. This death enrages Father Karras, and in his final act on this earth, in all anguish, he accosts the demon, demanding of it, "Try *me!* Leave the girl and take me! Take *me!*" (371) Upon a first glance, it would seem Father Karras did not follow Father Merrin's spoken of model of an equilibrium of life's faults and peaks, as his life has been plagued with misery. The scene to follow, however, suggests otherwise. His old friend Father Dyer approaches Father Karras' body, cut and bruised from the long fall from the window of Regan's room. The description is as follows:

"Karras lay crumpled and twisted, on his back, with his head in the center of a growing pool of blood...[Dyer] saw the eyes filled with peace; and with something else: something mysteriously like joy at the end of heart's longing."  
(373-374)

With death came Father Karras' contentment; his life concluded with symmetry, as the joy he felt at death balanced the suffering and pain he felt during his life. With the description of Father Karras' countenance, the reader is shown that his ultimate sacrifice allowed for happiness, fulfillment, and rebirth.

Father Merrin's contention about existence serves to elucidate an internal meaning which is expounded continuously throughout *The Exorcist* in the characters' personalities and actions. Life is an acute juxtaposition of happiness and misery, hopes and fears. The cycle refuses to end, even in death, as "one death is the parent of a thousand lives" (326). Laughing extends to crying, silence is replaced with sound, and war leads to peace. The characters I have described certainly have had their fair share of emotions, experiences, and beliefs; yet simply put, these elements are part of the human condition. The final lines of Father Merrin's passage are as follows:

"We mourn the blossoms of May because they are to wither; but we know that May is one day to have its revenge upon November by the revolution of that

solemn circle which never stops – which teaches us in our height of hope, ever to be sober, and in our depth of desolation, never to despair” (326)

Life is to be lived: the bad must be endured and the good must be appreciated, because one does not come without the other. This thought allows for hope that good can come out of any distressing situation, even when all seems to be lost. Life will always move forward, towards a better and brighter future. That “solemn circle” will continue to rotate, and the words of Father Merrin will ring in my ears like a bell summoning me to begin anew: “in our depth of desolation, never to despair.”

#### Bibliography

Blatty, William Peter. *The Exorcist*. New York: Harper & Row, 1971. Print.

*The Catholic Youth Bible New American Bible*. St Marys Pr, 2008. Print.

### “El Perspectivismo en *La Celestina*”

Author: Elena Brown

Faculty Mentor: Cynthia Halpern, Ph.D.

Abstract: *La Celestina*, written by Fernando de Rojas, helped direct the focus of Spanish literature during the Renaissance to a new emphasis in psychology. Rojas presented variations in human psychology in his work by using the literary technique of perspectivism. Through three principal characters, he offered the reader diverse perspectives on the theme of love.

Antes del Renacimiento, no había énfasis en la literatura ni en el individuo ni en la psicología. Con la aparición de *La Celestina*, sin embargo, hubo un cambio literario radical porque la obra empieza a demostrar aspectos del humanismo y la psicología. Por esta razón, *La Celestina*, escrita por Fernando de Rojas, se considera precursora de la literatura moderna. Uno de los enfoques nuevos y psicológicos del cuento es la presencia del perspectivismo. El perspectivismo ofrece la oportunidad de ver algunos puntos de vista diferentes de los personajes de *La Celestina*. Rojas usa el perspectivismo de sus personajes Calisto, Celestina, y Pleberio para revelar los puntos de vista distintos sobre el tema del amor.

En la primera parte de *La Celestina*, Rojas introduce la perspectiva de Calisto sobre el amor: una perspectiva que ve el amor como una idealización. Cuando Calisto se encuentra con Melibea en un jardín por primera vez, él se enamora de ella inmediatamente. Desde su perspectiva, él quiere a Melibea, y su última meta es conocerla y poseerla. Desafortunadamente para Calisto, ella lo rechaza, y lo deja con un deseo inalcanzable para ella. Aunque ella no muestra interés en él, Calisto todavía idealiza a Melibea sin saber mucho de su personalidad y carácter. Calisto le pide consejos a su criado, Sempronio, sobre el amor no correspondido de Melibea. Cuando está explicando su situación a Sempronio, Calisto admite que ahora es “Melibeo” — a Melibea adora, en Melibea cree, y a Melibea ama. Calisto la idealiza a ella hasta el punto que ella es su religión y su diosa. Sempronio y otro sirviente, Pármeneo, están de acuerdo que Calisto está perdido y totalmente enamorado de su diosa, Melibea. Pármeneo dice: “Deshecho es, vencido es, caído es: no es capaz de ninguna rendición ni consejo ni esfuerzo” (Mujica 66). Calisto no puede ver la realidad y la razón en este momento. Esta perspectiva de amor presentada por Rojas a través de Calisto

no es racional ni lógica. Su perspectiva es una de idealización y obsesión que se distingue mucho de las perspectivas de otros personajes en *La Celestina*.

Otro personaje de *La Celestina* que ofrece una perspectiva diferente sobre el amor es Celestina. Celestina es una alcahueta que funciona como una intercesora entre dos personas que buscan una relación ilícita que, en este caso, son Calisto y Melibea. Sempronio le aconseja a Calisto que busque los servicios de Celestina para juntarse con Melibea. Con este trabajo de Celestina como alcahueta sirviendo a Calisto, se revela su perspectiva sobre el amor. Para Celestina, el amor es una condición mental que puede ser manipulada. Con su inteligencia y astucia sobre el amor, Celestina engaña y manipula a Melibea para que ella se enamore de Calisto. La vieja convence a Melibea que ella necesita asistir a Calisto porque él está enfermo. Si Melibea lo cura y actúa como su remedio, podría servir a Dios. Ella dice, “Que en alguna manera es aliviado mi corazón viendo que es obra pía y santa sanar los pasionados y enfermos” (Mujica 73). Entonces, Celestina la persuade a creer que ella debe ayudar a Calisto, y ahora Melibea tiene interés en él. Celestina manipula a Melibea y sirve a Calisto para ganar recompensa de él, un noble rico; no lo hace por la belleza ni por la bondad del amor. Celestina solamente ve la manipulación del amor entre los jóvenes como un trabajo provechoso.

Rojas usa el perspectivismo otra vez en el lamento final de Pleberio, el padre de Melibea. Después del suicidio de su hija, Pleberio declara su opinión negativa sobre el amor. Pleberio dice que como habían pasado unos cuarenta años y tiene su “conyugal compañera,” pensaba que el amor no podía afectarlo una vez más. En este día, sin embargo, su hija se murió por la pérdida de Calisto, y ahora Pleberio lamenta que el amor sea poderoso y cruel todavía. Pleberio dice, “¡Oh amor, amor! ¡Que no pensé que tenías fuerza ni poder de matar a sus sujetos!” (Mujica 85). Se da cuenta que el amor es un poder fuerte y grande que posee la oportunidad de matar a los amantes inocentes. Por esta razón, Pleberio afirma que el mundo le parece “un laberinto de errores, un desierto espantable, una morada de fieras, juego de hombres que andan en corro, laguna llena de cieno, región llena de espinas, monte alto, campo pedregoso, prado lleno de serpientes, huerto florido y sin fruto...” (Mujica 85). En este mundo que ha pintado, Pleberio no tiene mucha esperanza. Piensa que el amor en el mundo es algo falso que sirve para

engañar a sus sujetos. Pleberio adquiere una perspectiva negativa y desesperada sobre el amor que él describe como malo e influyente.

Con la utilización de la técnica del perspectivismo, Fernando de Rojas ha creado una obra que presenta opiniones vastas y diferentes sobre la misma condición, el amor. La primera perspectiva que demuestra a los lectores es la de Calisto. Calisto expresa su amor hacia Melibea como una idealización fuerte. Otra perspectiva que difiere mucho del punto de vista de Calisto es la de Celestina. Celestina usa el amor para ganar recompensa para ella misma. Ella no ve el amor como un sentimiento puro entre dos personas porque ella solamente quiere manipular el amor para su provecho personal. Finalmente, Pleberio mira el amor como un veneno poderoso que daña a los amantes inocentes. A él no le parece que el amor exista para beneficiar a nadie sino una manera para hacer víctimas a las personas sin sospechas. Con estas tres perspectivas sobre el amor, Rojas produce evidencia que el mismo tema puede tener puntos de vista contrarios por la técnica literaria del perspectivismo.

#### Referencia

Rojas, Fernando de. "La Celestina." Compiled by Bárbara Mujica. *Texto y vida: Introducción a la literatura española*. New York: John Wiley and Sons, Inc., 2002. 60-86. Print.

“Los dos amores de Juan Ruiz, el Arcipreste de Hita”

Katie Cruz

Faculty Mentor: Cynthia Halpern, Ph.D.

Abstract: “El libro del buen amor”, written by Juan Ruiz El Arcipreste de Hita, in the Spain of the fourteenth-century makes a notable distinction between two types of love, “divine” love and “illicit human” love. In his work, Juan Ruiz attempts to underscore the difference between these two forms of love, using religious references to highlight divine love and real-life references to highlight illicit love. This literary analysis demonstrates the symbiotic relationship of these kinds of love and attempts to explain the ever-present struggle to recognize the dangers of human passion and the glory of divine love.

En “El libro del buen amor” son notables las dos distinciones que hace Juan Ruiz, el Arcipreste de Hita, en referencia al amor para darle a entender al lector los dos tipos de amor que existen y dominan a todo el mundo. El Arcipreste de Hita, Juan Ruiz, es el autor de la obra y trata de darle a entender al lector los dos tipos de amor que existen en el mundo, los amores que dominan a todo el mundo. Los dos amores que el Arcipreste trata de explicar son el amor divino, y el amor ilícito. En su obra, el autor separa los dos amores y trata de ilustrar la importancia de cada uno de ellos usando diferentes métodos de escritura para referirse a cada uno. Para el amor divino, usa una forma más formal, como un rezo para describir la gloria de este amor. Para el amor ilícito, Juan Ruiz usa una forma más informal, usa historias, metáforas y alegorías para describir este amor. El Arcipreste habla sobre los dos amores porque representan dos diferentes sentimientos emocionales de todos los seres humanos. El amor divino y el amor ilícito en “El libro del buen amor” es un ejemplo de la batalla entre dos aspectos diferentes del amor que todo el mundo tiene. Es la batalla contra lo que quiere el cuerpo y lo que quiere el alma y por eso “El libro del buen amor” no se refiere a un solo tipo de amor sino a los dos amores, como el buen amor.

Juan Ruiz comienza su obra hablando sobre el amor divino y la necesidad que él tiene de esta clase de amor. Cuando el autor dice: “ Dios Padre, Dios Hijo, Dios Espíritu Santo/El que nació de Virgen esfuerzo nos dé, tanto/Que siempre lo loemos en prosa como en canto;/Sea de nuestras almas la cobertura y manto” (Mujica 43). En esta estrofa, Juan Ruiz está diciendo que Dios siempre le da fuerza a todo ser



humano de alabarlo en cualquier forma sea en una obra literaria o en un canto glorioso. Es como su manera de pedirle a Dios que le ayude a poder escribir una obra que inspire a la gente y que a la vez halague a Dios por su bondad. Juan Ruiz está demostrándole al lector que Dios y el amor a Dios es algo necesario en la vida. Con la línea “que siempre lo leemos en prosa como en canto; sea de nuestras almas la cobertura y manto” (Mujica 43) está refiriéndose a que todos deben de siempre alabar a Dios en cualquier forma para que él pueda ser el alivio que se siente en el alma, el sentimiento de tranquilidad y felicidad son causas del amor a Dios. No sólo en esta línea se nota su necesidad por la inspiración de Dios sino que es un tema recurrente en esta obra.

En otra estrofa, Juan Ruiz dice que la creencia y el amor hacia Dios es una clase de amor que tiene una parte importante en la vida de mucha gente. “Si quisieres, señores, oír un buen solaz,/escuchad el romance; sosegaos en paz/no diré una mentira en cuanto dentro yaz:/todo es como en el mundo se acostumbra y se haz “(Mujica 43). En esta estrofa, Juan Ruiz trata de decir que en su obra él no ha escrito nada falso, nada que no ocurra en la vida de cada persona. Él menciona que el lector si quiere puede leer sobre el amor ilícito pero también sobre la paz del alma, lo cual se refiere a las dos clases de amor que se mencionan en la obra. Los dos amores; el amor a Dios y el amor ilícito, son temas que la gente trata de entender mejor. Esta obra le puede ayudar a alguien a entender mejor los dos amores que son comunes en la vida de todos. En toda la primera parte de la obra, el Arcipreste alaba a Dios y habla sobre la paz que el amor de Dios inspira. Después, continúa describiendo los Gozos de Santa María como manera de rezarle a ella que interceda ante Dios para que Dios lo ilumine a él a escribir su obra. Después de los Gozos de Santa María, Juan Ruiz comienza a hablar sobre el amor ilícito. Juan Ruiz explica que el amor ilícito es un instinto humano pero a la misma vez no es algo aceptable en la sociedad.

El amor ilícito, según Juan Ruiz, es algo que forma parte de todos los seres humanos. Es otro aspecto de la vida que causa conflicto porque es algo que no es muy aceptado en la sociedad. El amor ilícito tiene aspectos que son contrarios a los valores de la Iglesia y por eso es muy difícil aceptar el amor divino cuando se practica el amor ilícito o el amor ilícito si ya se tiene el amor divino. Juan Ruiz ofrece la teoría que toda persona vive con los dos amores si los acepta o no. En la estrofa que dice: “Que dice

verdad el sabio claramente se prueba;/Hombres, aves y bestias, todo animal de cueva/desea, por natura, siempre compañía nueva/y mucho más el hombre que otro ser que se mueva (Mujica 45). El autor está aceptando que es instinto humano desear a otro ser, es algo que todo animal hace. Pero, en contraste con el animal, el ser humano es el que desea más los placeres de tener a otro ser con él/ella. Este placer es un aspecto del amor ilícito. En otra estrofa Juan Ruiz dice como todos los otros animales sólo se juntan para tener relaciones sexuales con el propósito de procrear pero el ser humano es el único que en todo tiempo, siempre quiere tener ese placer sin moderación. El autor se refiere al acto constante del hombre de tener relaciones sexuales como locura. La razón por la que se refiere al sexo constante como locura es porque el deseo de tener a alguien, sin importarle nada de la persona sólo el cuerpo y el acto sexual, es algo no aceptable porque es un pecado. El deseo hacia otra persona es parte de todo ser humano, pero el acto de entregarse a estos deseos es el pecado que causa dilema entre el amor ilícito y el amor divino.

Con la historia de doña Endrina y don Melón, se puede notar el amor ilícito entre los dos y la causa de entregarse a este amor. Cuenta don Melón en la primera estrofa “Aleje la tristeza, el anhelo engañoso,/ busqué y encontré dama de que era deseoso” (Mujica 45). En esta forma Juan Ruiz enseña al lector que el amor que supuestamente don Melón sentía por doña Endrina solamente era un deseo sexual que él tenía por ella. Cuando por fin don Melón logra conquistar a doña Endrina y se entregan el uno al otro, doña Endrina siente vergüenza y se arrepiente de haberlo hecho. Sus valores morales son la causa de su sentimiento de culpa, y decide casarse para evitar vergüenza en frente de la sociedad que no acepta el amor ilícito.

Juan Ruíz demuestra dos aspectos muy diferentes del amor en una sola obra. La razón por la que él crea una obra ambigua, en la cual no se sabe cuál amor es el amor correcto, es tal vez para presentarles diferentes aspectos de amor al público. Tal vez mucha gente no crea en el amor divino y en la obra, Juan Ruíz habla sobre la importancia del amor divino. O tal vez mucha gente no crea en el amor ilícito, y en la obra Juan Ruíz habla sobre la naturaleza de esta clase de amor. Juan Ruíz no distingue cuál amor es correcto sino que lo deja al lector que lo interprete por sí mismo. La intención de este libro es presentarle al público dos tipos de amor que coexisten en el mundo y los conflictos que estos dos amores causan en

toda persona. El amor divino y amor ilícito son dos aspectos diferentes del amor y la confusión causada en cada persona por estos dos amores es lo que trata de recrear Juan Ruiz en su obra. Esta obra confunde al lector porque no se sabe cuál amor es el correcto y cuál amor es el amor verdadero.

En conclusión, el amor divino y el amor ilícito causan mucha ambigüedad en la obra de Juan Ruiz. “El libro del buen amor” se refiere a los dos tipos de amores que se encuentran dentro de cada persona. El Arcipreste ofrece los dos tipos de amor en su obra esperando que el lector escoja el mejor amor entre los dos. El Arcipreste no dice directamente cuál amor es el amor verdadero, eso queda para que lo interprete el lector usando los ejemplos ya mencionados del libro. Aunque el lector puede interpretar a su manera cuál es el amor verdadero entre los dos, el Arcipreste es claro al decir que aunque el amor divino esté presente, el amor ilícito también está presente en todo ser humano y el hombre debe ser consciente de la coexistencia de los dos amores en la vida humana.

#### Referencia

El Arcipreste de Hita. “Libro de buen amor.” Compiled by Bárbara Mujica. *Texto y vida: Introducción a la literatura española*. New York: John Wiley and Sons, Inc., 2002. 43-49. Print.

## **Air Quality Legislation: An Exploration of The Clean Air Act of 1990 and**

### **The Clean Cars Program**

Bryan Churchey

Faculty Sponsor: Shelby Hockenberry, Ph.D.

#### **Abstract**

The purpose of the paper is to provide a detailed timeline and history of the events leading up to the Clean Air Act of 1990 and demonstrate the significance this piece of legislation has had on environmental policy, more generally. One piece of future legislation that was made possible by the Clean Air Act of 1990 was the Clean Cars Program started in California in 2007. The Clean Cars Program's objective is to increase the CAFÉ standards that were set by the CAA of 1990 and to increase future standards set for 2016 and 2020. This paper reviews the policy process from the Clean Air Act of 1970 to the Clean Air Act of 1990 and how the powers of Federal vs. State governments, or federalism, are invoked via the Clean Cars Program. The connection between the Clean Air Act of 1990 and the Clean Cars Program has influenced the future of environmental policy in the United States.

#### **Introduction**

In 1990, The Clean Air Act was passed into law, making amendments to the outdated Clean Air Act of 1970. It made amendments to acid rain control and prohibition of leaded gasoline in motor vehicles by the end of 1995. The bill's focus was on acid rain, though, and offered an innovative way to curb sulfur dioxides (SO<sub>2</sub>) and nitrogen oxides (NO<sub>2</sub>), which are the two main causes of acid rain. However, the Clean Air Act of 1990 was more of an amendment than a new bill in itself. It wouldn't have been possible without the Air Quality Act of 1967 and of course the Clean Air Act of 1970; which was the first

major piece of legislation aimed at curbing pollution and founded the National Ambient Air Quality Standards. In 2007, California, using its authority under the Clean Air Act of 1990, started what it called the Clean Cars Program to cut down air pollution and set tougher C.A.F.E. standards than those set by the Federal government. This paper reviews the policy process from the Clean Air Act of 1970 to the Clean Air Act of 1990 and how the powers of Federal vs. State governments, or federalism, are invoked via the Clean Cars Program.

### **History of the Clean Air Act**

The first clean air act was more or less a modest response to the initial concern of the nation's air pollution problems. The Clean Air Act of 1970 increased funds for research and established a legal process for local, state, and federal governments to follow when taking regulatory actions against air pollution. At the time, 60% of all air pollution was caused by motor vehicle emissions such as carbon monoxide, hydrocarbons, and nitrogen oxides. This was started in 1965 when congress authorized the Department of Health, Education, and Welfare (HEW) to establish standards for emissions of carbon monoxide and hydrocarbons emitted by motor vehicles. Air pollution became a major discussion in congress from 1955 to 1970 and made its first real stride at making a national air pollution policy in 1967 with the passage of the Air Quality Act of 1967. This said that the federal government was to establish metropolitan air quality regions all around the country. The states were also supposed to establish air quality standards and then develop plans to implement them. When 1970 came, not a single state had developed or implemented any standards of any kind<sup>1</sup>

In January 1970, President Richard Nixon, at his State of the Union Address, called for "Comprehensive new Regulations" to protect the environment. His administration made proposals to

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<sup>1</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington, D.C: CQ, 1993. Print.

strengthen the Air Quality Act of 1967 mostly because they believed that if only some states regulated air pollution and some didn't that those states may be put at an economic disadvantage. The Nixon administration proposed that the Federal government, under the H.E.W., be allowed to put in place national standards for ambient air quality for pollutants it deemed hazardous to one's health. Under a presidential reorganization plan the Environment Protection Agency and Earth Day were founded in 1970. The problem with the bill being proposed was whether the newly formed EPA would set the new vehicle emissions standards or if the House and Senate would write it into law. The auto industry launched major lobbying efforts to deny the EPA that right. By June 3, 1970 the House Interstate and Foreign Commerce Committee produced a bill similar to the Nixon administration's bill. On June 10<sup>th</sup> the bill was passed in the House though some standards were not as stringent as originally proposed. Some House members who had pushed for more stringent measures said that the committee had "bent over backward to accommodate the auto and oil industries," which had been heavily lobbying house members during this time.<sup>2</sup>

In September 1970, the Senate Environment and Public Works Committee drafted out its own bill which was much more aggressive than the one proposed by the House. It wanted to authorize more money for research and grants and required that there be a 90% reduction in auto emissions by 1975 with a one-year extension if needed. It also gave the EPA the ability to regulate use of fuels and would allow citizens suits against polluters. At the House-Senate conference some of the Senate's provisions were accepted such as the 1975 deadlines for auto emissions and the EPA regulation of fuel emissions. Other provisions such as funding levels and testing standards were compromised between the House and Senate bills. In December of 1970 the nation's first groundbreaking air pollution bill was passed and signed into law by President Nixon as the Clean Air Act of 1970.<sup>3</sup>

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<sup>2</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington D.C: CQ, 1993. Print.

<sup>3</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington, D.C: CQ, 1993. Print.

The Clean Air Act of 1970 stated and was aimed to “Protect and enhance the quality of the Nation’s air resources so as to promote the public health and welfare and the productive capacity of its population.” The act established national ambient air quality standards and made states develop and enforce the implementation plans to meet the standards. The goal was to clean up the nation’s air quality substantially within the first five years through these provisions. An important part of the bill was that it gave larger amounts of federal funds to states for the development of implementation plans, which the Air Quality Act of 1967 didn’t include. It also gave funds to states to research the health effects of airborne pollutants and required that such plans be submitted to the EPA within the first nine months of the issuance of the state standards. The bill also said that the EPA was to monitor and make sure that each states standards included emission limitations, put requirements on stationary sources, and included a new program for regulation of new sources of pollution. The inspection and testing of motor vehicle emissions was also put in place at this time to make sure that each car on the road had met or exceeded the national standard which required there be a reduction of 90% by 1976. The 90% reduction in emissions included carbon monoxide, hydrocarbons, and nitrogen oxides. These were to be met for five years or 50,000 miles; and if anyone was caught removing the pollution control devices they would be subject to a \$10,000 fine.<sup>4</sup>

The EPA was also authorized to test and to inspect all new vehicles by auto manufacturers to make sure that their vehicles were in compliance with the mandated reductions. The Clean Air Act of 1970 put in place both enforcement powers and penalties. Polluters who had knowingly violated provisions of a states implementation plan were subject to fines of up to \$25,000 a day for each violation and up to a year in a state prison. Following the Clean Air Act of 1970 was amendments to it in 1971, 1973, 1974, and again in 1976. Most of these amendments were for waivers to the motor vehicle emissions standards. The 1975 deadline for achieving the goals set by the 1970 act were missed terribly

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<sup>4</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington, D.C: CQ, 1993. Print.

and needed amending for a final time. Tailpipe emission had to be extended three times, twice by the EPA and another by Congress and to apply to the 1978 model year.<sup>5</sup>

The problem with the Clean Air Act of 1970 was that it was, in some ways, overly ambitious to set such standards in only a five-year time frame. Lee Iacocca of Ford said the one-year extension was needed to “keep us in business for another year.” The Clean Air Act of 1970 was plainly requiring automakers to have catalytic converters which it later found would only cost automaker’s \$1,300 per vehicle rather than the \$3,000 price tag that General Motors executive Ernie Starkman said would pose an “unreasonable risk of business catastrophe.”<sup>6</sup> Automakers after the 1977 model year would be fined \$10,000 for every car made if they didn’t meet the stringent tailpipe emissions standards as set by the act in 1970. Knowing they wouldn’t meet the deadline, the automakers said that they would rather shut down all their auto plants than be fined \$10,000 for every car produced. President Carter, at this time, decided to step in and urged congress to pass the amendment lengthening the time to meet the new standards. It was passed in the summer of 1977. The other problem with the Clean Air Act of 1970 was that many of the states failed to achieve national ambient air quality standards and then enforce them within their states was a disaster<sup>7</sup>

The Clean Air Act of 1977 carried over the first set of amendments passed in the original act of 1970. It added the New Source Review, which would address the older facilities deteriorating that were grandfathered by the original law. This included facilities such as power plants and refineries, which were not environmentally friendly and were still, in 1977, emitting huge amounts of carbon monoxide, hydrocarbons, and nitrogen oxides. Congress wrote in legislation that if these older facilities were to

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<sup>5</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington, D.C: CQ, 1993. Print.

<sup>6</sup> "Previous Auto Industry Arguments." *Arizona Pirg Education Fund*. Arizona Pirg Education Fund. Web. 6 Oct. 2010. <[http://www.arizonapirg.org/uploads/No/PG/NoPGxJk75nTKhUIhKHvVlw/auto\\_industry\\_arguments\\_4-08.pdf](http://www.arizonapirg.org/uploads/No/PG/NoPGxJk75nTKhUIhKHvVlw/auto_industry_arguments_4-08.pdf)>.

<sup>7</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington, D.C: CQ, 1993. Print.



survive that would need to be assessed by the EPA and meet the new standards by having special equipment installed and the facilities retooled to substantially decrease its emissions.<sup>8</sup>

The amendments made in the Clean Air Act of 1977 were those that would decrease or phase out some of the programs in place by the 1970 Act. For instance the Prevention of Significant Deterioration of air quality was practically phased out and disbanded. The PSD had set air quality standards throughout the NAAQS areas, which were mostly cities and had said that a city would have limits on the amount of emissions permitted and included a gasoline rationing program that was very unpopular. The Reagan Administration said that these goals were too stringent and needed to be stripped out in the 1980's. The authorization for the Clean Air Act was also terminated in 1981 and congress funded its implementation throughout the 1980's. During the 1980's there was much political unrest to amend the act which would later lead to the Clean Air Act of 1990. The single most important change, though, made by the Reagan administration was the phase out of leaded gasoline, which researchers said was the largest single source of atmospheric lead. After EPA administrator Ann Gorsuch admitted to a gas refiner that the agency wouldn't enforce lead limits it became a political nightmare for the Reagan Administration, which had previously been against it. The Reagan Administration, as a result, called for an unplanned speedup of the phase out of leaded gasoline and is said to be the single most important event since the inception of the Clean Air Act of 1970.<sup>9</sup>

In 1983, the main concern up for amendment were the implications on acid rain. Three major scientific committees had examined the problem and gave Congress a reason to amend the Clean Air Act. The problem was that there was a deadlock in Congress over whether to amend the issue or not. Many of the states in the northeast were for amending it while those in the coal-burning states of the Midwest

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<sup>8</sup> Hill, Gladwin. "Timeline of the Clean Air Act." *Environmental Defense Fund – Finding the Ways That Work*. 30 Nov. 1969. Web. 16 Nov. 2009. [http://www.edf.org/documents/2695\\_cleanairact.htm](http://www.edf.org/documents/2695_cleanairact.htm).

<sup>9</sup> History | Clean Air Act | US EPA." *U.S. Environmental Protection Agency*. 19 Dec. 2008. Web. 15 Nov. 2009. [http://www.epa.gov/air/caa/caa\\_history.html](http://www.epa.gov/air/caa/caa_history.html).

opposed it. By the end of 1983 an amendment was proposed but with much frustration. EPA Administrator Ann Gorsuch along with other top administrators in the Reagan Administration were being very defiant with criticisms of the existing law. She wanted to work closely with industrial leaders to help solve the problem of pollution so that aggressive measures wouldn't have to be used. This created a trust issue between the EPA and Congress, which was very evident in the amendment. Also in 1986 Democrats had taken over the Senate and passed amendments to act on acid rain and smog issues. Senate majority leader Robert Byrd, whose state of West Virginia being a coal-reliant economy, refused to bring the bill to the floor knowing that it would threaten the coal jobs of his state.<sup>10</sup>

### **The Clean Air Act of 1990**

Over the time frame of the 1980's many bills were drafted and countless attempts were made to negotiate the compromise of the Clean Air Act of 1990. With George H.W. Bush elected president in 1988 many were afraid that it would be another four years of the Reagan Administration; which was for the most part not for protecting the environment and heavily sided with big business and less government intervention. Instead, it was George Bush that turned out to actually be the final piece in passing the Clean Air Act of 1990. Though he was the Vice President during the Reagan Administration, Bush actually distanced himself from Reagan on issues pertaining to the environment. In 1989 congress made another attempt to compromise on the Clean Air Act. This was helped immensely by the replacement of Democrat majority leader Robert Byrd by George Mitchell. A bill was proposed by the Senate Committee on Environment and Public Works to tackle the issues of acid rain, air toxics, and urban area non-attainment. Republicans in the House wanted President Bush to show leadership in environmental protection and, on June 12, introduced a bill called "The Bush Administration's Clean Air Bill". The main provisions to the Clean Air Act in the bill were to make the enforcement titles consistent with the current

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<sup>10</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington, D.C: CQ, 1993. Print.

environmental laws. There were also provisions pertaining to alternative-fueled vehicles, which the administration and White House officials were very interested in.<sup>11</sup>

As soon as the bill was released on June 21<sup>st</sup>, it was torn apart by environmentalists as being too weak. Industry groups were calling it too expensive and inconsistent with the regulatory flexibility that was to be expected in the bill. The Office of Management and Budget, Department of Energy, and the EPA, though, drafted the bill itself. These three were the drafters because the administration wanted to make sure that both economic and energy issues were addressed in the bill. The bill's focus was on three major areas which were non attainment of national ambient air quality standards, air toxics, and acid rain. The most aggressive of these three was on acid rain and became the keystone part of the bill. This was smart because the public itself viewed acid rain as a serious problem that affected them. Another upside to making acid rain the keystone of the bill was that it would only affect a few coal plants in the Midwest instead of all the coal plants. The provisions, though, to acid rain were more or less a scheme of emissions trading that an industry-oriented and conservative member of Congress could accept as reasonable.<sup>12</sup>

The House of Representatives was also working on clean air legislation at this time with the Energy and Commerce's Subcommittee on Health and the Environment. John Dingell who chaired the committee made sure that he put people in the committee that would block more stringent bills that he knew wouldn't be agreed upon in the House or the Senate. Henry Waxman, who was also on the committee and a supporter of more stringent regulations, thought the opposite. He believed that if a more stringent bill was able to get out of the committee that it would be passed. The White House, at this time, launched lobbying efforts on the House and had several Waxman amendments shot down. Waxman and Dingell had been at opposite sides of the environmental spectrum for more than a decade arguing on just about everything. The current debate focused again on the auto industry and on the tailpipe emissions

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<sup>11</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington, D.C: CQ, 1993. Print.

<sup>12</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington, D.C: CQ, 1993. Print.

issue. Waxman wanted more stringent standards in a shorter amount of time which in the Clean Air Act of 1970 proved to be an unattainable goal and had to be extended multiple times. Dingell knowing this, on the other hand, wanted less stringent standards and a longer timeline for the auto manufacturers to comply with them.<sup>13</sup>

Once the clean air bill moved from the House to the Senate things began to roll more quickly. Industrialists have seen the Senate Committee on Environment and Public Works as “a wholly owned subsidiary of the environmental community”. Environmentalists, on the other hand, saw the committee as “the conscience of the Senate on Environmental matters.” Two of the big players in this committee were both the majority and minority staffs, most notably Katharine Kimball and Jimmie Powell. They directed the bill through committee debates, negotiations, floor debate, and House-Senate conferences. These two people were very committed, personally, to aggressive environment regulations. The committee rarely if ever compromised on markups and bipartisanship was the norm. Unfortunately it was not the case once the bill left the committee and was on the Senate floor for debate. A lobbyist once said “they don’t have to cut any compromises in committee level...[but] that makes their job twice as hard when they get to the floor”. While the Senate tore the bill apart for failing to be attainable, the Subcommittee on Environmental Protection began marking up three separate bills. The three bills were on air toxics, acid rain, and urban smog with the air toxics bill being the more stringent one with more provisions in it than that of the President’s; but still managed to pass with bipartisanship. The provisions of the urban smog bill were passed in a very small amount of time on October 26<sup>th</sup> taking less than an hour. The acid rain bill was issued on November 14<sup>th</sup> after only half a day of discussion on it. Once all three bills had reached the full committee, Majority Leader Mitchell put some pressure on them to get it passed. Feeling the pressure, the full committee combined all three bills into one and passed it relatively quickly... taking less than a day to ram it through. With the bill approved by both the House and the Senate Committee, all the bill

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<sup>13</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington, D.C: CQ, 1993. Print.

needed was to get voted on the Senate floor; and if favored move onto President Bush's desk to be Signed into law as the Clean Air Act of 1990.<sup>14</sup>

The bill would arrive on the Senate floor on January 23, 1990 after clearing committee on hearings and markups. Once on the floor, the main concern of the bill was that it was a little too expensive to implement all the compliances. Some industry experts put the cost of the bill up at \$104 billion. The biggest cost of the compliances lay in the acid rain controls on Midwestern utility consumers and high-sulfur coal miners. The other issue was whether the bill should mandate the sale and production of alternative fuels and clean-fueled vehicles. Senate Majority Leader Mitchell feared that there may be a filibuster looming and that even if the bill passed that a presidential veto may also be waiting. This was the case because the EPA had estimated the bill was twice the cost of the President's original proposal.<sup>15</sup>

After Majority Leader Mitchell took the bill off the floor, revised it with a group of 15 other representatives and put it back on the floor; the bill was nearing its final stages. The revised bill was passed by the House on May 23<sup>rd</sup> and the Senate soon after. Once this was done it went to the House-Senate Clean Air Conference for a final agreement between the two. This part of the policy making process took quite some time to get through as some revisions were debated but agreed upon and left the conference in October. The House of Representatives overwhelmingly voted for the bill on October 26<sup>th</sup> with a 401-25 in favor of the bill. On the very next day the bill was in the Senate and put up for a vote and was passed by a majority vote. Finally, after years of debating and arguing over the now outdated Clean Air Acts of 1970 and 1977; a new bill was being sent to the President's desk for signing. On November 15, 1990 President George W. Bush signed the bill into law as the Clean Air Act of 1990.<sup>16</sup>

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<sup>14</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington, D.C: CQ, 1993. Print.

<sup>15</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington, D.C: CQ, 1993. Print.

<sup>16</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington, D.C: CQ, 1993. Print.

The Clean Air Act of 1990 substantially increased the authority and responsibility of the Federal government on environmental regulation. New regulations were approved on the control of acid rain and the issuance of stationary operating permits. The NESHAP's were incorporated into the bill and expanded the program's control over toxic air pollutants. Finally, there were major provisions made to the attainment of maintenance of NAAQS, which had been needed for more than a decade. Some new pieces that were added into the Clean Air Act of 1990 that were not in the previous acts were the provisions to stratospheric ozone protection, increased enforcement authority, and the expansion of research programs.<sup>17</sup>

Will Reilly was the EPA administrator at the time and hailed the signing of the Clean Air Act of 1990 by President Bush as breaking "the 13-year stalemate by submitting an innovative, market-based bill which will achieve the nation's environmental goals in the most effective matter". Reilly was a big advocate of the Bush Administration's leadership that broke a decade long stalemate on how to amend the Clean Air acts of 1970 and 1977. Reilly was very pleased to see that both emissions and acid rain was to be cut in half in the first phases of the plan, which were from 1990-96. Another big piece of the act that he praised was for the new reasonable timeline the act gave states to adequately attain air quality standards that the previous act didn't do a good job of and was amended multiple times.<sup>18</sup>

One of the most important pieces of the act, the compliance methods, gave utilities multiple options to choose from to implement reductions in their SO<sub>2</sub> and NO<sub>X</sub> emissions. The first was a fuel blending or switching method that required energy companies to choose either a different fuel or lower the sulfur content emitted by coal plants. The installation of glue desulphurization equipment was another option that they were given along with retiring old units and commissioning new ones. The final option that

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<sup>17</sup> "History | Clean Air Act | US EPA." *U.S. Environmental Protection Agency*. 19 Dec. 2008. Web. 15 Nov. 2009. [http://www.epa.gov/air/caa/caa\\_history.html](http://www.epa.gov/air/caa/caa_history.html).

<sup>18</sup> "EPA Administrator Reilly Hails Signing of New Clean Air Act | EPA History | US EPA." *U.S. Environmental Protection Agency*. 10 Sept. 2009. Web. 15 Nov. 2009. <http://www.epa.gov/history/topics/caa90/02.htm>.

companies had was to comply with phase II units or to compensate with phase II units which required a 50% reduction in SO<sub>2</sub> and NO<sub>x</sub> emissions by the end of the first phase, which lasted from 1990 to 1996. This gave companies a reasonable amount of time to comply with the Clean Air Act of 1990 and to lower their emissions to eliminate smog and acid rain.<sup>19</sup>

### **The Clean Cars Program**

The Clean Air Acts of 1970, 1977, and 1990 were major pieces of legislation in setting national standards on emissions and toxics. The Clean Air Acts of 1970 and 1990 were the first major pieces of legislation to deal with the industries' poor environmental standards and to make air clean in the United States. Because of the Clean Air Act of 1990, in May of 2007 the California Air Resources Board and Senator Henry Waxman launched what they called the "*Clean CARS Program: How States Are Driving Cuts in Global Warming Pollution*". With this new program launched, the objective of the program being to increase the CAFÉ standards that were set by the Clean Air Act of 1990.

Global Warming has always been a top priority to lawmakers in California. The state has made itself known as a leader in environmental protection programs and hard line regulations on everything you could ever think of. Using its authority under the Clean Air Act, California wanted to set tougher vehicle emissions standards that far exceeded the current CAFÉ standards. CAFÉ stands for Corporate Average Fuel Economy and is the sales weighted average fuel economy expressed in miles per gallon of auto manufacturers' fleet passenger and light trucks with a gross vehicle weight rating of 8,500 pounds. The Clean Cars Program was started in 2007 by California because of the Bush Administration's unwillingness to reduce global warming pollution. As a result, California along with twelve other states

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<sup>19</sup> Hill, Gladwin. "A Timeline of the Clean Air Act." *Environmental Defense Fund – Finding the Ways That Work*. 30 Nov. 1969. Web. 16 Nov. 2009. [http://www.edf.org/documents/2695\\_cleanairact.htm](http://www.edf.org/documents/2695_cleanairact.htm).

made it a priority for their own states to take up the issue and implement statewide emission standards on motor vehicles.<sup>20</sup>

The Clean Cars Program says that with the twelve states that have adopted the program, they'll be able to reduce pollution from light trucks and SUVs by 74 million metric tons per year in 2020. The entire program, as a whole, is said to reduce emissions by 392 million metric tons between 2009 and 2020. At the time in 2007 six other states were looking into adopting the Clean Cars Program; and the summary of the program says that if they joined, that number would jump up to 536 million metric tons in reduced emissions. The program also said that it would cut gasoline consumption by consumers and as a result have them money. It would eliminate 8.3 billion gallons per year and save consumers up to \$25.8 billion annually at the pump by 2020.<sup>21</sup>

### **Federal vs. State Powers and The Clean Cars Program**

On December 21, 2005 the California Air Resources Board filed for a waiver to allow California to move forward with a program to increase the state's own CAFÉ standards. On December 19, 2007 the Bush Administration denied California's initial request. California, though, cited Section 177 of the Clean Air Act, which "permits other states to adopt California motor vehicle standards as long as 'such standards are identical to California standards for which a waiver has been granted for such model year'". They also cited Section 209, which "specifically creates the right for California to set better-than-federal emissions standards for most moving sources of pollution". The Clean Air Act basically said in writing

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<sup>20</sup> Ridlington, Elizabeth. "The Clean Cars Program." *Cleancarscampaign.org* Environment California Research & Policy Center, May 2007. Web. 16 Nov. 2009. <http://www.cleancarscampaign.org/web-content/newsroom/docs/CleanCarsandGlobalWarmingFinal07.pdf>.

<sup>21</sup> Ridlington, Elizabeth. "The Clean Cars Program." *Cleancarscampaign.org*. Environment California Research & Policy Center, May 2007. Web. 16 Nov. 2009. <http://www.cleancarscampaign.org/web-content/newsroom/docs/CleanCarsandGlobalWarmingFinal07.pdf>.



that California could move forward with its own emissions reduction and fuel economy expansion programs as long as the other states adopting it didn't alter anything. All the states that adopted the program used the same set up and followed everything California's Air Resources Board had done.<sup>22</sup>

Under the Clean Air Act of 1990 the Federal government's is to establish and periodically revise National Ambient Air Quality Standards via the EPA. Through the EPA the federal government oversees the development of State Implementation Plans and has the right to disapprove any such plans that do not maintain or improve air quality in accordance with the Act. The role of states under the Clean Air Act of 1990 ranges from direct control of air pollution from stationary sources to restrictions on parking in urban areas. Even though the Federal government doesn't allow states to impose their own regulating measures on new vehicles it does allow other states under section 209 of the Clean Air Act to adopt the California car standards in their states. This is a sharing of powers compromise within the Clean Air Act of 1990 between Federal and state that allowed states to pursue two sets of vehicle standards rather than allow them to create their own.<sup>23</sup>

On January 2, 2008 the California Air Resources Board published a technical assessment in response to U.S. EPA Administrator Steven Johnson making claims that California's motor vehicle greenhouse gas emissions rules were less effective than the newly adopted CAFÉ standards in reducing air pollution. What the assessment did was compare California's proposal standards versus the newly updated Federal CAFÉ standards. In the comparison, California's standards repeatedly came out on top in both the 2016 and 2020 requirements. In 2016 California's program, if implemented, would reduce emissions by 17 million metric tons of carbon monoxide compared to the Federal's 8 million metric tons.

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<sup>22</sup> Ridlington, Elizabeth. "The Clean Cars Program." *Cleancarscampaign.org*. Environment California Research & Policy Center, May 2007. Web. 16 Nov. 2009. <http://www.cleancarscampaign.org/web-content/newsroom/docs/CleanCarsandGlobalWarmingFinal07.pdf>>.

<sup>23</sup> Litz, Franz T. "Toward a Constructive Dialogue on Federal and State Roles in U.S. Climate Change Policy." *Pew Climate*. PEW Center on Global Climate Change, June 2008. Web. 6 Oct. 2010. <<http://www.pewclimate.org/docUploads/StateFedRoles.pdf>>.

Between 2009 and 2016 California's more stringent rules would reduce emissions by 58 million metric tons compared to the Federal's 20 million metric tons.<sup>24</sup>

The Air Resources Board assessment was in response to EPA Administrator Steven Johnson's decision to deny the state's waiver request to move forward with its motor vehicle emissions rules, which were adopted in 2004. These rules were made in the California legislature and passed into law in 2004 as AB1483 which is also known as the Pavley Bill/Law. Johnson's explanation for the denial of California's request was section HR6 of the 2007 Energy bill, which mandated improved national standards for fuel economy. California's waiver would have gone against the 2007 Energy Bill along with the other states who had adopted the Clean Cars Program from California. The national fleet standards set by the 2007 Energy Bill said that all vehicles must obtain a 35-mile per gallon average by 2020 and beyond. Johnson claimed that California's AB1493 standards would actually result in an average of 33.8 miles per gallon which was lower than the new CAFÉ standards of 35 miles per gallon. With that in mind, Johnson said that because of this the CAFÉ program mandated by the 2007 Energy Bill would be a better approach in reducing greenhouse gas emissions.<sup>25</sup>

A problem that the California Air Resources Board found with the 2007 Energy Bill was that it gave out a fuel economy credit for vehicles capable of running on E85 gasoline that was cleaner than regular gasoline. In the assessment, the ARB found that this credit did more to hurt than to help fuel economy increases. It allowed manufacturers to lower the fuel economy of that vehicle by 1.2 miles per gallon when compared to the standard. Since many auto manufacturers have said and have already begun

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<sup>24</sup> Benjamin, Michael. "California Air Resources Board Technical Assessment." *Cleancarscampaign.org*. 2 Jan. 2008. Web. 16 Nov. 2009. <http://www.cleancarscampaign.org/web-content/cleanairact/docs/AB1493-vCAFE-Add-50-States-1-23-08.pdf>.

<sup>25</sup> Benjamin, Michael. "California Air Resources Board Technical Assessment." *Cleancarscampaign.org*. 2 Jan. 2008. Web. 16 Nov. 2009. <http://www.cleancarscampaign.org/web-content/cleanairact/docs/AB1493-vCAFE-Add-50-States-1-23-08.pdf>.

to produce large numbers of vehicles able to run on E85, the ARB actually feared that this resulted in automakers taking full advantage of the credit until it is phased out in 2020.<sup>26</sup>

It is very evident that the states have taken the leadership role over the Federal government in trying to lower their own vehicle emissions by both 2016 and 2020. Pennsylvania is one of the states that has taken this issue up and adopted the California Clean Cars Program. Pennsylvania's projected total emissions by 2020 are 49.7 million metric tons of CO<sub>2</sub>. With the Clean Cars Program adopted, Pennsylvania would reduce its emissions to 43.7 million metric tons, which would equate to a 12% reduction in emissions.<sup>27</sup>

Many people don't understand exactly what the Clean Cars Program is all about or what its objectives are. The program is a series of air pollution standards, which the state of California designed and implemented into law in the Pavley Bill. There are three main components to the program with the first being the Low-Emission Vehicle Program. This program sets strong standards for emissions that produce smog or toxic air pollutants. The second is the Zero-Emission Vehicle Program that promotes the usage of hybrid, fuel cell, and electric vehicles. The third part of the Clean Cars Program is the Global Warming Emission Standards, which limits emissions of pollutants that contribute to global warming.<sup>28</sup>

The Current Clean Cars Program includes 17 states and represents some 139 million Americans throughout the country. Out of these 17 states there are 202 congressional districts represented along with 73 Republican and 129 Democratic representatives. Another interesting fact is that there are 10 House

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<sup>26</sup> Benjamin, Michael. "California Air Resources Board Technical Assessment." *Cleancarscampaign.org*. 2 Jan. 2008. Web. 16 Nov. 2009. <http://www.cleancarscampaign.org/web-content/cleanairact/docs/AB1493-vCAFE-Add-50-States-1-23-08.pdf>.

<sup>27</sup> Ridlington, Elizabeth. "The Clean Cars Program." *Cleancarscampaign.org*. Environment California Research & Policy Center, May 2007. Web. 16 Nov. 2009. <http://www.cleancarscampaign.org/web-content/newsroom/docs/CleanCarsandGlobalWarmingFinal07.pdf>.

<sup>28</sup> Ridlington, Elizabeth. "The Clean Cars Program." *Cleancarscampaign.org*. Environment California Research & Policy Center, May 2007. Web. 16 Nov. 2009. <http://www.cleancarscampaign.org/web-content/newsroom/docs/CleanCarsandGlobalWarmingFinal07.pdf>.

Committee Chairmen and 11 Senate Committee Chairmen represented in this group with the most influential one being Henry Waxman, a Democratic Senator from California and one of the main advocates of the Clean Cars Program. Automakers have repeatedly launched suits against all 17 states without any victories on appealing the Clean Cars Program over claims that the goals set in it are not being feasible to attain. The only thing holding the entire program back, as stated earlier, is a waiver from the EPA to allow the states to go ahead with the implementation process of the Clean Cars Program which would start taking effect in 2010.<sup>29</sup>

To get back to the California Air Resources Board's Assessment study, part C of the paper focused on the greenhouse gas emission reductions in 2016 and 2020 in California alone. Under the Pavley rules percent reductions, in 2016 the state is estimated to reduce its carbon emissions by 473,000 tons per day. That number would be equal to 17 million metric tons per year by 2016. By 2020 the Pavley II rules would take effect enforcing even stricter rules on fuel economy and emissions standards. By 2020 the estimated reduction in emissions per day in California would be a 20% reduction from 496,000 tons a day to 395,000 tons per day. Compared to the CAFÉ standards, there would only be an 11% reduction in emissions from the 496,000 tons per day, which would only equate to a 57,000 tons per day reduction.<sup>30</sup>

At the end of the California Air Resources Board Technical Assessment study, there were numerous benefits to the Clean Cars Program over the Federal CAFÉ standards. The first benefit for California in using its Clean Cars Program would be a reduction in greenhouse gas emissions from cars by nine million tons of carbon dioxide by 2016, which exceeds that of the Federal standards. By 2020 the Pavley phase II emissions reduction plan will have been put into effect ramping up more stringent greenhouse gas emissions limits as set forth in the Climate Action Plan. This would result in almost 14

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<sup>29</sup> "Veto Threat Imperils 17-State Clean Car Program As EPA Decision Pending – Environmental Defense Fund." *Environmental Defense Fund – Finding the Ways That Work*. 7 Dec. 2007. Web. 19 Nov. 2009. <http://www.edf.org/pressrelease.cfm?contentID=7416>.

<sup>30</sup> "Clean Air Act and State Authority." *Clean Cars Campaign*. Web. 20 Nov. 2009. <http://www.cleancarscampaign.org/web-content/cleanairact/cleanairact.html#Anchor-Clean-49575>.

million metric tons of carbon dioxide or a 77 percent reduction from the 2016 standards. This again would exceed those set by the Federal standards. By using the Clean Cars Program in California over the new Federal CAFÉ standards, the reduction in greenhouse gas emissions would be much more significant in both the near and long term projections. It would produce an average of 44 miles per gallon fleet wide by 2020 beating the Café standard's 35 miles per gallon by an astounding 9 miles per gallon. The Clean Cars Program is also 16 percent more stringent for 2016 model year vehicles and 18 percent more stringent on 2020 model year vehicles when the Pavley phase II rules take effect.<sup>31</sup>

Under the Bush Administration and EPA Administrator Steven Johnson, getting the Clean Cars Program passed was practically impossible. President Bush supported Johnson in his assessment that the Federal government's standards take precedence over the states standards. More power resides in the Federal government and states depend on many Federal grants and funding to support many of their own programs. On June 29, 2008 the Senate Environment and Public Works Committee Chairman Barbara Boxer and committee members Sheldon Whitehouse, Amy Klobuchar, and Frank Lautenberg called for the resignation of EPA Administrator Steven Johnson. On December 9, 2008 the EPA inspector general report determined that California's waiver decision met statutory procedural requirements. By this time Barack Obama had been nominated the President of the United States with his administration's goal of bringing change to Washington politics. On January 21, 2009 California Governor Arnold Schwarzenegger asked the new President for a waiver to implement the states Clean Cars Law. The new EPA Administrator, Lisa Jackson, reviewed California's request for a waiver and on February 6, 2009 signed a Federal Registrar Notice announcing a March 5<sup>th</sup> public hearing and 60-day comment period on California's request for the waiver. After the 60-day comment period had ended on March 4, 2009 the Union of Concerned Scientists showed an array of existing technologies that automakers can use now to

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<sup>31</sup> Benjamin, Michael. "California Air Resources Board Technical Assessment." *Cleancarscampaign.org*. 2 Jan. 2008. Web. 16 Nov. 2009. <http://www.cleancarscampaign.org/web-content/cleanairact/docs/AB1493-vCAFE-Add-50-States-1-23-08.pdf>.

improve fuel economy numbers all but proving the feasibility of the Clean Cars Program proposed by California. Finally on June 30, 2009 the EPA grant California its waiver request giving it the ability to set its own standards along with now 18 other states. It took an astounding three years, six months and nine days after California's initial requests to receive a waiver from the EPA to set its own standards. The Clean Cars Law is set to take effect in 2010 starting with the 2011 model year vehicles.<sup>32</sup>

## Conclusion

To conclude, both the Clean Air Act of 1990 and the Clean Cars Program were very aggressive yet innovative responses to dealing with greenhouse gas emissions from motor vehicles. The Clean Air Act of 1990 was a big step in the right direction implementing a national CAFÉ standard for automakers to follow. The Clean Cars Program took a necessary step further in 2007 and was able to be granted its wish with help from the Obama Administration. The bill finally became a law in California through a waiver by the EPA and today has set a new standard for all automakers operating in the United States to reach or exceed by both 2016 and 2020. What I've learned from doing research on both of these pieces of legislation is that it is the Federal government's job to set a benchmark for everyone to reach or surpass. It also gives businesses an equal playing field in all 50 states instead of 50 different standards. But in the Clean Air Act of 1990 the sharing of powers was given so that California could set more stringent standards plus allow other states to adopt those standards. This was a great compromise in the policy process because it allowed for room to pursue above the bar but still limited to two standards that the Federal government in the end can oversee and adopt if necessary.

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<sup>32</sup> "Clean Air Act and State Authority." *Clean Cars Campaign*. Web. 20 Nov. 2009.  
<http://www.cleancarscampaign.org/web-content/cleanairact/cleanairact.html#Anchor-Clean-49575>.

## Bibliography

- <sup>1</sup> "Previous Auto Industry Arguments." *Arizona Pirg Education Fund*. Arizona Pirg Education Fund. Web. 6 Oct. 2010.  
<[http://www.arizonapirg.org/uploads/No/PG/NoPGxJk75nTKhUIhKHvVIw/auto\\_industry\\_arguments\\_4-08.pdf](http://www.arizonapirg.org/uploads/No/PG/NoPGxJk75nTKhUIhKHvVIw/auto_industry_arguments_4-08.pdf)>.
- <sup>1</sup> Bryner, Gary C. *Blue skies, green politics the Clean Air Act of 1990*. Washington, D.C: CQ, 1993. Print.
- <sup>1</sup> Hill, Gladwin. "A Timeline of the Clean Air Act." *Environmental Defense Fund – Finding the Ways That Work*. 30 Nov. 1969. Web. 16 Nov. 2009.  
[http://www.edf.org/documents/2695\\_cleanairact.htm](http://www.edf.org/documents/2695_cleanairact.htm).
- <sup>1</sup> History | Clean Air Act | US EPA." *U.S. Environmental Protection Agency*. 19 Dec. 2008. Web. 15 Nov. 2009. [http://www.epa.gov/air/caa/caa\\_history.html](http://www.epa.gov/air/caa/caa_history.html).
- <sup>1</sup> "EPA Administrator Reilly Hails Signing of New Clean Air Act | EPA History | US EPA." *U.S. Environmental Protection Agency*. 10 Sept. 2009. Web. 15 Nov. 2009.  
<http://www.epa.gov/history/topics/caa90/02.htm>.
- <sup>1</sup> Hill, Gladwin. "A Timeline of the Clean Air Act." *Environmental Defense Fund – Finding the Ways That Work*. 30 Nov. 1969. Web. 16 Nov. 2009.  
[http://www.edf.org/documents/2695\\_cleanairact.htm](http://www.edf.org/documents/2695_cleanairact.htm).
- <sup>1</sup> Ridlington, Elizabeth. "The Clean Cars Program." *Cleancarscampaign.org* Environment California Research & Policy Center, May 2007. Web. 16 Nov. 2009.  
<http://www.cleancarscampaign.org/web-content/newsroom/docs/CleanCarsandGlobalWarmingFinal07.pdf>.
- Litz, Franz T. "Toward a Constructive Dialogue on Federal and State Roles in U.S. Climate Change Policy." *Pew Climate*. PEW Center on Global Climate Change, June 2008. Web. 6 Oct. 2010.  
<<http://www.pewclimate.org/docUploads/StateFedRoles.pdf>>.
- <sup>1</sup> Benjamin, Michael. "California Air Resources Board Technical Assessment." *Cleancarscampaign.org*. 2 Jan. 2008. Web. 16 Nov. 2009.  
<http://www.cleancarscampaign.org/web-content/cleanairact/docs/AB1493-vCAFE-Add-50-States-1-23-08.pdf>.
- "Veto Threat Imperils 17-State Clean Car Program As EPA Decision Pending – Environmental Defense Fund." *Environmental Defense Fund – Finding the Ways That Work*. 7 Dec. 2007. Web. 19 Nov. 2009. <http://www.edf.org/pressrelease.cfm?contentID=7416>.
- <sup>1</sup> "Clean Air Act and State Authority." *Clean Cars Campaign*. Web. 20 Nov. 2009.  
<http://www.cleancarscampaign.org/web-content/cleanairact/cleanairact.html#Anchor-Clean-49575>.

**"And how do you go about getting an exorcism?": The Role of Non-Institutional Medicine in**

**William Peter Blatty's *The Exorcist***

**Ben Danner**

**Faculty Mentor: Leonard Primiano, Ph.D.**

Abstract:

This essay examines the boundaries between institutionalized and non-institutionalized/folk/vernacular medical belief systems in the narrative context of William Peter Blatty's 1971 novel, *The Exorcist*. In particular, my paper will discuss how non-institutionalized medicine was employed by the main character as a desperate remedy to "cure" her daughter's case of demonic possession, when institutionalized allopathic medicine failed. The inefficacy of institutional medicine, therefore, is analyzed through the use of vernacular medicine as described in the novel.

This paper is a study of how the 1970s novel, *The Exorcist* by William Peter Blatty foreshadows the rise in interest in non-institutional healthcare while critiquing the "official" system in all its dehumanizing and rigid methods of treatment. Chris MacNeil, the mother of a demonically possessed child, demonstrates an interest in non-institutional healthcare only after experiencing the "official" allopathic medical system. Examining the boundaries between institutionalized and non-institutionalized/folk/vernacular medical belief systems in the narrative context of *The Exorcist*, my paper, in particular, will discuss how non-institutionalized medicine was employed by the main character as a desperate remedy to "cure" her daughter's case of demonic possession, when institutionalized allopathic medicine failed. The inefficacy of institutional medicine, therefore, is analyzed through the use of vernacular medicine as I illustrate below in my synthesis of the novel, which emphasizes the twentieth-century medical context.

As the novel opens, in Washington, D.C.'s upscale Georgetown neighborhood, a successful actress, Chris MacNeil begins experiencing strange phenomena. Chris lives with her twelve-year-old daughter Regan, her personal assistant Sharon, and two housekeepers. Regan's new found interest in a Ouija board develops into a relationship with an unknown entity named "Captain Howdy" and ultimately leads to her possession by the demon *Pazuzu*.



When MacNeil begins recognizing strange occurrences around her house, she immediately infers that it is her daughter and possibly a psychological illness; it is to no surprise that she calls Dr. Marc, her family physician for a referral to a psychologist. Chris tells the doctor that her daughter is constantly moving, touching, turning; tapping; running; and jumping about with her fantasy playmate. Chris assumes that psychological counseling is necessary. Dr. Marc explains to Chris that it is a problem of society to recognize psychosomatic illness without recognizing the reverse: the illness of the body causing illness of the mind. Dr. Marc tells Chris that all of these symptoms are evidence of a brain tumor and that she needs to see a local internist, Samuel Klein. Dr. Klein performs every rudimentary examination of Regan that is possible: urine sample, red-cell count, white-cell count, and a check for exotic blood diseases. Regan passes all of the examinations that Dr. Klein performs, so he concludes that she has a hyperkinetic behavioral disorder and prescribes her a regimen of Ritalin. Ritalin, a psycho-stimulant drug, has no effect on a metaphysical entity. On her next visit to Dr. Klein, Chris complains that the bed is shaking violently, the doctor tells her that it is Regan's clonic contractions that cause the shaking; Chris seems hardly convinced. Following the mechanical approach, the next step is to verify that Regan has a healthy brain free of tumors. Dr. Klein performs an EEG (electroencephalograph) to look for any possible signs of dysrhythmia which, turns out negative. Klein also orders an X-Ray scan to obtain a visual image of Regan's brain. The scan prints out, and Regan's brain appears perfect, Klein is at a loss for a symptom disease relationship, his medical skills have reached their limit. Klein immediately dismisses the idea of the tumor and assumes the problem is psychological and advises MacNeil to administer chlordiazepoxide, a sedative. This logical progression of the body to the mind is typical of conventional, or what is termed Allopathic medical belief.

Regan is, thus, sent to a psychiatrist where she exhibits signs of multiple-personality disorder: tonal change in voice, alternating personalities. During hypnotherapy, Regan attacks the psychiatrist, so her dosage of chlordiazepoxide is increased. The doctors' lack of spiritual knowledge blinds them from the possibility that Regan is under demonic possession. Chris realizes that the medical professionals simply cannot understand Regan's disease or disorder. Chris, an atheist, immediately turns to her social

secretary, Sharon, who leaves her a book about demonic possession. Chris explores the belief in demonic possession and only after exhausting all of the official medical possibilities, she turns to the only solution she can symptomatically relate to Regan's problem, her new found knowledge of exorcism. Chris discovers that she will have to help Regan herself and that she must rely on the "medicine of the church" to save her daughter; the route of exorcism is pursued. Chris goes to the local priest Father Karras and convinces him that her daughter "needs an exorcism." Indeed, even Father Karras, a Jesuit priest, tells Chris that "it just doesn't happen anymore/since we learned about mental illness" (Blatty 224). Even Karras needs to be convinced that exorcism is the only route of treatment to pursue. In a very short period, both Chris and Karras change from trusting the *official*, to trusting the *non-institutional*.

Modern medicine is an extraordinary work of reason according to Paul Starr's history of American Medicine: "an elaborate system of specialized knowledge, technical procedures, and rules of behavior" (Starr 3). From such knowledge and procedural specialization, modern medicine has had an especially persuasive claim to authority. Doctors and other medical professionals maintained a distinctive basis of legitimacy in Western society during the twentieth and into the twenty-first centuries that adds to the strength of their authority. They claim authority, not as individuals, but as members of a specialized community that has objectively validated their competence. The medical professional offers advice not based on personal belief, but as a representative of a community of shared standards based on years of research. This communal or "official" approach to medical authority has established what David Hufford calls cultural authority, "the acceptance of statements about how the world works" (Hufford 14). Not only does cultural authority refer to the acceptance of statements, but it may also reside in products of past intellectual activity, such as religious texts (the Bible), scholarly publications, culturally recognized standards of reference (dictionaries, maps, mathematical tables), college degrees, or scientific works (Starr 13).

Physicians combine such cultural objects and their technical skills to establish their credentials not only for their medical colleagues, but also for the lay community i.e. those individuals outside the allopathic medical community. Patients consult physicians not just for advice, but to find out if they are

“really” sick and what their symptoms mean. Authority is entrusted in the physician to diagnose and interpret signs and symptoms, to name diseases, and to offer a prognosis. Of course, not all patients who accept doctors’ judgments as authoritative also take their medical advice (Starr 14; Brady 5; See also Gevitz 1-28). A doctor may tell a patient, for example, that if he or she does not start exercising, hypertension may surely develop, a significant causal factor in heart disease. The patient may take this advice as an authoritative judgment, but decline to follow the direction. Other patients may go to a number of doctors that are unsuccessful in the diagnosis or treatment of their disease. In this case, the doctors might lose their authority, therefore, making the patient distrust modern medicine and its scientific component. The patient, therefore, may rely on other cultural forms of healing that they know such as folk healing or non-institutional healing. This system of medicine can include a set of religious, spiritual, and metaphysical health beliefs and practices, as they are maintained by people in their lives and in their self-care (O’Conner 16). Contrary to popular belief, the use of non-institutional health care is not confined to marginal groups, and is ubiquitous throughout the world. Lay people frequent both official and non-institutional systems of healing in their lives (O’Conner 5-6).

In *The Exorcist*, Blatty creates a character consistently failed by official medical practice who independently seeks non-institutional care for her daughter. Chris MacNeil, in fact, can be looked upon as a non-institutional physician. MacNeil is the one that diagnoses Regan with possession after her own self study, and seeks experts in the field, called exorcists, to help pursue a treatment process called exorcism. Allopathic medical authority clearly has diminished in the eyes of Chris MacNeil. Her non-institutional treatment can also be seen as a personal-reduction in official medical authority because of her beliefs “apart from and alongside official medicine” (Yoder 80).

Blatty's novel, though understood as a work of supernatural fiction, compellingly argues that we are all unofficial doctors for ourselves, like Chris MacNeil was to her fictional daughter Regan. Chris MacNeil created her own treatment plan, once official medicine failed her. This process eventually led to the "curing" of her daughter and a reduction in cultural authority of the medical establishment, at least in

MacNeil's eyes. Throughout the text of the novel, Blatty demonstrates that *official* medicine is not the only method of treatment, but an option for treatment.

### Bibliography

Blatty, William Peter. *The Exorcist*. New York: HarperTorch, 2000. Print.

Brady, Ericka. "Introduction" in *Healing Logics*, ed. Brady, Ericka, 3-12. Utah State University Press, 2001. Print.

Gevitz, Norman. "Three Perspectives on Unorthodox Medicine." *Unorthodox Medicine in America*, ed. Gevitz, Norman, 1-28. Johns Hopkins University Press, 1988. Print

Hufford, David. *Folk Remedies Healing Wisdom*. Minneapolis: Publications Intl, 1999. Print.

O'Connor, Bonnie Blair. *Healing Traditions Alternative Medicine and the Health Professions (Studies in Health, Illness, and Caregiving)*. New York: University of Pennsylvania, 1994. Print.

Starr, Paul. *The Social Transformation of American Medicine*. New York: Basic, 1982. Print.

Yoder, Don. "Folk Religion." *Discovering American Folklife: Essays on Folk Culture and the Pennsylvania Dutch*, ed. Yoder, Don, 67-84. Mechanicsburg, PA: Stackpole, 2001. Print.

## **Distorted Perceptions of Body Image: Who is to Blame?**

Rachel Buttarro

The Department of English, Cabrini College  
Faculty Sponsor: Michelle Filling, Ph.D.

Throughout the history of women's studies, scholars quickly place blame on the media for its damaging impact on young women and their body image. Because magazine stands only feature size-zero models on their covers, it is easy to assume that women only acknowledge the airbrushed representations being shown to them on a daily basis. Feminist Eve Ensler articulates a radically different stance on the matter. Instead of pointing fingers at television and magazine covers, she boldly places the ownership for self-doubt and deprecation on women for buying into what is portrayed as ideal in society. It is suggested by Ensler in her work, *The Good Body*, that women impose this self-hatred onto themselves and are the ones held responsible for their distorted body images. This paper compares Ensler's beliefs on who is to blame for women's negative body perceptions with the beliefs of other scholars and examines the way in which Ensler empowers women by the assertion that women are their own victims.

In today's critical and media-obsessed society with issues of *Vogue* on every newsstand, it is no surprise that women have distorted images and perceptions of their own bodies. Women believe that they are less than perfect when everyday, they walk past emaciated runway models in magazines like *Glamour* and *Cosmopolitan*, wishing to look exactly like the Barbie-replica centered glamorously on the covers. Blame is placed both quickly and easily upon the media for eating disorders and fad diets, while the women to which these ads are geared toward are being pledged as the offenders. While the initial reaction of most feminists is to point fingers in the direction of the media with its negative influences on women, Eve Ensler, feminist and author of the empowering play, *The Good Body*, illustrates that women are responsible for their negative self-perception, and empowers women not to feel guilty when they eat ice cream or have flabby stomachs.

Television shows like *America's Next Top Model* and *Project Runaway* and beauty pageants such as *Miss America* display unrealistic images of women that communicate to viewers unrealistic appearances; yet, feminist critique and author, Eve Ensler, suggests in her work, *The Good Body*, that the real culprit and finger pointing is directed at the women buying into these materials. As she mentions early in her play, "I am my own victim...I pick up the magazines. I buy into the deal. I believe that blond, flat girls have the secret."<sup>1</sup> Ensler suggests that although it is the women feeding into the media's depiction of what is "ideal," women have the power to ignore the images of airbrushed models and celebrities. Society presents the strong image of blonde and thin as ideal beauty, an image that women, oftentimes to an obsessive extent, wish to obtain; yet for the majority of women, this stereotypical image and societal expectation is unobtainable. Instead of making the decision to set a new and positive standard to imitate, women choose to participate in the poisoning attempt at ideal beauty as portrayed through the media. Ensler believes that if women put down the magazines and refused to buy into the deal that blonde, flat girls have the secret, women will be happier with their bodies and will stop trying to fix what was never broken in the first place.

It is a common societal belief that the infamously emaciated Ralph Lauren model and the airbrushed Tyra Banks are the culprits of the many distorted perceptions women have of their bodies. There are countless issues of *Cosmopolitan* and *Glamour*, in which thousands of skinny models grace the covers. Likewise, many television programs star thin, beautiful Angelina Jolie prototypes, that all reflect back at women on a daily basis. Browsing through advertisements and turning the pages of magazines only to continually see tall, slender and physically-fit barbie look-a-likes can become discouraging and intimidating for women. If this is all that the media advertises, why should women not believe this is an image to model? Ensler admits subscribing to the fantasies of media with everyday life by reminiscing,

I'm walking down a New York City street, and I catch a glimpse of this blond, pointy-breasted, raisin-a-day stomached smiling girl on the cover of *Cosmo* magazine. She is there every minute, somewhere in the world, smiling down on me, on all of us. She's omnipresent. She's the

American Dream, my personal nightmare. Pumped straight from the publishing power plant into the bloodstream of our culture and neurosis. She is multiplying on every cover.<sup>1</sup>

Ensler's comparison to the blonde, raisin-a-day-stomached smiling girl on the cover of *Cosmopolitan* magazine to the American Dream emphasizes the strong impact these media representations can have on a woman's psyche. Ensler's correlation between the media's representation of women and their cravings to remold their bodies into Angelina Jolie's and runway models show that it is difficult for women to avoid the messages sent through various forms of media when movies, television, advertisements, and magazines are everywhere.

Knowing not to be consumed by the barbie-prototypes and acting on this knowledge is complicated for women, as Ensler openly admits that she, too, feeds into the *Vogue* magazines and *Project Runway* models. In *The Good Body*, Ensler includes herself as a character, showing that she also buys into what the media sells to women. Ensler confesses, "I have bought into the idea that if my stomach were flat, then I would be good, and I would be safe. I would be protected. I would be accepted, admired, important, loved."<sup>1</sup> By including herself as a character and sharing personal experiences and emotions with readers, Ensler explains that women are not alone in feeling unsatisfactory and disgust with their bodies. She expresses that her purpose in writing *The Good Body*, was an attempt to empower women struggling with their bodies. She explains that, "This play is my prayer, my attempt to analyze the mechanisms of our imprisonment, to break free so that we may spend more time running the world than running away from it; so that we may be compelled to act and resist, rather than continue on our path as dangerously distracted consumers. This play is an expression of my hope, my desire, that we will all refuse to be a corporate-cutout Barbie."<sup>1</sup> Ensler acknowledges the pressures women endure to live up to media standards and focuses her attention on reasons why women should look beyond the cutout Barbies and fashion models to form their own, unique identities.

Enslar is not alone in her logic that women create their own distorted body perceptions. Author of *Bringing Our Bodies and Ourselves Back In: Reflections on a Past, Present, and Future Medical Sociology*, Irvin Kenneth Zola agrees with Enslar in that women are the ones who are to blame and should be held responsible for their misperceptions of body image by stating, “The body is no longer the metaphor which we employ to understand the reality of the social world. Rather the body is the constitutive image schemata in which we have created that world. Our bodies talk not only in our metaphors...but in all we can know of all we can do.”<sup>2</sup> Both Enslar and Zola agree that it is not only the messages the media is sending out, but how women are receiving these messages along with how they choose to act on societal expectations. Yet, unlike Zola and many other feminist scholars, Enslar gives credit to women in being capable of looking beyond the depictions media portrays as “ideal” and illustrates that women have the power to refrain from molding their bodies into a replica of Cindy Crawford and be proud of the body they already have.

*The Good Body* recognizes the media’s stronghold on women’s self-esteem issues but also acknowledges that women have the largest role in the development of their own low self-esteem. Enslar reveals her own struggle with feeding into pop culture admitting, “Of course, the tools of my self-victimization have been made readily available. The pattern of the perfect body has been programmed into me since birth. But whatever the cultural influences and pressures, my preoccupation with my flab, my constant dieting, exercising, worrying is self-imposed”<sup>1</sup> The power of *The Good Body* comes from the fact that it is a work of creative nonfiction based on Enslar’s life experience and personal interviews with women around the world. Thus, unlike other feminist scholars, who merely theorize about the media, Enslar gives the voice needed to women through her own self struggle with food and her body. Enslar shifts the focus from the images that bombard women to the internal monologue and battle that women endure on a daily basis when they attempt to eat something as simple as ice cream while also having a constant awareness and self consciousness about their stomachs. What Enslar achieves through the format and content of her play is an ability to connect women and reveal what happens in their psyche



as they make decisions that impact bodies and eating. She breaks down the concept that some women have a “secret” that makes them beautiful and unites women by having them recognize shared issues with their bodies; thus empowering women to be open and engage each other in conversation about their anxieties in order to learn and grow.

In simply blaming the media for women’s poor self-esteem, a feminist perspective on women’s bodies is limited. Scholars like Zola do not recognize women’s power and ability to make decisions without being influenced by the celebrities and runway models. At the end of *The Good Body*, Ensler ties in her argument of women being responsible for their negative treatments to overcoming society’s expectations by stating, “Let the fat sweet sugary wet enter and encompass me. Let me not be afraid of my fullness, let me not be afraid to be seen.”<sup>1</sup> Ensler continues this realization of the power and control she has over her own body by stating, “maybe being good isn’t about getting rid of anything. Maybe good has to do with living in the mess in the frailty, in the failures, in the flaws. Maybe what I tried to get rid of is the goodest part of me.”<sup>1</sup> Ensler’s bold statements are similar to these along with her admitting “I am my own victim,” and “I buy into the deal,” prove contradictory to Ensler’s feministic background in that she is blaming herself and other women for the negative treatment of their bodies. “What I can’t believe is that someone like me, a radical feminist for nearly thirty years, could spend this much time thinking about my stomach.”<sup>1</sup> Incorporating herself as a character of self-doubt and admitting to obsessing over her body, Ensler shows the complexities of feminism. She reveals that feminism is not always about placing blame on a patriarchal society but can be about taking ownership and control of women’s bodies, minds and actions.

While media does in fact play a strong psychological role in the lives of women and can influence their lifestyles negatively, the superior authority of women’s negative choices and demands rest on women themselves. Eve Ensler portrays in her play, *The Good Body*, she, along with every other woman in society, are victims of their own wrongdoings. It is women who obsessively exercise in efforts to rid of their flabby stomachs and it is women who forbid themselves the pleasures of ice cream. Having

experienced these controlling and unnecessary treatments performed to women's already perfect bodies, Ensler sends the message to all women to; "Tell the image makers and magazine sellers and the plastic surgeons that you are not afraid. That what you fear the most is the death of imagination and originality and metaphor and passion. Then be bold and LOVE YOUR BODY. STOP FIXING IT. It was never broken."<sup>1</sup>

#### References

1. Ensler, Eve. The Good Body. New York: Villard Books, 2004.
2. Zola, Irvin K. "Bringing Our Bodies and Ourselves Back In: Reflections on a Past, Present and Future Medical Sociology" *JSTOR*. American Sociological Association. Web. 28 Nov. 2009.

<http://www.jstor.org/stable/2136796>

**Mental Constructs: Deinstitutionalized Slavery in Morrison's *A Mercy***

Author: Katherine Sullivan

Faculty Mentor: Michelle Filling, Ph.D.

Abstract: A close inspection of Toni Morrison's most recent novel *A Mercy* reveals slavery as more than the institution at the heart of the Civil War. It is possible for a person to be a slave to madness, love, or material possessions and such a loss of power can happen regardless of gender or race. All forms of slavery strip the individual of identity; wild and desperate attempts to regain control of oneself can have devastating consequences. The idea of power in regard to slavery and mercy, respectively, is also examined in an attempt to understand the role such relationships play in the various manifestations of slavery.

The world does not wait for us to grow. It shapes us and can transform us as fundamentally as the shifting of the seasons and the changing of the tides but it will not hesitate to pull us away before we reach absolution. Self-identity is a difficult concept; it is taxing to create and nurture it. Slavery is an institution that denied millions the opportunity to form their own identities. Aside from the physical torment and losses, slavery left deep psychological wounds that rendered many unable to feel free even after they had been liberated. Slavery, however, is not just a power construct that exists between two races or even between two people. An individual can enslave themselves; they can be held captive by emotions or dreams without even being aware of their confinement. In Toni Morrison's most recent novel *A Mercy* there is institutional slavery, but there are also prisons of a different kind. A person can be a slave to love, to madness, or to material possessions, and the extent to which they can or cannot exercise power has no bearing—no one is immune to mental imprisonment.

Many relationships have a built-in power disparity: parent/child, teacher/student, and boss/employee. One party is understood to have control over the other. Such is not meant to be the case in romantic relationships; however, the ideal is rarely the norm. Every day we have reason to believe that

“love may exist in starkly unequal power relations”<sup>3</sup> and may endanger people in regards to their individuality and freedom of self-expression. In *A Mercy* Florens is accused of being a slave to love. She is already a slave in the sense that she is an African-American girl who is owned by a white man, so she has the concept of slavery ingrained in her existence. This does not help her any in realizing her situation regarding her obsessive and singular love for the blacksmith. She is so enamored she defines herself only in terms of her relationship with him: “when I see you and fall into you I know I am live.”<sup>2</sup> Love essentially swallows Florens whole, burying her under the delusion that she can place responsibility for her entire being in the hands of another, one she barely knows. The most dangerous aspect of the situation is Florens’ inability to realize that the blacksmith does not want all she is giving him. She is unable to reconcile the fact that he may actually care about a person other than her.

Florens harbors the damaging thought that she was given up because her mother preferred her little brother. She wants to be owned by someone because she is so haunted by being disowned as a child. Malaik, a child being cared for by the blacksmith, reawakens in her that jealousy of her brother and fear that she is being abandoned. Lashing out at him is part of releasing a pain long-buried, a hurt that she likely cannot even fully process. The blacksmith, horrified at her actions, scathingly accuses her: “You are a slave...your head is empty and your body is wild...no constraint. No mind...a slave by choice.”<sup>2</sup> Florens is confused and horrified. Her only concept of slavery is that of history’s institution where blacks are subject to the whims of whites—she acquiesces to her love that yes, she is a slave because she became one when she was sold to Jacob Vaark. But she is human because of her devotion to him. The blacksmith disagrees that Florens’ obsessive adoration makes her less of a human and more of a slave; she loves blindly and with her body rather than her mind. Florens exhibits more distress over the loss of his love for her than over his cruel assertions that she is animalistic. She cannot tolerate the loss of identity that goes hand-in-hand with the loss of his affections—he is her only reference for both freedom and life. Cut free from him, she has no basis on which to build herself. Ironically, it is far more painful for Florens to be free of the slavery of love. She loved entirely at her own expense, confining herself to a prison of her own

design. She was incapable of realizing what she did to herself because she would not think to associate something as beautiful as her love for the blacksmith with the dark reality of slavery.

It is important to note that the wildness in question was believed by Florens to already be nesting in her before she reached the blacksmith; he was merely the catalyst for its release. Her hope is that the blacksmith will tell her of her worth, of the life she hosts that is not dark and violent. When he does the exact opposite, accusing her of being savage rather than comforting her lost sense of self, she asserts her new reality: “I am become wilderness.”<sup>2</sup> This is a moment of empowerment rather than deference because although she takes the words of her former lover, she follows them with the emphatic “...but I am also Florens. In full. Unforgiven. Unforgiving.”<sup>2</sup> She is asserting her identity for the first time and is absolutely unashamed. The wildness was planted and encouraged by slavery, fueled by hatred and compliance, but its ferocity is what allows Florens to pull through without losing her mind. This quality of turning a negative outcome to her advantage will help her move forward.

Florens is fortunate enough to have her slavery pointed out to her before her self-identity becomes irretrievable. She is unaware of her position, but she is the only one who fails to notice. What would befall an enslaved person if no one, including themselves, managed to realize the enslavement? What force can slip so quietly into a person’s life that it takes control without challenge or even acknowledgement? Mental illness can be that silent master—sometimes it is so subtle the person does not even realize they are sick, much less that they are suddenly at the mercy of something beyond their control.

Sorrow suffers from such an ailment. The trauma she lives through on the ship leaves deep psychological scars; however, she does not view herself as ill or disordered. Twin, a manifestation of Sorrow’s confusion, loneliness, and fear after the shipwreck, is to Sorrow merely a new friend who looks like her. She sees nothing foreboding or intrusive about Twin’s presence. For one reason or another, though, Sorrow keeps Twin’s existence a secret. She must know that she will remain better protected if

she keeps to herself. As this is the case, no one else has any idea of the extent of the damage to Sorrow's mind. They regard her as "mongrelized," daft, and aimless but do not know how far the roots of psychological trauma reach. People are too put off by Sorrow's melancholy attitude and frequent disappearances to attempt connecting with her. As a result, she is severely isolated. The existence of Twin feeds into this isolation, as Twin tells her when it is alright to speak and when she must stay away from people. Sorrow is being controlled by a force beyond her understanding; she believes Twin is merely a friend and would not have the knowledge or the resources to deduce the truth about her mental state. Sorrow cannot become any more than what people expect of her and her identity centers on the opinions of those around her. They do not offer her any chance to change, nor do they seem to anticipate it.

The birth of Sorrow's daughter fundamentally transforms her—Twin disappears and Sorrow renames herself "Complete." But has the wilderness disappeared with the birth of her daughter or has it just been rerouted? Now determined to do something singly and well, it would not be surprising if Sorrow became more set on fulfilling a mission than being a mother, if her daughter became not the ends but the means to which Sorrow could feel as if she has found an identity, as if she has completed something she chose. Trouble lies in the fact that she never did choose the child; she was impregnated by a stranger and possibly against her will. Similarly to Florens, Sorrow is trying to claim something that did not originate as her own. The situations of both women were born of powerlessness and now they are attempting to wrench some control out of the pieces they have left. The disconcerting fact is that power cannot keep them safe.

We want to believe that those who have power are safe, spared from the pain of violence, loss, or insanity. Jacob Vaark is supposed to be "safe" because he is white. He has established dominance over a plot of land he inherited and the slaves who work it for him. He fails to recognize that "he is enslaved to an idea of prosperity that costs him his life."<sup>1</sup> Jacob becomes so consumed with the gaining of material possessions that he can think of nothing else. He is entirely transformed by greed. When he speaks to Peter Downes and gets wind of the lucrative sugar enterprise, he is suddenly no longer a man who wishes

not to deal in slavery. However, he justifies it to himself by asserting that as long as he is not actually whipping slaves in Barbados, he is not doing anyone harm. Jacob distances himself from the far-reaching consequences of his actions and thinks only about what he will gain from them. He seems more pacified than happy to have his grand home finally built.

His quest for possessions becomes a mission he cannot separate himself from. In response to Rebekka saying they do not need another house, Jacob asserts “Need is not the reason...what a man leaves behind is what a man is...I will have it.”<sup>2</sup> He no longer thinks of his character in terms of his actions, emotions, or behaviors. Instead he believes the only legacy he can leave behind is locked in material items. Jacob needs something tangible, something he can touch, something he can withhold from others, just as Florens needs to feel wanted and Sorrow relies on Twin. He feels he can only identify himself by what he has. He is feverish with desire and like Florens and Sorrow, he does not see what he is becoming. It is difficult for him to tell that he is rendering himself a slave.

Even when Jacob falls ill he does not stop his desperate rush towards material gain. He demands to be put in his new house, to die there even though he was never able to live in it. He is rendered completely impotent. He is not saved by his status as a white landowner or by the money he manages to accumulate. The power society offers him does not save him from becoming beholden to materialism. He is meant to be above his slaves, but he falls victim to the same fate.

The truth is that no one can be spared from the various forms of mental and physical slavery because they are too far-reaching, intrusive, and sometimes difficult to realize. Slavery as a construct impairs self-identity. Florens feels her identity lies in the blacksmith, Sorrow in Twin, and Jacob in the legacy of wealth he can leave behind. They are all inundated with wildness. Florens decides to move on with it and attempt to make it hers even though it was bestowed upon her by others. Sorrow suffers its stigma as she is called a mongrel and then realigns it into tenacity regarding her daughter. Jacob grows

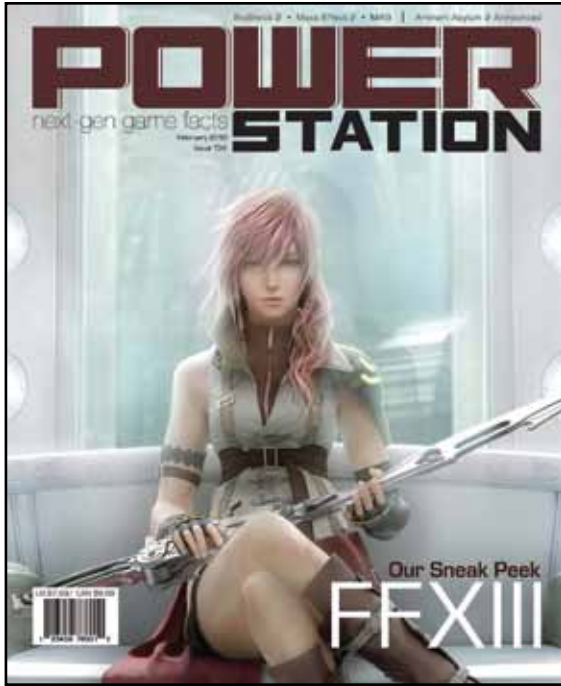
sick with and dies with it. No one moves forward without scars. The human mind is complex enough to be at once an incredible asset and a domineering curse. There are some things it holds onto forever.

#### References

- <sup>1</sup>Frykholm, Amy "A Mercy." *Christian Century* 126.4 (2009): 46-47. Academic Search Premier. EBSCO. Web. 28 Oct. 2009. <<http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=36634868&site=ehost-live>>.
- <sup>2</sup> Morrison, Toni. *A Mercy*. New York: Alfred A. Knopf, 2008. Print.
- <sup>3</sup> Rushdy, Ashraf H.A. "The Iron Fettered Weight of All Civilization: The Project of Barbara Chase-Riboud's Narratives of Slavery." *Callaloo* 32.3 (Summer 2009): 758-772. Project Muse. Web. 30 Sept 2009. <<http://muse.jhu.edu.ezproxy.library.cabrini.edu/journals/callaloo/v032/32.3.rushdy.html>>.



# BRIAN BIRDSALL, "Power Station Magazine"



# MARY GUNHEIM, "Corporate Identity Manual"

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[ INTRODUCTION & HISTORY ]



### THE BOOKCAROUSEL STORY

It all began in 1978, founded and led by Mary Gunheim, who had just graduated from the University of Wisconsin-Madison. She had a vision for a children's bookstore that would be a place where children could find a book that would help them learn, grow, and dream.

She knew that books were the key to a child's future, and she wanted to create a space where children could find the books they needed to succeed. She wanted to create a space where children could find the books they needed to succeed.

The name BookCarousel was chosen for its simplicity and its ability to evoke a sense of wonder and discovery. The name was simple, easy to remember, and it perfectly captured the spirit of the store.

[ COLOR PALETTE ]

**YELLOW**


HEX: #FFD700  
CMYK: 100, 0, 0, 0


**RED**

HEX: #E67E22  
CMYK: 0, 100, 0, 0

**PURPLE**

HEX: #9B59B6  
CMYK: 0, 0, 100, 0





[ BLACK & WHITE LOGO ]

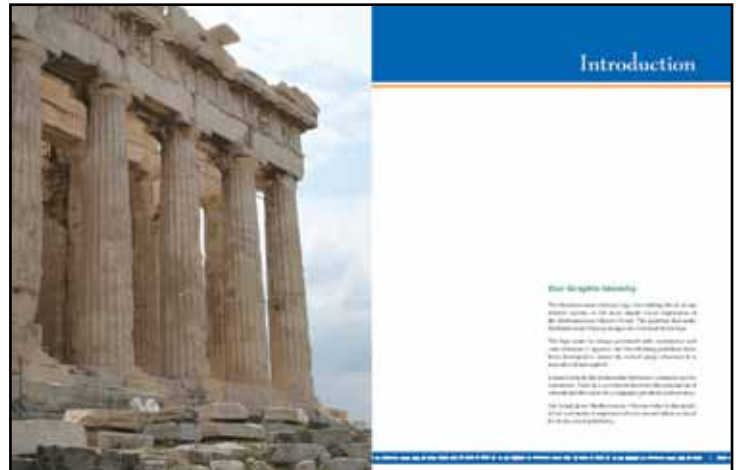
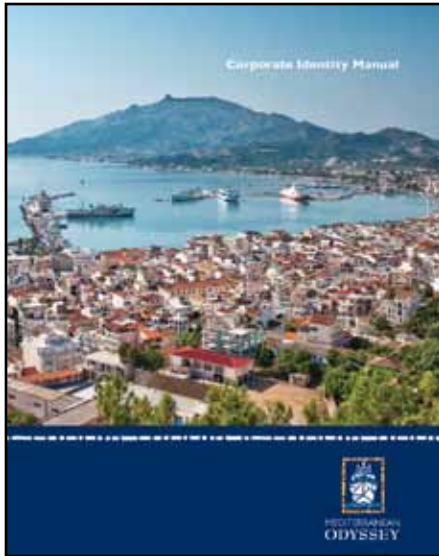
**TYPOGRAPHY**

**BOOKCAROUSEL**

**BOOKCAROUSEL**



# MARCIA McCONNELL, "Corporate Identity Manual"



# ANNA PARKER, "Chik Magazine"







