The Carthage Vanguard

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This is an original, academic journal. Any findings are academic and do not go so far as to claim to be true under every circumstance. Academic review is welcomed for the furtherment of education.

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A Letter from the Editor

By Allison Von Borstel

I am proud and excited to present you the inaugural issue of this research journal. Inspiration arose for the Carthage Vanguard from a conversation regarding the underappreciated talent of collegiate scholars. This research journal is a place for talented, young researchers to share and showcase their research at the undergraduate level. The articles published in this journal highlight the original perspectives, scholarly ambition, and excellent research of our authors. Their research is of exemplary quality and should be celebrated.

This year’s publication’s staff is comprised exclusively of students at the small, liberal arts school of Carthage. When creating the title of this journal, the team wanted a name that described the unique mission of the group: to create a multi-disciplinary journal by undergraduate students that could publish exemplary work from every corner of academia. “Vanguard” seemed fitting as it denotes a group of people leading the way in a new development; while its original meaning (troops moving at the head of the army) also nods to ancient Carthage during the Third Punic War.

A special thank you to our primary advisor, Joe Wall, without whom this journal would not be possible. Professor Wall has been instrumental to the journal since its inception, and he embodies the person we all aspire to become: a person who chases his dreams, emanates happiness, and proves that one really can have it all. Thank you for believing in us. I am truly blessed to count you as both a mentor and a friend. To my team: the success of this journal depended on each and every one of you; I am proud to have you on the team and couldn’t imagine taking this journey with anyone else. To Gregory Woodward, Julio Rivera, Kevin Crosby, and Dennis Munk, your academic advice was fundamental and much appreciated. To Ed Smeds, our generous benefactor, we extend our gratitude. Your support of this venture made The Carthage Vanguard feasible.

This journal was created to celebrate young ideas and foster curiosity. I hope you enjoy the articles and catch a spark of inspiration. Thanks again, it’s been an unforgettable ride.

Best regards,

Allison Von Borstel

Allison Von Borstel
Co-Architect & Editor in Chief
Humanities and Social Sciences
A Letter from the Advisor

The issue you see here is the direct result of the students credited. All of the submission guidelines, style guide, article selection, peer review, editing, website, and publication process was done by students for students, and I could not be more delighted with the team that launched this inaugural issue.

To Allison, my research colleague and the leader who made sure everything was done: I am proud beyond words of the woman you are and can’t wait to meet the one you choose to become. In you I see the old proverb of the student becoming the teacher come true. To Jacey, the leader who made sure we are known and funded: I hope my family is lucky enough to have someone like you as our doctor; now go cure cancer please. To Ben, our resident Phage Hunter and fraternity member: your quiet and steadfast approach will serve you and others well. To Steven, our mathematical heart and soul: thanks for sharing the joy of logic, you rekindled my thirst for science and for that I will be forever grateful. To John, the man who I learned can transform any canvas into a thing of beauty: your work will be displayed throughout any city in which you reside -- I can’t wait to see it. To Laurel, the most passionate and robust editor I will ever meet: I am amazed at your talent. I look forward to seeing where you go from here as you can do anything. To Cami, the heart of the team without whom we might all fall apart: you have an inner strength that is a thing of beauty, and I am thrilled to have watched you grow into the superb leader you are. To Taylor, the most impressive sketch artist you may not have heard of but should: you re-inspired my passion for educational breadth. I am excited for the future because of people like you.

I am thrilled and honored to be associated with this team. Students like these are the reason we teach, are inspired ourselves, and see a better world ahead. Should you be reading this and need someone of the highest caliber, please know you can likely find the person you need listed on the cover page - our staff. I vouch for each and every one of them without reservation. Thanks again for joining the journey with us. I hope you enjoy the read as much as we have enjoyed being able to bring it to you.

Thank you!

Joseph Wall
Chair, Business Department
A Letter from the College President

By Gregory Woodward

Undergraduate education is all about learning and growing. It is a truly special period during which students can share their passions and interests through their research. The Carthage Vanguard serves as a venue for talented, driven students to share their research with the undergraduate community and realize personal, academic growth beyond the classroom through the publication of their work.

The Carthage Vanguard is unique in that it is fully operated by undergraduate students. The editorial board is composed of bright, articulate students deeply involved in both their academic pursuits and other Carthage organizations ranging from further academic studies to community outreach. The College is excited to have them on board and feels they will contribute to the academic success of other students at Carthage.

A rigorous submission and review process for academic journals will ensure that the best pieces are chosen for publication. Due to the multidisciplinary nature of this journal, papers will have to pass multiple stages and checkpoints to reach publication. The review process is double blind and includes rigorous editing states from grammatical to argumentative revisions. The editorial staff of the journal retain full liberty regarding the number of articles published and will refer back to the final quality of papers. I have full faith that this journal will soon be an exemplary showcase of undergraduate work.

I encourage each student to submit their work – what better way to leave your mark during your years in college than to be published in a highly regarded journal.

Sincerely,

Gregory S. Woodward
President, Carthage College
Carthage College’s Brainard Writing Center was created in 2001. The program’s purpose was to help students take their thoughts and put them into writing. The Center assisted students at any stage of the writing process and in any division – ranging from the creation of an outline for a Western Heritage paper, to checking APA citations for a senior thesis. The tutors, students themselves, were trained individuals who not only aided students within the center, but also took an active role in working with students in the classroom and through various programs. Since its beginning, the Writing Center has developed into a useful and prestigious resource for all students at Carthage.

Problem Statement

As with numerous other organizations, the Center always looks for ways to improve its operations. The Fall 2013 Writing Center staff meetings focused on how to help clients with specific and unique cases concerning writing needs, as well as the development of strategies to help global writing issues among students.

Because the client sessions differed based on what type of paper the student brought in and what he or she wanted to work on, there was no basic way to structure a session. This was also due to the fact that each tutor had a different personality, and thus went about sessions in various ways.

The most efficient method to best-fit clients’ needs with the Center’s services would be the development of strategies based on past practices from sessions.

Purpose Statement

The purpose of this paper was to examine how the Director, Jean Preston, and her staff could better assist the clients that came into the Center in terms of scheduling sessions, refining the tutor selection process, and the preparedness of the tutors.

Guiding Questions

1. What was the most common time frame when students used the Writing Center?
2. What academic divisions were most represented in the work that students brought to the Writing Center?
3. Which writing techniques were most focused on in the writing sessions?

Hypotheses

1. Most students utilized the Writing Center between the hours of 12pm-4pm. 
   \( H_0 = \text{Most students did not utilize the Writing Center between the hours of 12pm-4pm.} \)
   \( H_1 = \text{Most students utilized the Writing Center between the hours of 12pm-4pm.} \)
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\[ H_0 = x_1 > x_2 \]

Terms:
- \( x_1 \) = the time period of 12pm-4pm
- \( x_2 \) = the time period of not 12pm-4pm

o Not 12pm-4pm = the Writing Center was open from 9am – 10pm on Mondays – Thursdays. Thus, the “not 12pm-4pm” referred to the hours between 9am-12pm and 4pm-10pm.

- Writing Center = a location in Carthage College’s Hedberg Library where student tutors aided other students in brainstorming, formatting, and writing papers.

2. Western heritage papers were brought into the WC more than other types of papers.

\[ H_0 = \text{Western Heritage, Social Science, and Natural Science papers were brought into the Writing Center most frequently.} \]

\[ H_1 = \text{Western Heritage papers were brought into the Writing Center more frequently than Social Science and Natural Science papers.} \]

Terms:
- \( x_1 \) = average number of Western Heritage papers
- \( x_2 \) = average number of Social Science papers
- \( x_3 \) = average number of Natural Science papers

- Western Heritage = a class offered at Carthage College that all incoming students (freshmen, transfers and adult education clients) took in order to graduate the college

- Social Sciences = subject areas including psychology, political science, communication, social work, sociology, economics, and geography

- Natural Science = subject areas including astronomy, biology, chemistry, environmental science, geography and Earth science, meteorology, mathematics, and physics

3. The issue of how to structure a paper was most common issue in sessions.

\[ H_0 = \text{The issues of structure, sentence-level concerns, and pre-writing were addressed in sessions frequently.} \]

\[ H_1 = \text{The issue of structure was address more often in sessions than sentence level concerns and pre-writing.} \]

Terms:
- \( x_1 \) = average number of times structure was addressed
- \( x_2 \) = average number of times sentence-level concerns were addressed
- \( x_3 \) = average number of times pre-writing was addressed

- Structure = refers to the formatting and organization of the paper; how the paper is designed to connect back to the client’s thesis statement in a thoughtful manner

- Sentence-level concerns = refers to issues regarding mechanics, grammar, word choice, and formality of the sentences written

- Pre-writing = refers to brainstorming ideas and creating an outline for a paper

Chapter Summary

The Writing Center continuously desires to investigate the strategies for improving its methodologies for how to help clients during sessions. By reviewing past practices regarding scheduling, academic divisions, and writing issues, the Writing Center staff can better assess how to create appropriate client schedules and how to prepare for addressing clients’ key writing issues.

Review of Related Literature

Overview of Study in relation to Related Literature

Writing centers throughout the country have worked on improving their methodologies in order best serve their clients. Many have presented research regarding their findings in relation to scheduling formats, academic focus, and proper tutor training, each of which relate to this researcher’s study of evaluating common time frames, academic divisions, and writing issues.

Scheduling Time Frames

In his essay “Efficiency and Insecurity: A Case Study in Form Design and Records Management,” C. Michael Smith of Winthrop College reveals complications he faced in the early years of the writing center he started at the College. He states the importance of keeping accurate records on client information and progress; however, this may be lost as writing center staffs tend to focus on “the responsibility to see that a busy office runs efficiently, that services are delivered to students and faculty as effortlessly as possible” (Olson, 115). The centers’ directors and tutors tend not to worry about recording keeping of client forms, or in the Brainard Writing Center’s case, the statistics regarding the common time frames students use the center. Thus, as Smith details in his work, it is necessary to learn the methods that work best for a center during its development, as each center functions in a different way and therefore will develop different practices for going about tutoring and record
keeping. In his case, Smith and his fellow colleagues began recording client information with hand-generated, complicated forms; after three years, a more simplified, computer-generated version was used (Olson, 117). This center, therefore, used emerging technology to aid them in the documentation process, which the Brainard Writing Center has done by using the WCOnline program for scheduling and record keeping purposes.

The tutors, students themselves, were trained individuals who not only aided students within the center, but also took an active role in working with students in the classroom and through various programs.

Smith notes, however, “a writing center, like a person, can be slowed down by excesses” (Olson, 122). While in this instance Smith was referring to excess papers needing to be filed within the center, this idea can also be applied to excess tutors in the center. The Brainard Writing Center’s Director, Jean Preston, currently assigns two tutors to every hourly shift between 9am and 10pm. She believes this is a good balance so that the Center is not too crowded or loud that it detracts from the tutoring. To her, having more tutors in the center at a time would be, as Smith refers to it, excess. However, the two tutors per shift limit may be hindering writing center performance; it may be beneficial to have three tutors working during certain time frames so that more students can use the Center’s services. Thus, there is a need to research the most common time frame students use the Center so that Jean Preston can assign more tutors to work during the frequent hourly shifts. This will allow more clients to schedule appointments during those times and benefit from the Writing Center’s services.

Academic Divisions

Lynne Ronesi of the American University of Sharjah, UAE researched the Writing Fellows program at the university to understand the process of how tutors assist students in a variety of different disciplines. She states one case of an engineering professor’s astonishment,

“Somewhat to Dr. Davenport’s surprise, the writing center tutor who turned up to present on citations was actually a student in that engineering class... the writing fellow’s savvy regarding the services of the writing center clued the professor into a heretofore untapped resource—tutor presentations on writing issues—and simultaneously reinforced the notion that engineering students can be excellent writers” (Ronesi).

Issues Within Students’ Writing

While Alexander Friedlander’s essay “Meeting the Needs of Foreign Students in the Writing Center” focuses on how to tutor students who acquire English as a second language, his methodologies and insights can be

This shows while students may be skilled in one area, they are capable of assisting others in various academic areas, which is seen the in Brainard Writing Center. The tutors’ majors encompass a variety of disciplines including, but not limited to, Chinese, mathematics, marketing, and environmental science. This array of subject areas helps tutors relate to clients, as they are able to make connections with similar interests in those areas, thus creating a stronger tutor and client relationship. The variety of majors also allows the tutors to take different approaches when conducting a writing session, as they come from different backgrounds regarding the writing process.

However, Ronesi’s article also relayed that without proper knowledge, tutors are incapable of assisting others:

“Once trained, writing fellows—all placed in courses outside of their major—would be expected to work closely with the professor to understand the discipline-related demands of the writing assignment. While this generalist approach worked well...when writing fellows supported a few higher-division classes, certainly, the gravitation to lower-division classes made the writing fellow debate surrounding generalist vs. specialist approaches a moot issue for our program, since the discourse of the lower-division classes was not yet that specialized” (Ronesi).
applicable to all types of students. The University of Alabama professor details the need for proper tutor training that provides an “introduction to error analysis” and addresses typical errors seen in students’ writing (Olson, 209). Friedlander states “tutors must become aware of which errors contribute most to the students’ difficulties and learn not to correct every single error” (Olson, 209). Also in the training sessions, students should “become acquainted with the formal terminology they will be using” (Olson, 210). These methodologies of tutor training can be applied to the Brainard Writing Center. By addressing key problems seen in students’ writing, the tutors can develop strategies to address the issues pertaining to specific areas, such as the organization of a paper and sentence level concerns.

It is also important for tutors to address problems within clients’ papers, yet the tutors need to know how to address the most common issues that clients have when writing.

Friedlander found that organization of a paper is a “major problem area for many foreign students” and is “often culturally based” (Olson 211). Thus, there is a need for the construction of a basic outline for how to format a paper and key elements to include in each section. This resource will allow tutors an easy reference and aid in clarification of any problems or concerns that they, or the client, have about how to organize their work. Friedlander also saw that sentence level errors are commonly found, yet “one of the most effective pedagogical tools tutors can use is sentence combining” (Olson, 212). The tutors in the Brainard Writing Center not only want to help students fix these types of errors, but also desire to elevate students’ writing academically. Thus, by teaching students to combine their thoughts into more cohesive and complex sentences, the students’ writing will become more sophisticated and well constructed. Therefore, the Center should research which writing techniques were most focused on in sessions in order to prepare proper training instruction for the tutors. This will allow both the tutors and clients to feel more comfortable in fixing issues regarding specific problem areas.

Chapter Summary

There is extensive research in regards to creating efficient writing centers. While there is a want and need to provide tutors and clients with many opportunities to schedule sessions, the most appropriate times to have more tutors in the center must be found so that there is not an “excess” of tutors every hour. Many students are competent writers, but centers should try to hire tutors that can aid specific academic areas to best assist clients by understanding the material the students work with. It is also important for tutors to address problems within clients’ papers, yet the tutors need to know how to address the most common issues that clients have when writing. Thus, more research is required to provide tutors with the information needed to best help clients that not only come into the Brainard Writing Center, but also centers throughout the country.

Methodology

Setting, Participants, and Data Collection

All of the Writing Center sessions took place in Carthage College’s Brainard Writing Center located in the Hedberg Library. The participants included students of the college in the following categories: freshmen, sophomore, junior, senior, and adult education.

The statistical records of the Center provided all of the data collected for this research. There are two sources of this data: hand recorded Writing Center statistics transferred into excel documents and statistics from the WCOnline website, which was introduced to the Center starting in Fall 2012. The statisticians of the Center provided this researcher the records needed to collect the necessary data. The Director of the Writing Center, Jean Preston, provided permission for the use of these statistics for this research. No student names were disclosed due to confidentiality.

Time Frame of Data

The data used to research the most common time frame when students used the Writing Center was obtained from WCOnline statistics during the Fall Semester of 2012 and Spring Semester of 2013. In fall of 2012, 995 sessions were held, whereas in Spring 2013, 676 sessions were held. The data obtained was separated into each semester and by hours, ranging from 9am to 9pm. The hours were split into three sections: 9am-12pm, 12pm-4pm, and 4pm-9pm. Two chi-square tests, one for each semester, was used to analyze this data and then compared between each other.

Academic Divisions Data

The data used to research the academic divisions that were most represented in students papers was ob-
tained from Writing Center Statistics during the Fall Semester of 2011 and Spring Semester of 2012, along with data obtained from WConline statistics during the Fall Semester of 2012 and Spring Semester of 2013. In fall of 2011, 634 sessions were held, and in spring 2012, 750 sessions were held. In fall of 2012, 995 sessions were held, whereas in spring 2013, 676 sessions were held. The data obtained was separated into each semester and by academic divisions, mainly focusing on the areas of Western Heritage, Social Science, and Natural Science. A Kruskal-Wallis test was performed with the semesters indicated to investigate if there was a certain academic division that was more represented in sessions than others. Then, two Test of Hypothesis, One Proportion were performed to determine if the proportion of Western Heritage papers brought into the center was greater than Social Science papers.

**Writing Issues Data**

The data used to research common writing issues focused on in sessions was obtained from Writing Center Statistics during the Fall Semester of 2011 and Spring Semester of 2012, along with data obtained from WConline statistics during the Fall Semester of 2012 and Spring Semester of 2013. In fall of 2011, 634 sessions were held, and in spring 2012, 750 sessions were held. In fall of 2012, 995 sessions were held, whereas in spring 2013, 676 sessions were held. The data obtained was separated into each semester and by writing issues addressed in sessions, mainly focusing on issues with structure, sentence-level concerns, and pre-writing. A Kruskal-Wallis test was performed with the semesters indicated to see if there were certain writing issues that were addressed more often in sessions than others. Then, two Test of Hypothesis, One Proportion were performed to determine if the proportion of structure issue papers brought into the center was greater than sentence level concern papers.

**Data Analysis Tools**

To analyze the first set of data, a chi square test was used with a 0.1 significance level. This value was used due to the fact that there is not a lot of research in this field, and thus not much data to use.

A Kruskal-Wallis test was used for the latter two sets of data with a 0.1 significance level. This value was used due to the fact that there is not a lot of research in this field, and thus not much data to use.

A Test of Hypothesis, One Proportion was used for the latter two sets of data with a 0.1 significance level. This value was used due to the fact that there is not a lot of research in this field, and thus not much data to use.

**Chapter Summary**

The data used for this research consisted of counts: the number of times clients used the Center during a specific time frame, the amount of academic divisions represented in student work, and the types of writing issues addressed in sessions. Thus, chi square tests, Kruskal-Wallis tests, and Test of Hypothesis, One Proportion were used to analyze the data. By using these tests, this researcher is able to assist the Brainard Writing Center in recognizing necessary adjustments with scheduling and tutor training.

**Results**

**Time Frame Data Analysis**

The data obtained was separated into Fall 2012 Semester and Spring 2013 Semester, and then was separated by 3 hour sections: 9am to 12pm, 12pm to 4pm, and 4pm to 9pm. Two chi-square tests, one for each semester, was used to analyze this data and then compared between each other.

The results are as follows:

- **H10**: for both Fall 2012 and Spring 2013 semesters = Most students did not use the Writing Center more frequently from 12pm-4pm when compared to the 9am-12pm and 4pm-9pm time frames.
- **H10**: for both Fall 2012 and Spring 2013 semesters = Most students used the Writing Center more frequently from 12pm-4pm when compared to the 9am-12pm and 4pm-9pm time frames.

Decision rule for both Fall 2012 and Spring 2013 semesters: Reject H10(1) if

\[ x^2 > 4.605 \]

Decision for both Fall 2012 and Spring 2013 semesters: Reject H10(1) and accept H10(1) since for Fall 2012, \[ x^2 = 78.10 > 4.605 \], and for Spring 2013, \[ x^2 = 97.31 > 4.605 \], which are both significant beyond .1 level.

**Academic Divisions Data Analysis**

The data obtained was separated into Fall 2011 Semester, Spring 2012 Semester, Fall 2012 Semester, and Spring 2013 Semester, and then by the academic divisions of Western Heritage, Social Science, and Natural Science. A Kruskal-Wallis test was performed with the semesters indicated to see if there was a certain academic division that was more represented in sessions than others.
Then, two Test of Hypothesis, One Proportion were performed to determine if the proportion of Western Heritage papers brought into the center was greater than Social Science papers. It was hypothesized that 30 percent of papers were related to Western Heritage, and less than 30 percent of papers were related to Social Science. A Test of Hypothesis, One Proportion was not performed for the Natural Science division because its results from the Kruskal-Wallis test were insignificant when compared to Western Heritage and Social Science divisions. The results were as follows:

Kruskal-Wallis test Results:
H₀ (2) = Western Heritage, Social Science, and Natural Science division papers were all brought into the Writing Center the same number of times
H₁ (2) = Western Heritage, Social Science, and Natural Science division papers were not all brought into the Writing Center the same number of times

Decision rule: Reject H₀ (2) if x² > 4.605
Decision: Reject H₀ (2) because x² = 9.846 > 4.605 at .1 level of significance

Test of Hypothesis, One Proportion for Western Heritage Results:
H₀ (3) = p₁WH < .30
H₁ (3) = p₁WH > .30
Defined terms: = proportion of Western Heritage papers brought into the Writing Center

Decision rule: Reject H₀ (3) if z > 1.28
Decision: Reject H₀ (3) because z = 11.351 > 1.28 at .1 level of significance

Test of Hypothesis, One Proportion for Social Science Results:
H₀ (4) = .30
H₁ (4) = < .30
Defined terms: = proportion of Social Science papers brought into the Writing Center

Decision rule: Reject H₀ (4) if z < -1.28
Decision: Reject H₀ (4) because z = -11.548 < -1.28 at .1 level of significance.

Writing Issues Data Analysis

The data obtained was separated into Fall 2011 Semester, Spring 2012 Semester, Fall 2012 Semester, and Spring 2013 Semester, and then by writing issues of structure, sentence-level concerns, and pre-writing. A Kruskal-Wallis test was performed with the semesters indicated to see if there were certain writing issues that were addressed more often in sessions than others.

Then, two Test of Hypothesis, One Proportion were performed to determine if the proportion of structure issue papers brought into the center was greater than sentence level concern papers. It was hypothesized that 30 percent of papers concerned structure issues, and less than 30 percent of papers concerned sentence level issues. A Test of Hypothesis, One Proportion was not performed for the pre-writing issue because its results from the Kruskal-Wallis test were insignificant when compared to structure and sentence level concern issues. The results are as follows:

Kruskal-Wallis test Results:
H₀ (5) = Structure, Sentence Level Concerns, and Pre-Writing issues were all brought into the Writing Center the same number of times
H₁ (5) = Structure, Sentence Level Concerns, and Pre-Writing issues were not all brought into the Writing Center the same number of times

Decision rule: Reject H₀ (5) if x² > 4.605
Decision: Reject H₀ (5) because z = 5.102 > 4.605 at .1 level of significance

Test of Hypothesis, One Proportion for Structure Issue Results:
H₀ (6) = .30
H₁ (6) = > .30
Defined terms: = proportion of papers brought into the Writing Center that worked on structure issues

Decision rule: Reject H₀ (6) if z > 1.28
Decision: Reject H₀ (6) because z = 10.088 > 1.28 at .1 level of significance

Test of Hypothesis, One Proportion for Sentence Level Concern Issue Results:
H₀ (7) = .30
H₁ (7) = < .30
Defined terms: = proportion of papers brought into the Writing Center that worked on sentence level concern issues

Decision rule: Reject H₀ (7) if z < -1.28
Decision: Accept H₀ (7) because z = 19.723 > -1.28 at .1 level of significance.

Chapter Summary

The time frame results proved the investigator’s first original research hypothesis: Most students utilized the Writing Center between the hours of 12pm-4pm. The academic division results proved the researcher’s second original research hypothesis: Western heritage papers were brought into the Writing Center more than other types of papers. The writing issues results were not sufficient to reject the researcher’s third null hypothesis: The issue of how to structure a paper was not the most common issue discussed in sessions. It was found that the issue of sentence level concerns was most common issue discussed in sessions. This can be seen in the data.
as the z score for sentence level concerns (19.723) was higher than that of the z score for structure (10.088).

Discussion

Time Frame Data

The first original research hypothesis was supported by the data analysis – most students used the Writing Center services from 12pm-4pm. The reasoning behind this could result from a number of factors. One could be that some students cannot use the Center because they have class during the morning hours, from 9am to 12pm. Another factor could be that students cannot use this resource because they have athletic practice and club meetings to attend during the hours of 4pm to 9pm. Thus, there are two actions the College could take.

The first option is that Carthage should rearrange its class, athletic, and club meeting schedules so that they occur at various times of the day, rather than centralized between the 9am to 12pm and 4pm to 9pm time sections so that students could utilize the Center during these times. This, however, would be tedious and inconvenient; even though the Writing Center is a useful resource on campus, it is not the College’s central focus – that would be the academia of the College. Thus, the schedule of the College should reflect its most prominent focus.

The other, more reasonable, option would be to accommodate more students in the Center during the times between 12pm and 4pm. Currently, the Writing Center employs two tutors per hour to work with students. Thus, it may be beneficial to add an extra tutor during these time slots so that more students can use the Center’s services when it is most convenient for them. This would not only assist the College’s students who need help with papers, but also give the Center’s tutors more hours to work. Thus, the data studied in regards to time frames of the Writing Center was useful as it presented a need for increased tutor presence in the Center between the hours of 12pm and 4pm to assist students with their papers. In discussing these results with the Center’s director, this researcher was able to implement the use of three tutors in the Center from 12pm-4pm, Monday through Thursday, for the Spring 2014 semester.

Academic Divisions Data

The second original research hypothesis was supported by the data analysis – most students brought Western Heritage papers into the Writing Center. The reasoning behind this could result from a number of factors. One could be that some students are unfamiliar with how to properly write a textual analysis essay, and thus take it upon themselves to come into the Center to receive help and improve their writing. Another factor could be that some Western Heritage teachers require their students to use the Center’s services to work on paper corrections or certain writing issues. Thus, while there are many actions the Writing Center can take using the data presented to their benefit, two actions will be discussed.

The first action could be to hire more tutors that are proficient in tutoring Western Heritage papers. Carthage College currently employs two Western Heritage tutors to help students work on the content of their papers. The Center may consider hiring these tutors to work in the Center to integrate working on both writing and content issues in students’ Western Heritage papers.

Another action to take using this information would be to train the current tutors to be more proficient in assisting with Western Heritage papers. This can be done during the weekly staff meetings that the director conducts. The College’s Western Heritage tutors could come in for a few meetings to provide the tutors with tips on how to best assist students with their papers in that discipline. All tutors are capable of providing assistance with all types of papers, especially Western Heritage, because they see these types of papers so frequently. However, their tutoring can be enhanced with the help of tips from Western Heritage tutors. Thus, the data studied in regards to academic division papers most prevalent of the Writing Center was useful as it presented a need for increased tutor knowledge in regards to Western Heritage papers.

Writing Issues Data

In contrast to the prior two sections discussed, the third original research hypothesis was not supported by the data analysis – most students’ sessions did not address structural issues; they addressed sentence level concern issues. This finding is surprising, yet rational. Many students that come into the center have ideas and just need help putting them into a logical structural format. However, once the structure of the paper is determined, many students still have difficulty conveying their ideas through words. Thus, while there are many ways the Center can use the data presented to their benefit, two strategies will be discussed.

One strategy could be creating mini workshops for Writing Center tutors during their weekly staff meetings. Director Jean Preston could conduct sessions regarding proper terms to use in describing how to fix certain sentence level concerns, such as how to describe indepen-
dent vs. dependent clauses, fix run-on sentences, and address punctuation issues. The tutors could also share their own experiences, tips, and techniques for how to assess these issues.

Another strategy to help clients would be to create mini workshops for Carthage students. The tutors could conduct the sessions so that the Center still retains the peer tutor relationship it already practices. These workshops could be held within the Center so the students can become familiar with the Center and the resources it provides, and hopefully come back to utilize the resources after the workshop. Thus, the data studied in regards to writing issues addressed in Writing Center sessions was useful as it presented a need for increased tutor and client knowledge in regards to how to address sentence level concern issues.

Chapter Summary

Overall, the research conducted provided sufficient information in regards improving the methodologies of the Brainard Writing Center at Carthage College. The Center should look into adding more tutors between the hours of 12pm and 4pm. They should also hire more tutors that are proficient in Western Heritage content or provide more assistance to current tutors on how to tutor Western Heritage papers. The Center should hold sentence level concern workshops for tutors and clients to keep them up to date on grammar rules and provide them the overall tools to best assist their clients in terms of wording issues. Thus, while the Brainard Writing Center has grown into a prestigious service at Carthage College, it is always looking to improve its current practices. The research in this paper can assist them in further development of the center to best aid the clients they serve.

Author Reflection

I thoroughly enjoyed conducting this research for two reasons. The first is because I am tutor in the Writing Center. Thus, I work closely with these issues. It was interesting to learn the statistics behind the job I perform on a weekly basis. Not only did I get to understand how the Brainard Writing Center at Carthage College functioned, but I also learned some of the ins and outs of centers at other universities. While all have the same purpose, their methodologies and logistics vary, and these are the items that can make a writing center successful or a failure.

In researching related literature and comparing the Center’s statistics over the past few years, I was able to not only make conclusions about if the way this re-source functions is beneficial or not, but also investigate how to make improvements in our current operations. The main area that I work with in the Center is in terms of scheduling. Thus, the findings from the Time Frames Data was useful to review in making the schedule for the 2014 Spring semester for the tutors’ availability. In reviewing my findings with the Center’s director, Jean Preston, she agreed with my findings and suggestion of allocating three tutors to be in the center from the times of 12pm to 4pm on Mondays through Fridays. Thus, not only did I find this research interesting, but it also turned out to be beneficial for my duties as a tutor and manager of the Center’s schedule.

References


How to Create Sustainable Healthcare Systems in Rural Kenya

By Vivian Onano

Kenya faces significant healthcare challenges resulting from a significant population growth in the past decade. According to figures from the World Bank, the population has doubled over the last 25 years, to about 40 million people, and the rapid population growth is set to continue. As a result of this, the country’s healthcare sector has been facing huge challenges such as underfunding and shortage of skilled health workers to keep up with the population growth. This has made it very crucial to create sustainable healthcare systems that will be affordable and accessible to all. The goal of sustainable healthcare systems is to have local communities run the healthcare facilities efficiently by themselves.

Rural healthcare in most parts of Kenya has been adversely affected by mismanagement by the various healthcare managers in the rural communities, low morale of healthcare workers, acute shortage of trained professionals, disconnect between needs of the community and the healthcare service available. As a result of these problems, mortality rates have remained high and continue to rise, particularly among women and children in the disadvantaged communities.

As of 2009, the mortality rate of children under the age of five years was 84 per 1,000 live births, which is higher than the Millennium Development Goal of 33 per 1,000 live births (“Kenya Health Statistics Profile”, 2010). While maternal mortality was at 530 per 100,000 per live births, the Millennium Development Goal target is 95 per 100,000 live births by 2015 (“Kenya Health Statistics Profile”, 2010). The maternal mortality rate in Kenya is higher than the rate in most troubled countries in the world. In comparison to the war-torn Afghanistan, which recorded 460 deaths per 10,000 live births in 2010, Kenya is worse-off, according to World Bank research (Gathigah, 2013).

There is a significant amount of work that needs to be done to improve access to healthcare in Kenya, and more so in rural areas where 66.7% of Kenyans live (Toda et al., 2012). According to Toda et al (2012), 46% of the rural dwellers in Kenya live below the poverty line. This makes it very imperative that healthcare services should either be very affordable or free. This is in light of the fact that infant and child mortality rates are important indicators that show the health status and socio-economic development of a country (Patterson, 2011).

In addition to maternal and infant mortality, most Kenyans suffer from contractile diseases such as malaria, HIV/AIDS and tuberculosis that are also part of the Millennium Development Goals and have targets to be met by 2015 (UNEP, 2006). According to the UNEP report (2006) six percent of the Kenyan population between the ages of 15 and 49 years is affected by HIV/AIDS, in comparison to 4.9% in the Africa Region. The report also shows that among the East African countries, Kenya has the highest adult prevalence of HIV/AIDS: about 13.9% compared to 8.1% in Tanzania and 8.3% in Uganda (UNEP, 2006).
The HIV/AIDS incidence is most prevalent amongst young people within the ages of 14-15 and vulnerable young women with little or no education. According to the UNEP report (2006), teenage girls are five to six times more likely to get infected with the virus than their male counterparts. The high HIV/AIDS prevalence rate is worrisome and has negative effects on the economic growth of the country. This is detrimental to the future of any country as young people are very crucial to the long-term economic growth and development of a nation.

**History and Background**

Quality healthcare is very critical to the economic development of every country. Kenya has a population of over 43 million people and almost half the population is living in poverty. This has made provision of basic healthcare services to the citizens very difficult (Bliss, 2013). The most affected are people living in rural communities and densely populated slums. With 60% of the population in rural areas, there is need for investing in quality healthcare systems in rural parts of Kenya (Shakwei, 2013).

In 2011, the Kenyan gross domestic product was estimated at 33.6 billion, yet only 4.6% was invested in healthcare systems (Bliss, 2013). There has been significant dependence on donor countries and foundations to supplement the national health budget in Kenya. This has increased from 4.9% in 1995 to slightly above 14.8% in 2006 (Bliss, 2013). Interestingly, this donor dependence percentage in Kenya is still lower than some other African countries that have donors contribute almost 30-40% of their health expenditures (Bliss, 2013). Despite all of the aid coming in to facilitate the healthcare operations, Kenya and many other countries Sub-Saharan Africa are far from achieving the health-related Millennium Development Goals that are intended to be reached by 2015.

After attaining Independence in 1963, the Kenyan government came up with a plan to provide free healthcare services to its people. Healthy citizens are very essential for the economic development of a country. The practice of free healthcare services was implemented two years after it was proposed under the name "free health for all" (Bliss, 2013). Due to the lack of user fees for those seeking healthcare in public clinics, the idea for "free health for all" was not sustainable. The concept failed and did not continue after 1973 due to financial constraints, and the government had to re-introduce user fees in public clinics at the community levels (Bliss, 2013).

Since then, there have been tremendous changes in the healthcare sector; for example, institutionalizing the Kenya Health Policy Framework that aimed at "providing quality healthcare that is acceptable, affordable and accessible to all" in Kenya by 2010 (Bliss, 2013). These policies by the Kenyan Ministry of Health helped develop standards and allocation of resources for healthcare services.

As of 2013, Kenya has 5,000 health facilities with 41% being overseen by the government, 15% run by NGOs and 43% operated by the private sector (Bliss, 2013). Most private sector operated facilities are for people with a higher income, and they include the nursing homes and maternity facilities (Bliss, 2013). Though Kenya has many health facilities, the shortage of physicians is another major problem that has been facing the healthcare sector. According to World Health Organization, the country only has 4,500 physicians (Bliss, 2013). The U.S physician to patient ratio is 26 per 10,000 people; in Kenya the ratio is 1 per 10,000 people, which is even below average for the Africa region (Bliss, 2013). These physicians - 3,500 in total - prefer to work in the private sector rather than with the government, because of the incentives and the conducive working environment provided by these non-governmental health institutions (Bliss, 2013). The migration of these health experts to either the private sector or outside the country has made it very difficult to retain the qualified health personnel.

A recent study estimated the net emigration rates of doctors in the world, and Kenya ranked highly with a 51% (Bliss, 2013). This is because of the better working conditions that these physicians are guaranteed abroad, and also appealing high salaries (Bliss, 2013). The side effects of these emigrations are very lethal because human life is involved. In addition, the government experiences a financial
loss due to all the training that had been invested in professionals who later leave.

**Solution 1: Increase the Number of Health Workers**

The shortage of community health care workers has been one of the reasons why mothers in Kenya shun Free Maternity Health Care (Gathigah, 2013). As a result, 92% of the expectant mothers in Kenya do attend antenatal care and only half of that percentage delivers in the hospital (Gathigah, 2013). Apart from the hospitals being understaffed, the facilities do not provide a clean environment for women to deliver (Gathigah, 2013). For example, at a health facility in the Kibera slums in Nairobi, newborns are forced to share beds while the mothers sleep on the floor (Gathigah, 2013). Some of the possible causes of shortage of community health care workers include: outbreaks, natural disasters, conflicts and lack of incentives to work in hard-to-reach places (WHO, 2006). The ratio of healthcare workers to individuals in a population has a direct relationship to the health of the population. There is a direct relationship between the ratio of health workers to the population and the population’s health: as the number of health workers reduces, survival of women during birth and children in early infancy declines proportionately (WHO, 2006).

World Health Organization describes community health workers as people whose main activities are aimed at improving health (WHO, 2006). These people include people who provide health services and management and support workers. Globally, there are 59.8 million health workers, of which two-thirds of them provide health services and one-third are management and support workers (WHO, 2006). It is significant to note that only 3% of the 59.8 million healthcare workers worldwide are in sub-Saharan Africa, yet the region accounts for 25% of the global burden of disease (WHO, 2006). The Americas enjoy 42% of health workers, and only account for 10% of the global burden disease (WHO, 2006). The disparity is enormous, and most African countries would benefit greatly from investing in the training and empowering of more health workers.

According to a World Health Organization analysis, the African continent needs at least 2,360,000 more health service providers and 1,890,000 more management and support workers (WHO, 2006). It is impossible to achieve the health goals of a country without a well-trained, adequate, and available health work force. Kenya’s lack of health workers 1.69 health workers per 1,000 people is below the World Health Organization standards (Green, 2013). It is a significant contributing factor to the rising rates in maternal and child mortality.

As of 2013, the Kenyan government had reduced its health budget to 2.5% of the national budget, which is below the 15% mark that was recommended at the African Union’s Abuja declaration in 2001 (Gathigah, 2013). While Kenya’s healthcare budget has been reducing, Cuba on the other hand has been increasing the government spending in healthcare from 5.5% of gross domestic product in 2004 to 9.6% of the gross domestic product in 2009 (Grogg, 2013). This increase in the money allocated to the healthcare docket has led to an increase in the number of community healthcare workers (Grogg, 2013).

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**Only 3% of the 59.8 million healthcare workers worldwide are in sub-Saharan Africa, yet the region accounts for 25% of the global burden of disease**

The empowerment of local health workers is a concept that parallels what the United States is trying to implement in their health care system (Singh, 2013). Most states in the United States are creating formal accreditation programs for Community Health workers so that their jobs will be recognized by the Department of Labor (Singh, 2013). The United States government has come up with three ways of integrating the community health workers in the healthcare process and compensating them. The models include: more employment of Community Health Workers as extensions of the hospital systems, management of the community health workers through community based non-profit organizations, and management of the Community Health Workers by entities that operate at the in-
interface between health systems and the community (Singh, 2013).

The first two approaches will broaden the health care system’s reach to the communities, and the last will combine these roles while borrowing ideas from global experiences with scalability and opportunities for financial sustainability (Singh, 2013). Research has shown that community health workers, who integrate their knowledge of the local social service with the knowledge of patients’ individual health conditions, can create a vital link for vulnerable populations (Singh, 2013).

Possible solutions to the shortage of community health workers include: improving the training for health workers, creating career incentives to encourage them to work in the rural and disadvantaged areas, creating a conducive working environment, ensuring they are safe, implementing the national plan on increasing the number of healthcare workers in the hard hit regions, and allocating more funds for training of healthcare workers (WHO, 2006).

It is necessary to enhance the relationship between the community health workers and the people they are serving. In a pilot project that was conducted by the General Electric Global Health program in Ethiopia, the results displayed the vital role that the community health workers play in improving the healthcare delivery in rural communities (“Developing Global Health”, 2008). The organization partnered with the Ethiopian government to train 34,000 community health workers in the rural areas (“Developing Global Health”, 2008). Ethiopia has 85% of the population living in the rural areas (“Developing Global Health”, 2008). The duty of these community health workers is to walk from door to door delivering services. Because they are known by the locals, the communication is easy and they are trusted. Since this program was started, there has been a tremendous decrease in child mortality in the past 5 years: it has decreased by 25% (“Developing Global Health”, 2008). Due to the success of this program in Ethiopia, Kenya can also apply it to improve access and delivery of healthcare services. As demonstrated, the aim of community health workers should be to do more actual treating of patients and less merely referring them.

The main disadvantage with this solution is that the government needs to invest more money in order to increase the number of community health workers. For the 2013/2014 budget, the Kenyan government has allocated 3.1 billion for the training of community health workers in the 47 different countries which will translate to about 30 community nurses and 10 health workers (“Highlights of Budget”, 2013). The budget does not include allocation for the management team that plays a critical role in the delivery of health care services in the rural areas.

Solution 2: Increase the Government Budget Allocation to Healthcare and Direct Facility Funding

The government budget allocation to health care sector in Kenya has been decreasing, yet with the rapid increase in the Kenyan population, the reverse should be happening. In 2012/2013 the government allocated 55.1 billion shillings to the health care, and only 34.7 billion shillings out of the 1.6 trillion shillings total budget for the 2013/2014 (“Highlights of Budget”, 2013). The decrease in budget allocation will have a negative impact on the delivery of healthcare in rural places. The reason for the low budget allocation is due to the current economic and development status.

Research has shown that healthcare systems in Kenya are pro-wealthy, and often the poor people have to contribute a larger portion of their income to health care than the rich (Toda et al.,2012). It is necessary for the government to allocate more money to the healthcare sector, so that every citizen has an equal access to quality health care services (Opwora et al.,2010). There is also the need to improve the public primary health care facilities, such as health centers and dispensaries that are always used by the poor. The poorest populations in Kenya have the highest health needs, and yet, they are the people who receive the lowest share of the total health systems benefits (Toda et al.,2012). Now that health care has been devolved in the new Kenyan government system, county governments should
allocate sufficient budgets to healthcare.

According to the World Health Organization, the Kenyan government only accounts for 38.7% of the total health expenditures while the private expenditures account for the remaining 61.3% (Bliss, 2013). Due to the small allocation of the budget to the healthcare sector, international donors such as PEPFAR, Global Fund, Gavi, Bill and Melinda Gates Foundation have been left to underwrite the country’s health sector, especially for communicable diseases such as TB & HIV/AIDS, and Malaria (Green, 2013). Comparatively, in South Africa, the government pays 83% of all the costs associated with running programs in the healthcare sector and the donors cover only 17% (Patterson, 2011). The case of South Africa demonstrates a great balance for sustainability beyond the donor funding. The South African government has also incorporated the Non-Governmental Organizations into the government health care infrastructure so that rather than exist as alternative health care providers, the entities work as a unit to tackle the issue on health care delivery in different parts of the country (Patterson, 2011). In Kenya, non-governmental organizations providing healthcare services exist independently and are often in constant competition.

Donor support can be great for a country, but most of the time it is not very sustainable because once the assistance is terminated, the healthcare sector comes to a standstill. For example, Somalia’s health care sector has greatly suffered since the main organization that was funding and facilitating their health care sector withdrew due to the ongoing instability in the country (Osman, 2013). The hospitals in the capital city of Mogadishu have been facing numerous problems such as understaffing, lack of basic drugs and vaccines, and the cleanliness and sanitation has gone down (Osman, 2013). Because the Somali government had been functioning with limited financial resources and essentially depended on the donor-funded services to facilitate its health care systems, it has been extremely difficult for it to contain this problem (Osman, 2013). The donors had handled most everything in the health care sector, from delivering free basic healthcare to malnutrition treatment to surgery to epidemic response and to water and relief supplies, which are very critical to people’s lives (Osman, 2013). Currently many citizens in Mogadishu are lacking these basic health care services, and it is feared that this might lead to a deadly health crisis (Osman, 2013). This is an example of the dangers posed when a government does not sufficiently fund their health care sectors locally, but rather depend fully on donors rather than using them as a supplement.

There has also been competition in the health diplomacy between China and the United States when it comes to financing health care systems in sub-Saharan Africa (Kadetz, 2013). “Health diplomacy” is described as, “any health care activity that aims at improving political, economic, and or cultural ties between the donor and recipient countries in keeping with the foreign policy of the donor state.” (Kadetz, 2013). It is about using health as a means to foster relationships, with the ultimate goal of achieving foreign policy objectives (Kadetz, 2013).

There has been contention over how these donor states tackle the lack of access to quality health care services in developing countries. For the Chinese, the main focus has been in the rural areas with large population of people who are underserved and have limited access to health care (Kadetz, 2013). The Chinese approach is to access the need of the target population and look carefully into how they can meet the demands in terms of human and resource allocation (Kadetz, 2013). Though the Chinese approach sounds sustainable, having their community health workers come and work in African countries for a period of two years, it is been previously shown that it is more advisable for countries to have their own community health workers do the work.

Application of health diplomacy by the United States in different countries has not been successful because of the fact that they do no consult with the locals. (Kadetz, 2013). Often this approach has failed, because unlike China, United States does not assess the local need, thus the approach is not recipient-led (Kadetz, 2013). Because of the United States approach, a country such as Somalia has severely suffered when donors left abruptly. The systems cannot function without them because they are not community-driven. Most of the donor-fund-
ed programs executed through the United States approach are only for specific short-term goals and are not sustainable in the long run (Kadetz, 2013).

With these shortcomings that face the donor-oriented solutions, it has been shown that it is necessary for governments to allocate more money to the health care sector with a focus on the weak health systems in rural areas, where most of the population is located.

Solution 3: Improving Technology in Healthcare Delivery

Mobile technology is changing how health care delivery is done across developing nations by offering the people who live in rural places the opportunity to connect with health care workers in major cities (Novak, 2012). In Kenya, 80% of the population owns a mobile phone (World Intellectual Property Organization, 2010). Statistics have also shown that mobile technology penetration in Kenya is higher in comparison to the other East African countries (World Intellectual Property Organization, 2010). The mobile technology is changing the way global health can impact masses of people within a short period, collect data in real-time, and use it to develop strategies in improving the healthcare delivery in the rural parts of developing countries (Novak, 2012). In Ghana, the mobile-based platform mPedigree is being used to detect counterfeit drugs and save millions of lives (“Dialing for Development”, 2010). This concept can be replicated in many countries in Africa including Kenya.

In South Africa, the mobile health initiative is being expanded to rural clinics through a collaborative effort that uses the mobile technology to support the work of rural health professionals (BiztechAfrica, 2013). Through this initiative, the rural health workers in South Africa’s Eastern Cape Province were provided with internet-capable smart-phones pre-loaded with a locally-relevant and reliable clinical library containing about 4,000 pages of content (BiztechAfrica, 2013). The Library on the phones contained South African treatment guidelines, drug formularies, and diagnostic tools (BiztechAfrica, 2013). The technology came at an appropriate time, as Eastern Cape had been on the news for the failing health care system in the region (Versteeg, 2013). The struggling system was due to the many socio-economic problems that these communities were facing which included: high rates of unemployment, lack of clean water and sanitation, inadequate education, and poor nutrition (Versteeg, 2013). Most people in these communities had also lost trust in the health care facilities after receiving consistently poor services.

Since the introduction of the technology in the community, the nurses have reported that the technology has improved their services to the patients. The mobile technology also diversifies the treatment. When a nurse finds out that the patient is suffering from a different ailment than what she had diagnosed, all she or he needs to do is refer to the mobile phone for more information for managing the condition (BiztechAfrica, 2013). In a recently concluded research on the impact of the mobile health information system in Eastern Cape Province, the findings showed that the technology assisted all nurses and approximately 85% of the doctors in making accurate diagnosis, all nurses and more than 92% of doctors in prescribing the correct treatment for their patients and all nurses and approximately 81% of the doctors in reducing the patient mortality (BiztechAfrica, 2013).

According to World Health Organization, only one quarter of the world’s population lives in countries where more than 90% of births and deaths are registered, and these are mainly the high-income countries (WHO, 2012). More than 75% of uncounted births and deaths are in Sub-Saharan Africa and South-east Asia (WHO, 2012). The world’s most populous countries, China and India, do not have national civil registration; instead they estimate births and deaths based on population samples (WHO, 2012). This is one of the reasons why the health care systems are underfunded and dysfunctional – the data gathered, such as from sampling, is of poor quality, incomplete, and most of the time not summarized in a way that can be understood by the decision-makers (“Part 2: Sustainable Development”, 2006).

A study was done by a group of researchers on how access to mobile technology in rural areas of
Kenya could improve the registration of mortality and live births in the communities (Gisore et al., 2012). This study was necessitated because a larger percentage of obstetric care in Sub-Saharan Africa is provided in the village by traditional birth attendants, and most of these pregnancies are not included in the vital statistics registers of the health and demographic system (Gisore et al., 2012). For the study, the village elders in different communities were each provided with a mobile phone and weighing scale after being trained (Gisore et al., 2012). The phones were to be used to contact the registry administrator after they had weighed any infant. Because elders are respected people in the African societies, it was appropriate to use them for this study (Gisore et al., 2012). The babies were either taken to the elders, or the weighing scale was taken by the elder to the household where the birth occurred.

This is one of the reasons why the health care systems are underfunded and dysfunctional — the data gathered, such as from sampling, is of poor quality, incomplete, and most of the time not summarized in a way that can be understood by the decision-makers.

At the end of the study, it was realized that there was a significant decrease of the number of newborns without exact birth weights (Gisore et al., 2012). Though the proportion of the people who delivered at the hospital remained the same, it is plausible to conclude that the village elders can be effective in introducing specific interventions to a community (Gisore et al., 2012). The mobile phone was a major factor that enhanced communication between the village elders and the registry administration to make sure that data was entered on time (Gisore et al., 2012). In an article by Jeffrey Sachs, he describes mobile phones as the new “virtual stethoscopes” of the community health workers (Sachs, 2013). The mobile phones provide the community health workers a link to the entire health system, including an expert automated system (Sachs, 2013). Technology is enabling the expansion of the African health systems. The mobile technology shows promise in places where health care for most people falls short of the developed countries’ standards — facilitating tasks such as the collection of public health data, monitoring vaccination campaigns, or reminding patients to take medication (Turney, 2013). For example, ChildCount+ is a mobile platform which allows community health workers in developing countries to register their patients in a central database by sending a simple text message (Gentile, 2013). The technology has been adapted to suit the goals of the local communities in health care, such as to prevent mother-child transmission of HIV in Kenya and Ghana (Turney, 2013). This mobile platform has so far helped register more than 10,000 children and 5,000 mothers in Kenya alone (Gentile, 2013).

The impact of technology in the delivery of health care services in rural communities is huge. Despite the successes of mobile technology in delivering health care to those who would otherwise have little to no access, there are challenges in making the technology effective. Cultural barriers and poverty level plays a major role when trying to introduce new technology to the communities (BiztechAfrica, 2013). The government has to increase funding in the health care sector to make these innovations possible, as this has been a major hindrance.

Solution 4: Re-adoption of Universal Healthcare

As stated earlier, Kenya adopted universal health care in 1965 under the name “free health for all,” but it failed (Bliss, 2013). The government had abolished user fees for people seeking care in public clinics which were mostly managed at the local level, and this led to the downfall of these institutions (Bliss, 2013). Economic stagnation after 1973 and
a paucity of funds available for operating clinics at the local level led to the government reintroducing the user fees by 1989 (Bliss, 2013).

Health care facilities emphasize access to equitable health care as the main goal, though this has not been achieved (Toda et al., 2012). Various interventions have been tried, such as reintroducing user fees, implementing social insurance schemes, and enhancing health care infrastructure at the local level, yet poor people still do not have access (Toda et al., 2012). Through rigorous analysis by health experts, it has been concluded that majority of public health budgets favors the wealthy, regardless of source of financing, proximity or whether care is delivered through the public or private sector, the wealthy are more likely to get access (Toda et al., 2012). For example, the tax-financed health services may benefit those in the urban middle and upper classes unfairly, even if the services are intended for the poor (Toda et al., 2012). Those who are economically stable are always in a position to afford the services and are located closer to these health care facilities (Toda et al., 2012).

Addressing inequity in access to healthcare is a key concern to policymakers and governments, and it is documented as a priority policy, though not much is being done to enact the policy (Toda et al., 2012). In most of the rural places, lack of electricity and access to medical laboratories poses a major hindrance. Electricity is very significant for enhancing the quality of care to patients at the facilities. Lack of electricity is an issue that is faced in rural areas of Ethiopia, though they have moved toward resolving the issue by using generators for emergencies and performing surgeries (“Developing Global Health”, 2008). It is probable that electricity and laboratory services are better in urban areas because they rely on local funding from the user fees, which privileged clients are more willing and able to pay (Toda et al., 2012). The electricity bills for the health care facilities are paid from revenues received from the facilities, and the laboratories are set up to bring in more revenue with fees per service (Toda et al., 2012). A system supported by user fees only favors some people, leaving the greater portion of the Kenyan population that lives in poverty without access (Toda et al., 2012).

For the government to reduce the user fee at the health facilities, it is necessary to increase the direct facility funding (Opwora et al., 2010). Now that health care has been devolved to counties in the new Kenyan government, there is need for a policy to be introduced to make sure that the money is directly sent to the bank accounts of these health facilities. This is a system that is being introduced through the Health Sector Services Fund, which transfers money directly into the facility bank (Toda et al., 2012). The accounts are being managed by the health facility committee and used for operational expenses (Toda et al., 2012). This is to ensure that patients who come into the health centers but are unable to pay the bills are still treated (Toda et al., 2012).

Often, health care systems have contributed to poverty when health-care payments push the poor into destitution, or when lack of access creates a lifelong disability and limits earning power (“Part 2: Sustainable Development”, 2006). Though everyone needs access, facilities have to be in operation. Research has shown that free health care, if not well funded, is not sustainable (“Part 2: Sustainable Development”, 2006).

A study carried out in Coastal province in Kenya, showed that despite the direct facility funding being available, there were still reports of the user fees being hiked above the official price in some facilities (Opwora et al., 2010). Even though the governments may approve the increase in direct facility funding to reduce the user fees, investment in improved training and documentation of how the funds are used is also necessary (Opwora et al., 2010). There should also be an emphasis on community engagement to make sure the patients are aware of the funding available and insist on the strict adherence to rules on charging user fees (Opwora et al., 2010).

As a result of the user-fee program not working effectively in the rural areas, the former Prime Minister of Kenya proposed free universal health care, though it was not supported with an increase in government funding (Green, 2013). The universal health care insurance plan would be dependent on the income of the customer (Green, 2013). Due to high poverty levels in the rural areas, a free health
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The goal of the universal coverage is to make sure that the poor do not deplete their resources in trying to pay for health services, and also make sure that everyone is able to access the necessary health services, which must be of quality (McIntyre, 2012). Because the donor funding is not always sustainable, it would be advisable to promote domestic funding for the universal coverage program. The domestic health funding can be sub-divided into two categories, out-of-pocket and pre-payments (McIntyre, 2012). The out-of-pocket involves the customer paying the provider directly at the health care facility after the service has been rendered (McIntyre, 2012). Pre-payments involve making payments toward the costs of health services before needing to use the services, and then the providers are paid from these payment funds when the need to use a service arises (McIntyre, 2012).

For the pre-payment, participation in the program is either mandatory under the law or it is voluntary, such as the community-based insurance or the private commercial insurance (McIntyre, 2012). With all these different payment methods in mind for the universal coverage, the research work concluded that the funds generated through the mandatory health insurance should be put together with funds from the government revenue to make sure that everyone receives the same service benefits (McIntyre, 2012). Under the universal health coverage, the less-privileged may access quality health care services the same as their wealthy counterparts. This will promote equity in health care delivery.

Conclusion

The Kenyan government has demonstrated its commitment to making sure that the Millennium Development Goals that focus on health care – those reducing child mortality, improving maternal health and combating major disease – are achieved. A lot still needs to be done because 60% of the country’s population live in the rural areas, and more than half live in poverty. The government, the public, and the private sector have to come together to find solutions that have the durability and social impact to provide healthcare to the rural communities.

The community health workers must be trained and empowered to work in these hard-to-reach areas. This is only possible if the government increases the budget allocation for health care. Through the devolved government, the country leaders must invest in locally training the community health workers. Most importantly, the healthcare mobile technology should be expanded to more regions of the rural communities. If the technology improves in these hard-hit areas, it will be possible to educate more community health workers and the physicians may use the technology to consult with those in the urban areas. Time and money will be saved as a result of the more developed health systems. By using the local administrators to be in charge of the new programs being introduced into the communities, the impact will be much greater.

Innovations in health care sector must be locally supported to make sure that the communities take ownership. It is only through this that sustainable social solutions can be found to improve the delivery of health care in rural communities. Improvement of the infrastructure is necessary to make sure that the standards meet the basic healthcare requirements. The facilities should be made more accessible and affordable.

Each of the four alternative solutions is fundamental to improving the healthcare delivery in the rural communities. Without more funding allocation, none of the other solutions would be applicable.

Author Reflection

Doing research on this topic was very interesting and mind-blowing as a result of the amount of information that was available. It came to my realization that health care even for a single country is very broad. The information is also conflicting on different best practices that should be emulated,
though the four solutions that I expounded on my paper stood out through my research.

The reason why I chose this particular topic was due to my experience working with Mama Maria Clinics in Western Kenya after graduating High School. Mama Maria Clinic is a small health care delivery center that serves over 50,000 people. The people around this community are very impoverished and cannot be able to afford to go to the hospital. As a result, most of them decide to visit the village doctors who are not licensed to treat them. So many lives have been lost to curable diseases in the process, and this is what I would like to change.

This research was a great eye opener, and I felt exposed to the real world challenges of providing sustainable health care in our communities. Health care is fundamental human right though there is a huge shortage when it comes to delivery. This thesis was a stepping stone to my bigger goal in life; to create sustainable health care systems in rural Kenya. This paper serves as an introduction to more research work that I would like to do in the field of global health and health economics.

References


“Proving that mobile can revolutionize healthcare.” BI-ZTECH AFRICA, 8 August 2013. Web. 30 September 2013.


Novak, Stephanie. “Exploring the role of Mobile Technology as a Health Care Helper.” The New York Times,


Make It Happen:
Reanalyzing the Image of Cleopatra VII

By Sage Calhoun

Cleopatra VII Philopator, the infamous seductress-queen from Alexandria, has appeared in numerous plays, books, films, and television shows ever since her relationships with Romans Julius Caesar and Mark Antony. Romans frowned on their mighty heroes becoming so easily ensnared by an Egyptian woman, blaming their enamored states on sorcery or madness. Many Roman writers and historians would go on to write slanderously about Cleopatra to humiliate not only her but the Caesar and Antony as well. Many of their claims would go on to survive in the Western world’s subconscious, and Cleopatra’s image remains that of the sexualized seductress. However, modern historians and writers are beginning to better understand just how twisted this image has become, noting that Cleopatra would have been an intelligent and talented person in her own right. Using information found in sources such as Schiff’s biography Cleopatra and Jones’ Cleopatra: A Sourcebook, this essay seeks to analyze how the image of Cleopatra has been portrayed over the past two millennia and how these media representations alter from historical evidence. Two texts in particular are analyzed – Shakespeare’s 1623 play Antony and Cleopatra and the popular 2007 HBO series Rome.

Age cannot wither her, nor custom stale / Her infinite variety,” states the traitorous Enobarbus to fellow Romans Maecenas and Agrippa in Shakespeare’s famous play Antony and Cleopatra (Shakespeare, trans. 1926, 2.2.240-241). Of course, Enobarbus in this scene is describing Antony’s exotic aging lover, Queen Cleopatra of Egypt, who has been forever immortalized in Shakespeare’s play as a woman who “makes hungry / Where most she satisfies” – a sexualized seductress of infinite charms (Shakespeare, trans. 1926, 2.2.242-243). Shakespeare, however, is not the only person to portray the famous queen in such a chauvinist way. Cleopatra VII Philopator, the famed Ptolemaic pharaoh of Egypt, has been misconstrued in portrayals ever since Octavian’s Roman forces defeated her in 30 BCE, if not earlier during her reign, which began in 51 BCE. Branded as a whorish temptress by her enemies due to her relations with Julius Caesar and Mark Antony, the image of Cleopatra in Western society continues to depict her only as a sexual deviant, as seen in both William Shakespeare’s 1623 play Antony and Cleopatra (which helped to popularize the sexualized Cleopatra) and the 2005-2007 British-American television series Rome. With increased interest in feminist deconstructionism during the 21st century, as well as advances in archaeological technology, works such as Stacy Schiff’s 2010 biography Cleopatra: A Life have helped to clear away the ancient slander clouding Western culture’s view of the last Ptolemaic pharaoh, allowing Cleopatra to appear as an intelligent,
independent, and powerful woman.

A Background of Cleopatra VII Philopator and Ancient Egyptians Women’s Rights

While Cleopatra may have been an Egyptia ruler, her heritage lies across the Mediterranean in ancient Greece, specifically Macedonia. Beginning with Ptolemy I Soter I, a general who had served under Alexander the Great and appropriated some land after the commander’s death, the members of the Ptolemy family had ruled over Egypt as pharaohs since 323 BCE. “As a consequence,” Schiff writes in her biography of the female pharaoh, “no one in Egypt except Cleopatra to be Egyptian,” even though the Ptolemies had adopted some traditional Egyptian practices (i.e. sibling marriage) and had reigned for over 250 years at the time of Cleopatra’s ascension to the throne (Schiff, 2010, p. 20). While the Ptolemy name came with much prestige and wealth, it was not without a few serious problems. For one, there were many incestual couplings (both full-blooded sibling pairings as well as uncle-niece and cousin pairings) in order to maintain the family’s exclusive status and reduce the need to find qualified suitors from other countries. Though this acceptable practice luckily did not cause birth defects in any of the resulting offspring, it did make succession of the throne a complicated affair. Many Ptolemy children grew up learning about the commonplace violence within their family history, as many successors often murdered relatives to either gain political power or to avoid being murdered themselves. Similarly, incestual marriages caused Ptolemaic women to be valued equally to Ptolemaic men, as both were desired to continue the family line. “Even without a regnant mother, Cleopatra could look to any number of female forebears who built temples, raised fleets, waged military campaigns, and, with their consorts, governed Egypt,” writes Schiff, who then goes on to state that the Ptolemies who had made the greatest impact in preceding generations to Cleopatra were entirely women (Schiff, 2010, p. 24).

However, the success of these great women was not only because of their important role of continuing a direct Ptolemy line, but also because of the protected rights which Egyptian women had retained and expanded on since before Ptolemy I Soter I had inherited the kingdom. These rights included (but were not limited to) a woman's say in her own marriage, financial protection after a divorce, the right to own property and inherit property, and the right to have an independent business. Additionally, the Egyptians did not commit infanticide when they gave birth to a female child, nor did Egyptian women generally marry earlier than Cleopatra’s age at the time of meeting Julius Caesar; Cleopatra was only 21 years old when she met Julius Caesar. Schiff estimates that approximately “one third of Ptolemaic Egypt” was run by women, a significant amount when one compares women’s importance in Egyptian society to neighboring countries, especially Roman society (Schiff, 2010, p. 24). Along with these rights, women of the upper class received a traditional Greek education equal to men of the upper class, and Cleopatra’s “may well have exceeded her father’s” since he had been raised away from the Mediterranean world (Schiff, 2010, p. 28). Cleopatra would have been mentored by a Greek tutor who had studied in Alexandria, which boasted a celebrated museum as well as the largest and most diverse collection of texts in Ptolemaic Egypt, and her education would have focused largely on written language and rhetoric (though she would also have been tutored in mathematics, music, astrology and astronomy, and philosophy). With an education heavily based on classical Greek texts, Cleopatra and other upper class children would have been well-versed in the various works of authors such as Homer, Sophocles, and Sappho, among others, and would have been heavily influenced by ideas presented in such texts. Cleopatra in particular became a master of the spoken word:

Cleopatra knew how to talk. Even her detractors gave her high marks for verbal dexterity. Her “sparkling eyes” are never mentioned without equal tribute to her eloquence and charisma. She was naturally suited to declaim, with a rich, velvety voice, a commanding presence, and gifts both for appraising and accommodating
To add to her repertoire of educational accomplishments, Cleopatra became proficient in many languages outside of her native Greek so as to avoid having to use an interpreter. In this way, she was able to give “her decisions herself to most of [the people she did business with], including Ethiopians, Troglodytes, Hebrews, Arabsians, Syrians, Medes, and Parthians,” among others (Jones, 2006, p. 34). Additionally, Cleopatra was reportedly the first Ptolemaic ruler to have learned the native Egyptian tongue, spoken by approximately seven million Egyptian citizens. Writers such as Plutarch would later admiringly write on her ability to “pass from one language to another” with eloquent ease (Schiff, 2010, p. 34). A Roman consul’s wife even wrote highly of Cleopatra, stating that “she was a woman of no mean endowments; she could write verses, bandy jests, and use language which was modest, or tender, or wanton; in fine, she possessed a high degree of wit and charm.” It would seem, then, that Cleopatra was a confident, charming, intellectual woman who would have been well-educated in numerous academic subjects, diplomatic affairs, and her own bloody family history – a portrait which contradicts sexualized depictions in Western culture.

After a series of power struggles that occurred between her father, Ptolemy XII Auletes, and her sisters Cleopatra VI Tryphaena and Berenice IV (which resulted in the death of both sisters, Cleopatra VI by Berenice’s hand and Berenice by Auletes’), Cleopatra was named joint regent with her father at the age of fourteen. However, she would not truly gain any governing power until her father’s death in 51 BCE, when 18-year-old Cleopatra was named joint regent with her 10-year-old brother, Ptolemy XIII. However, being an ambitious woman, “it soon became clear that Cleopatra desired sole power” of the kingdom, which did not sit well with her brother (Jones, 2006, p. 39). Problems between the monarchical couple ensued, in part due to increased conflict between Ptolemy’s greedy advisers (who wished to have their advisee as the sole regent) and Cleopatra, and also in part due to the fact that Auletes had left his children with a large monetary debt to the Roman Empire. With the increased tension, Cleopatra was forced to flee from Alexandria to Syria, where she was putting together an army in preparation for a civil war with her Ptolemy XIII. Meanwhile, as Ptolemy XIII waited in the seaside city of Cassium planning a defense against Cleopatra’s anticipated attack, the Roman civil war made its way to Egypt in the form of a fleeing Pompey. Gnaeus Pompeius Magnus, more commonly referred to as Pompey the Great, had come with his family and remaining forces to Egypt in 46 BCE to ask for aid from the young rulers, as he had been a great ally of their father Auletes. Unfortunately for all parties involved, Pompey was swiftly beheaded by a Roman soldier on a boat sent to receive him after Ptolemy’s advisers (Achillas, Pothinas, and Theodotus) convinced the 13-year-old sovereign that such a deed would help to gain Caesar’s alliance against Cleopatra. However, when Caesar arrived in Egypt a mere three days later and was presented with Pompey’s somewhat-rotting head, he was greatly angered at the cruelty they had shown an honorable citizen of Rome.

The Relationship between Cleopatra and Julius Caesar

Though the aging Caesar, then 52 years old, had come to Egypt in pursuit of Pompey, he stayed in order to calm the feud between Pompey XIII and Cleopatra. Schiff writes, “A stable Egypt was in Rome’s best interest, the more so when there were substantial debts to be paid,” and as such Caesar requested that the two monarchical siblings return to Alexandria, where he would moderate a discussion between the two parties (Schiff, 2010, p. 14). This summons was Cleopatra’s chance to regain political power, though her brother’s advisers most likely noticed this as well and tightened security around the palace to make sure she did not come into contact with the Roman ruler. This particular story of Cleopatra being smuggled into her own palace by having her servant Apollodorus carry her in a rolled rug has been retold on countless occasions, and is perhaps one of the most defining moments of her life. In many versions of this tale, including
its retelling in the HBO television series Rome, it is Cleopatra who seduces Caesar, appearing lusciously seductive after travelling many miles cramped in a rug. However, as Schiff is swift to point out, it is unlikely that a young woman of 21-years-old, who had only been united with her brother in marriage for three years with no resulting offspring, would have had much experience in the seduction of men, despite later labels branding her as a “matchless siren” and “harlot queen”. Oppositely, Caesar’s “amorous conquests were as legendary and as varied as his military feats,” and he was often praised for having such an active sex life even though he had a wife (Schiff, 2010, p. 17). Thus, in terms of who exactly seduced whom, it would be more likely that the aging veteran would have been more experienced. Additionally, though it is impossible to know the details of what occurred when Apollodorus unbound Cleopatra in front of Caesar, it is most likely that the Egyptian queen, instead of being nude, “would have been fully clothed, in formfitting, sleeveless, long linen tunic” as well as a diadem to signify her royal ties (Schiff, 2010, p. 16). Instead, what may have impressed Caesar more than her average appearance may have been her intelligence, as she was able to infiltrate her own home – a task which Caesar himself had had trouble with. In this way, the relationship between Caesar and Cleopatra may more likely have been sparked by the intellectual prowess and political nature found within both individuals. The entire union, however, was viewed by Cleopatra as vital for her survival in both a political and literal sense, for if she did not win Caesar’s favor and establish her status as ruling sovereign, it could be sure that her brother’s advisers would see that she perish.

By the end of the night, regardless of whether the experienced elder had been the seducer or the desperate queen had played the seductress, the pair was found in each other’s arms the next morning by one of Ptolemy XII’s men and Cleopatra gave birth to their son (named Caesarion) nine months later. As a result of their strong relationship, Caesar agreed to side with Cleopatra against her brother and his advisers in the Alexandrian War that had broken out, in which Cleopatra claimed victory when Ptolemy XIII accidentally drowned. In 47 BCE, she ascended to the throne once again alongside her other brother, Ptolemy XIV. Ultimately, Cleopatra’s relationship with Caesar aided her immensely not only in that she was able to regain political power by ridding herself of her brother’s regime, but also in that it produced for her a foothold in Roman politics as the new dictator’s lover and mother of his only male heir. Caesar also gained benefits from having her as a lover in that he had a more direct hand in Egyptian affairs and the Roman territory became stable without resorting to complete annexation. For the young and inexperienced Cleopatra to have engaged herself with Caesar was mostly a smart political move on her part in order to survive, rather than a manipulative ploy to seduce the most powerful man in Rome.

The Relationship between Cleopatra and Mark Antony

Following Caesar’s assassination in 44 BCE (at which time Cleopatra had actually been in Rome, though fled for Alexandria immediately upon hearing the news), the Second Triumvirate was formed between Augustus Caesar (previously named Octavian), Mark Antony, and Marcus Lepidus to counter the forces of Marcus Junius Brutus and Gaius Cassius Longinus. After the triumvirate defeated Brutus and Cassius’ forces, the union between the three was sanctified as an official ruling force and Roman Empire was split up, with Augustus Caesar taking control of Rome, Antony control of all eastern territories (including Egypt), and Lepidus control of Hispania and Africa. A crude, but handsome and well-liked man, 42-year-old Antony summoned Cleopatra (27-years-old at this time) to meet with him for the first time in 41 BCE in Tarsus, Cilicia (modern-day Turkey) where he had established himself, though Cleopatra responded to the summons only after much delay. In a spectacular entrance full of grandeur down the river towards Tarsus which differed greatly from her arrival in Alexandria to meet Caesar, Cleopatra “sent word [to Antony]…that Venus was arrived ‘to revel with Bacchus for the good of Asia,’” to which Antony replied with a dinner invitation (Schiff, 2010, p. 160). Schiff goes on to describe the negotiations of the dinner invite between the star-crossed lov-
ers in detail:

What happened next was revealing of both parties and the kind of behavior Cicero had deplored in each. Antony was a little too amenable, Cleopatra decidedly high-handed. It was the mark of status to give the first dinner; she insisted he come to her, with whatever friends he desired. Such was the prerogative of her rank. From the start she seems to have meant to make a point. She did not answer summonses; she delivered them. (Schiff, 2010, p. 161).

Here Cleopatra is demonstrating her power in a way which differs greatly from the desperation and cunning she had used to negotiate with Caesar. It affected Antony in such a way that he, “wishing to display his complacency and friendly feelings,” bent to Cleopatra’s wishes and allowed her to host a banquet to which he was invited (Schiff, 2010, p. 161). However, it is argued that Antony does not do this because he is smitten or enchanted by the Egyptian queen and her boldness, but rather as a political stratagem to gain her favor. Jones writes in Cleopatra: A Sourcebook that while the relationship between Antony and Cleopatra is often regarded as a romantic affair, it was more or less one of political alliance in that “Antony needed the wealth of Egypt to support his military campaigns to the east” and “Cleopatra needed his help in solidifying her power” as coregent with her son Caesarion (Jones, 2006, p. 94). At this point, Cleopatra’s brother-husband had been murdered, presumably poisoned by Cleopatra herself to make way for Caesarion as coregent and the next heir to the throne. This mutual political dependence coupled with the fact that they shared common motives and goals (i.e. neither particularly liked Augustus) is most likely how the relationship between the Antony and Cleopatra initially began.

The Image of Cleopatra in William Shakespeare’s Antony and Cleopatra

In William Shakespeare’s 1623 play Antony and Cleopatra, the relationship between the two protagonists is one in which Cleopatra dominates over the devout Antony in a way that causes him to struggle with his self-identity as a strong, masculine Roman and an obedient lover. Conversely, Cleopatra is portrayed as a complete, independent person who embodies both masculine power and feminine charm, as one “whom every thing becomes, to chide, to laugh, / To weep; whose every passion fully strives / To make itself... fair and admired” (Shakespeare, trans 1926, 1.1.49-51). Because of Antony’s double identity as both a proud Roman citizen and a loyal lover to Cleopatra, Antony receives a lot of criticism from fellow Romans within the play who believe that he has been completely bewitched by the foreign queen. In the opening scene of the play, Philo depicts the frustration that Antony’s struggle incites in the Roman soldiers who serve under him:

Nay, but this dotage of our general’s
O'erflows the measure: those his goodly eyes,
That o'er the files and musters of the war
Have glow'd like plated Mars, now bend, now
turn,
The office and devotion of their view
Upon a tawny front: his captain's heart,
Which in the scuffles of great fights hath burst
The buckles on his breast, reneges all temper,
And is become the bellows and the fan
To cool a gipsy’s lust (Shakespeare, trans. 1926,
1.1.1-10)

First it is interesting to note the masculine descriptors which begin these ten lines, especially the mention of how Antony’s eyes “glow’d like plated Mars” with proud admiration when he gazed upon his virile troops. However, the speech deteriorates to describing how Antony has started to lose his machismo and honor by allowing his infatuation for “gipsy’s lust” to cool his warrior’s heart. In a way, Antony’s men believe that Cleopatra is robbing their captain of his manhood, something which is highly prized in the aggressive war-faring society of ancient Rome. Here, though Cleopatra is indeed being insulted and branded with sexually-charged names such as “gipsy,” Antony is the one who is more or less considered weak for not resisting Cleopatra’s charms and succumbing to love for a foreign queen over his own country. Continuing on with his speech after Antony and Cleopatra enter the scene with the queen’s attendants, Philo says:
Look, where they come:  
Take but good note, and you shall see him  
The triple pillar of the world transform'd  
Into a strumpet's fool: behold and see. (Shakespeare, trans. 1926, 1.1.10-13)

Again, though Cleopatra is branded with unjust words questioning her virtue, Philo more so expresses his frustration with Antony for clinging on to a woman. In the Roman society which Shakespeare is depicting, men who give themselves up to strong, intelligent women lose their status as a man, since a man's role is to be the autonomous, domineering, and rational partner in any relationship. The men who serve under Antony are beginning to grow uncomfortable serving under him, which could possibly be because to follow him - a man who has be socially castrated and made into a woman in the sense that he has taken on gender roles acceptable for women - would mean losing their status as men, too. For Antony, then, the only way to regain his masculinity and redeem his sense of honor after feeling helpless and defeated by both Augustus Caesar (in the Battle of Actium) and Cleopatra (in their relationship) is to commit suicide, which is considered "what's brave, what's noble," as Cleopatra comments (Shakespeare, trans. 1926, 4.15.86). Cleopatra quickly follows Antony's lead, having an asp bite her bare breast.

The Image of Cleopatra in the HBO Television Series Rome

Echoes of these theme are heard in the HBO television series Rome, in which the relationship between Antony and Cleopatra is mostly summed up within three different hour-long episodes entitled “Son of Hades”, “Deus Impeditio Esuritori Nullus (No God Can Stop a Hungry Man)”, and “De Patre Vostro (About Your Father)”. Firstly, Antony is portrayed as a bit of a womanizer in that he has multiple lovers at his disposal. Prior to Cleopatra’s arrival in Rome to meet with Antony regarding her throne’s stability and the recognition of Caesarion as Caesar’s legitimate son, he discusses the young exotic queen with his main love interest of the time, Atia of the Julii, who immediately tells him that while lower-class Roman women are all-right for him to have relations with, she does not “want [him] making love to [Cleopatra’s] sort” out of jealousy (Heller, 2007). The attraction between the couple is not immediately evident, as Antony makes a comment to Cleopatra regarding her relationship with Caesar during their meeting stating that a Roman consul marrying an Egyptian woman is a very strange thought to him. It is evident that the two are completely about business, Antony offering to support and protect Cleopatra’s claim to the Egyptian throne so long as Cleopatra sends plentiful grain to Rome along with a monetary gift every month. Similarly, Cleopatra bargains with Antony for a public declaration of paternity stating that Caesar is Caesarion’s true father. Again, Antony is portrayed as a womanizer in that it is strongly implied (though not verbalized) that he would like sexual favors in return for such an act. When he tries to kiss her, Cleopatra demonstrates her dominance by slapping his face and telling him that he must pronounce Caesarion as Caesar’s legitimate heir first if he would like any favors, stating that “if [she] must prostitute [her] self for the good of [her] country, she will,” but that “the customer pays first, does he not?” (Heller, 2007). While this certainly reflects Cleopatra’s dominance as portrayed in Shakespeare’s work, Antony is allowed to retaliate here by calling her a whore and swearing that he will never make Caesarion legal. Some differences presented in Rome’s portrayal of Antony and Cleopatra occur in later episodes in which Antony seems to patronize Cleopatra, and a reversal in role seems to occur in that Antony becomes the one who is making decisions, acting rationally, and dominating over his lover with remarks such as “Hush, woman” and “Why don’t you shut your fucking mouth?” (Smith, 2007). Similarly, when Cleopatra wishes to run from occupying Roman forces and live to see another day, Antony acts stereotypically male in that he wishes to stay and fight in an attempt to avoid cowardice. While during their relationship Cleopatra seems to be clinging to Antony for support and stability, echoes of Cleopatra as being the stronger of the two lovers appears in the very last episode in which Cleopatra tricks Antony into killing himself. After receiving a letter from Octavian that offers safety for her and her family, and guarantees that she will retain her throne, in exchange for the deliverance Mark Antony, either dead or alive. With this, Cleopatra must choose between dishonoring her name...
forever and continuing to live as a queen ruling her people, or maintaining her honor and losing her life, as well as the lives of her children and her countrymen. Pretending to commit suicide and sending a fake suicide note to Antony, Cleopatra chooses dishonor and life. Upon reading the note, Antony goes hysterically mad, wondering why she did not wait for him so that they may have died together. He then kills himself with his “proper Roman sword” out of desperation and love for her, which is resonant of the Antony portrayed by Shakespeare. Returning to the throne room, Cleopatra poses his corpse in the throne, crying and kissing his face perhaps out of equal parts guilt and love. After meeting with Octavian and realizing that she is meant to be a trophy paraded around the streets of Rome, she orders her maid to bring an asp that will kill her swiftly so that she may escape such a terrible fate. Thus, Antony and Cleopatra’s relationship in Rome has many similarities to Shakespeare’s portrayal of Antony and Cleopatra’s relationship in that Antony does show a certain submission to Cleopatra, especially near the end of his life. However, Rome’s Cleopatra has lost a lot of the power and confidence exuded by the character of the same name in Antony and Cleopatra, perhaps as a way to allow Antony’s character the chance to stand out.

The Tarnished Legacy of Cleopatra

With the end of Antony, Cleopatra, and monarchical Egypt, which was swiftly annexed by the Roman Empire after Antony and Cleopatra’s defeat, most images of Cleopatra were wiped away and Roman writers would be the first ones given the task of penning biographies of Cleopatra with inaccuracy, spiteful bias, and deliberate slander. Schiff explains that these writers, who would most likely have seen her as a foreign enemy who corrupted two of their greatest leaders, probably are not the most accurate sources, even though they may be the sources we initially go to for descriptions about her:

Can anything good be said of a woman who slept with the two most powerful men of her time? Possibly. But not in an age when Rome controlled the narrative. Cleopatra stood at one of the most dangerous intersections in history: that of women and power. Clever women, Euripides had warned hundreds of years earlier, were dangerous. A Roman historian was perfectly happy to write off a Judaean queen as a mere figure-head – six pages later – to condemn her for her reckless ambition, her indecent embrace of authority. … We do not know if Cleopatra loved either Antony or Caesar, but we do know that she got each to do her bidding. From the Roman point of view she “enslaved” them both. Already it was a zero-sum game: a woman’s authority spelled a man’s deception. (Schiff, 2010, p. 4)

Not only was Cleopatra an enemy of the Romans simply because two of the most powerful Roman leaders were enamored by her charm, wit, and wealth, but she must also have been feared by the patriarchal Romans who had been warned by their forefathers that women in power were highly dangerous creatures and destroyers of men. If these male writers, who slander what they cannot comprehend and thus fear, are the sources closest to Cleopatra’s own time and for simply a matter of time period they are hailed as true, then it is no wonder that many representations of her in Western culture are far cries from her reality; one is unable to write an accurate portrayal of something that has been mostly covered up and skewed by those who found its truth dangerous.

Probably one of the most damaging depictions of Cleopatra within the last decade can be seen in the HBO television series Rome. Being a historical drama comprised of twenty-two hour-long episodes, beginning with the rise of Julius Caesar and later following with the rise Augustus Caesar up until the annexation of Egypt, one might assume that Cleopatra might have a somewhat large role, as she was influential in both Julius Caesar’s life and the fall of Egypt as a sovereign nation. Thus, the first injustice made by the creators of the series against Cleopatra is the lack of her presence within the show – her character appears in a total of only five episodes, one episode only giving her a single line of dialogue comprised of a single word (MacDonald, 2007). At the end of the episode entitled “A Necessary Fiction,” she is seen lounging seductively in a window of her palace at Alexandria, saying “Antony”
enticingly when he enters the room. This gives Cleopatra an extremely diminished role in comparison to the accomplishments and influence she is known to have had during her life. The next fault of the show is simply the combination of poor casting and somewhat poor writing that turns Cleopatra into simply a rebellious, immature woman who is addicted to the indulgent lifestyle. Though Lyndsey Marshal is not a bad actress necessarily, her frail appearance and lack of presence while portraying Cleopatra leaves the character feeling weak and unconvincing. The impression one gets from watching Marshal is that Cleopatra was a mousy individual with a squeaky voice who almost always wore scantily clad attire and was obsessed with physical pleasure such as drug use and sexual activity. This is most notable in the episode entitled “Caesarion” (Macdonald, 2007), in which Cleopatra makes her first appearance. Additionally, the character of Cleopatra, while faithfully shown to be intelligent and witty, is depicted in many respects as being an emotionally unstable person who needs to rely on others, specifically her loyal elderly servant and, later, Antony.

The scene which most sticks out in terms of this emotional instability can be seen in a fight between Antony and Cleopatra during the episode entitled “Deus Impeditio Esuritori Nullus (No God Can Stop a Hungry Man)”. Upon the arrival of Antony’s wife and former lover in Alexandria, Cleopatra argues that they should “flaunt [their] love” so as to make the two women jealous and simultaneously humiliate them publicly (Smith, 2007). When Antony tries to reason with Cleopatra by stating that neither woman deserves such degradation, Cleopatra goes to the extreme and suggests killing the women by having their ship sink on the way home. As Antony becomes angrier and tries to make Cleopatra understand that killing the women would injure him on a political level, Cleopatra gets upset and accuses Antony of either still having feelings for his ex-lover or being a coward. When Antony tries to avoid conflict by walking away, Cleopatra throws two vases at the throne, though it appears as though they were meant to hit him. At that point, both Cleopatra and Antony fight aggressively, even to the point where Cleopatra jumps on him and viciously bites at his neck. In a strange twist, this fighting leads the couple to being having violent sex, the scene finally ending with them reconciling happily. Not only does this scene show Cleopatra to be a person incapable of feeling for others or utilizing rational thought, it also shows that she is unable to reason with others and cannot be trusted to control her intense emotions. These portrayals go completely against what is actually known about Cleopatra – that she was an intelligent, calculating woman who functioned extremely well when negotiating with others. All in all, the way Cleopatra is presented in the HBO television series Rome is extremely inaccurate and portrays her in a way more similar to the slander of the spiteful Roman propaganda than to how she actually was as a successful woman and leader.

Conclusion

A powerful, intelligent, and charismatic woman, Cleopatra VII Philopator has been horridly misconstrued in depictions most likely ever since her reign began in 51 BCE. Mainly thanks to male Roman writers, spiteful of Cleopatra for not only being a highly successful woman but also for “seducing” two of their most influential leaders, she has been branded as a whorish temptress in an attempt to tear down her powerful image. Schiff (2010) is correct in saying that for men fearful of the opposite sex it “has always preferable to attribute a woman’s success to her beauty rather than to her brains, to reduce her to the sum of her sex life”. In some respects, they succeeded, as Western society continues to define Cleopatra as an over-sexualized figure based on her relationships with Julius Caesar and Mark Antony, as seen in both William Shakespeare’s 1623 play Antony and Cleopatra and the 2005-2007 British-American television series Rome. With new analyses emerging from an increased interest in feminist deconstructionism, such as Stacy Schiff’s 2010 biography Cleopatra: A Life, 21st century readers are able to challenge the sexualized representation of Cleopatra and see her for what she truly was – a successful woman known during her own time for her charisma and cleverness.

Author Reflection

This essay was written as an Honors project for the course Women in the Literary and Visual Arts, facili-
tated by Dr. Pamela Smiley (English department) and Professor Carolyn Hudson (Art department). It was through this course that I learned much about the influential, powerful women who have shaped our history as well as the sad fates their legacies have endured, particularly in our patriarchal Western society.

My long-time passion for learning about Ancient Egypt fueled by knowledge gained from this course led me to choosing Cleopatra as the topic for this essay. The image of the Ptolemaic queen has been grossly misconstrued since the initial slander from her Roman adversaries, reducing her to nothing more than a galvanizing seductress in the consciousness of Western society. However, when one takes the time to learn about Cleopatra, one will find that she was an extremely intelligent and powerful woman in her own right. It is this combination that I found particularly fascinating — the fact that society continues to generate representations of her in various texts (Shakespeare’s play Antony and Cleopatra in 1623, Cecil B. DeMille’s film Cleopatra in 1934, and the HBO series Rome in 2007, for example) and yet her individual achievements are hardly mentioned in favor of the sinful seductress. I wanted to explore what Cleopatra had actually been like and how her image had come to be so disfigured for nearly two millennia after her death.

References


The Theory of Music:

Warp Speed

By David Godbold

Warp Speed, composed by David Godbold, is a perpetual motion composition consisting of repetitive ostinato figures and fanfares. This article breaks down Warp Speed into music theory and musical thematic structures. Within this article, the reader will understand how Warp Speed was constructed through the use of music theory.

The process of composing Warp Speed was rather challenging. Warp Speed is a minimalistic piece based on the concept of perpetual motion and the idea of space travel universe. With a moderate tempo of =130, Warp Speed doesn’t move too quickly; what really conveys the sense of swiftness is the underlying fanfare and ostinato of the horns, trumpets, low voices, and strings moving throughout the majority of the score (Figure 1).

Its form is A A1 A2 B A A1 A2. It is a composite ternary form. What was most challenging about Warp Speed was working with the time signature. 5/4 is an uncommon time signature within Western Music with most of what we listen to either written in 4/4, 3/4, or 6/8. Due to the time signature, rhythms can become asymmetric which can lead to awkward beat placement – in this case resulting in a 1.5 + 1.5 + 1 + 1 pattern (Figure 2). What also aids the piece into feeling restless is that it flows on a I#7 (V#7/IV) chord - a secondary dominant. Generally, within music theory, secondary dominants are used to modulate to different keys, tonicize a chord, or are commonly used in Jazz. The first melodic statement begins at measure 2 with the Mallet Percussion and Violins. Finding the correct amount of beats to mathematically complete the measure and have a preferred melody was tricky. Clarinet and flute are introduced to contrast the aggression and add a sense of wonder to the section (Figure 3). They are the first lines that are legato. Measure 13 also marks the beginning of a repeated simple IV-I#7 progression, breaking away from the I#7 and which allows the piece to eventually perform a V-I#7 authentic cadence and gives the section a sense of finality. With this section complete, I could move on to a new section. Here, the piece becomes more stable, using less complex theory and simpler chord progressions. The piece is soon interrupted by the 4/4 which changes the meter of the music, but not the tempo allowing it to be symmetrical and familiar – yet still remaining perpetual (Figure 4). At measure 40, a new ostinato is created along with a new melody (Figure 5). This section employs juxtapositions of staccato and legato melodies which all take place within the trumpets and woodwinds, while violins are being played pizzicato.

Clarinet and flute are introduced to contrast the aggression and add a sense of wonder to the section.

Figure 1: Beginning fanfare.

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Figure 2: Time signature.

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Figure 2: Violin entrance

Figure 3: Clarinet/Flute Contest

Approaching the end of the piece, the piece finales in 3/4 keeping the same tempo (Figure 6). What should be noted about the end is that even though the piece has gone into 3/4 and the eighth note can into six equal beats, an asymmetric pattern can still be achieved. The idea here was to develop a strong finale that was not foreign in its time signature, but still very odd with its rhythm.

Theme:

Because of the varied ABA form, there are mainly two ideas that were conveyed. One is known as the Con Brio section, or “A Section” - which moves swiftly and lively (Figure 1). The other section – the “B section” (Figure 7) - is labeled as Dolce, or Delicate and moves in the same tempo, but is stylistically contrasting with the “A section.” ABA form was chosen due to its simplicity, yet its ability to portray a story effectively in music. To myself – the composer – Each section had its own picture to paint. The “A section” – to me – was to paint an image of a rocket lifting off the launch pad to explore a new region of space that we have yet to discover. The “B section” painted an image of gliding through space, seeing all of the universe’s colors, incomprehensible unexplored cosmos, planets, and immense and bountiful numbers of stars. I used the “B Section” to add different a cluster of new timbres. I brought in a bassoon and used a pizzicato technique in the Violin. The whole section works off of five things: The upper legato melody within the Clarinet, Bassoon, and Flute, the staccato melody within the trumpet, the underlying countermelody in the pizzicato, the ostinato in the lower voices, and the ostinato in the celesta.

Composition Style:

Warp Speed was influenced by John Adam’s Short Ride in a Fast Machine – another perpetual motion piece and Nintendo’s Super Mario Galaxy Soundtrack – Specifically the Gusty Garden Theme. Because Warp Speed is based on the concept of perpetual motion, it cannot drastically change in tempo and must remain fairly metronomic. The majority of the piece revolves around ≈130 with slight tempo changes only accentuate thematic changes.

This piece, despite its many uses of instrumentation, has a fairly minimalistic structure riding on one rhythm throughout the major of the piece. This piece is all about the idea of clusters, musical lines stacked
Figure 4: 4/4 Transition

Figure 5: Legato/Staccato Juxtaposition
The clusters are uniform and most of the music lines move together in uniformity. Within the 4/4 section, its uniformity is interrupted by the scattering of pizzicato and similar staccato rhythms. It is important to note that different instrumental sections (i.e. brass, string, woodwinds, and mallets) have their own rhythms that are unique to them.

**Reflection:**

Music has always been a part of my life. I’m a Music Education Major with an emphasis in Clarinet and Composition. I plan to teach music, I’d prefer to eventually end up solely composing or directing an orchestra, but we all have dreams. I have been working on this piece in my lessons with Dr. Mark Petering, the Composition and Music Theory professor at Carthage. I’ve been in his lessons for only a semester, yet composition has been a part of my life since I was about 13. I generally begin working on a non-melodic layer first – the harmonies - or if I do start with the melody, I generally create a short motif as a central idea, then begin working on the non-melodic layer to fit into that. The idea of Warp Speed came about because I had a friend who is a percussionist and wanted to write a percussion-heavy, piece for orchestra. In the case of Warp Speed, I started with the fanfare in the horns. Not very sure where to go with it next, I kept the same I#7 chord, which is really uncommon for me to do and I liked it. I imagined the rhythmically challenging melody that the marimba and xylophone could play and I wrote it down immediately. After writing an idea, I report to my lessons and Dr. Petering will offer amazing, credible insight to my work. Afterwards, I spend time revising and touching up my pieces. I never truly feel like I’m ever completely finished with one. Even to this day, my first pieces can always be revised in some way. I relate them to children, after they are done developing and growing up, there comes a time when you have to depart from trying to add more to your music because it might become overdone and may rebel. Regardless of Warp Speed the clusters stacked upon clusters as it is, I didn’t feel like enough was ever enough. I felt it was okay to have ideas stacked upon ideas, it was extraordinary how well it came out.
Figure 7: Clustering of Timbres

References:


A Communicative Context: Pedagogical Responses to the Social Contextualization of Language learning in SLA

By Taylor Khloa

The branch of applied linguistics focusing on second language acquisition (SLA) has seen rapid advancement over the past four decades. As researchers continue to explore how humans actually learn languages, practitioners are faced with the challenge of incorporating these findings into effective classroom methods. Steven Krashen’s Input Hypothesis was the first theory to prompt such a pedagogical reaction; he controversially claimed that acquisition is a meaning-driven process occurring solely through exposure to comprehensible input. The “Natural Approach” of classroom teaching was developed as a response. As research began to suggest that Krashen’s theory does not fully account for all features of SLA, however, theorists such as Bill VanPatten posited the learner is actually motivated by the need to express, rather than comprehend, a certain concept. This understanding was developed into his “input processing” teaching method. Subsequent approaches to SLA, notably Firth and Wagner’s 1997 article, have continued this trend, advocating a more socially contextualized understanding of the acquisition process and a classroom pedagogy focused on communicative interactions. Increasing dissent among theorists and practitioners over the use of the term “communicative” necessitates a review of the trend in interaction between research and praxis through study of the pertinent literature.

Foreign language instruction is a component of curricula at every educational level, from elementary school Spanish programs to upper-level university courses in the Native American language Choctaw. However, despite the fact that the vast majority of curricula in use today are marketed as “communicative,” there is a vast degree of variation in teaching methods across the field; every teacher and linguist seems to have a different idea of what methods work best to enable students to learn a second language. Such dissent is hardly surprising when one steps back to consider the rapid developments that have unfolded within the study of second-language acquisition, or SLA, over the course of the past 75 years. A main trend that has emerged could be described as the contextualization of SLA, described by Savignon as “the shifting of the locus of activity in the language classroom...in favor of a model of learning in which interlocutors negotiate and co-construct meaning intersubjectively” (2007, p. 742). This view of language as a tool designed to facilitate the transfer of meaningful information has become increasingly prevalent. Subsequently, researchers began investigating the role communication might play in the process of second language acquisition. The progression of research in this direction has had significant implications for how foreign language ought to be taught in order to maximize facility and benefit for the learner.

Background

Before embarking upon an investigation into issues of pedagogy, it is important to understand in overview
how the various theoretical backgrounds have in large part given shape to them, since “the history of language teaching is reflected in a constant tension between theory and methodology” (VanPatten 1998, p. 929). Early approaches to SLA, influenced by the principles of such behaviorist psychologists as B.F. Skinner and Jean Piaget, did not address the concern of meaning or communication at all, instead dealing solely with how the formal aspects of language such as grammar and phonology can be taught to the individual. Impelled by the need for multilingual proficiency in the wake of the World Wars when the United States was faced with an increasingly hostile global environment, instructors and practitioners drew on these concepts to develop what was know as the audiolingual or Army method. The aim was perfect memorization of vocabulary, verb conjugations, phonology, and other formal elements of language; consequently, students were made to repeat drills such as conjugating the French verb aller or correctly pronouncing the Spanish noun hombre. Such tactics were essentially a transferal of the methods that were used to teach classical languages such as Greek and Latin; there was little to no research or evidence into modern foreign language learning to suggest any other way.

The aim was perfect memorization of vocabulary, verb conjugations, phonology, and other formal elements of language

This changed in the 1970s and ’80s, when Noam Chomsky’s postulations of a “universal grammar” revolutionized scientists’ and thinkers’ conceptions of how language functions in the mind, though not directly addressing the role of meaning or communication in language as a phenomenon. The claim that the capacity to learn any language is an intrinsic part of human mental capacities did, however, cast a shadow on the validity of the audiolingual method; if language is innate, what use is repetitive practice in acquiring it? None at all, claimed linguist Steven Krashen in his Input Hypothesis, which proposed that acquisition is a meaning-driven process occurring solely through exposure to comprehensible input, without any implementation of explicitly learned grammar forms except as a sort of monitor. Thus, the context of SLA began widening with the suggestion that social factors external to the learner might play a role in the process.

A growing body of research began to suggest, however, that not all features of a second language or L2 can be learned exclusively through comprehension of meaningful input. This ran contrary to Krashen’s claims, and so linguists began to investigate alternative approaches. One perspective that emerged dealt how both instruction in and practice with the forms of the target language might further the acquisition process. Notably, the Input Processing approach outlined primarily by Bill VanPatten attempted to reconcile the seeming conflict between implicit acquisition of meaning and explicit acquisition of form. According to Firth and Wagner (1997), however, even the emphasis placed on communicative competence in this approach did not provide the level of meaningful contextualization needed to optimize the SLA process. Their position was founded in the earlier theory of Vygotsky that language is a means of cultural mediation and all meaning is negotiated within a social context, with the implication that language can only be acquired through complete engagement in this context.

Practitioners and instructors are left with the challenge of designing foreign language programs that satisfy the expectations of teachers, students and administrators while applying these often-conflicting theories and claims in a meaningful way. Indeed, writes Savignon, “When it comes to curricular design and implementation, there exists widespread confusion and debate” (2007, p. 208). Evidently, a gulf formed between theory and practice in the field of SLA, a factor which may ultimately be problematic for the optimal instruction of foreign language.

Input Hypothesis

Krashen’s Input Hypothesis, formulated primarily during the 1970s and early 1980s, was the first SLA approach to explicitly address issues of pedagogy; as such, it was—and remains—extremely influential and controversial in the development of the field over the past half-century. Indeed, VanPatten and Williams (2007) write, “An understanding of this theory is crucial to understanding the field of SLA theory as a whole” (p. 25). In overview, Krashen’s position is that language is acquired, exclusively and unconsciously, through attention to comprehensible input; explicit instruction cannot contribute to the development of communicative competence. In a 2000 article, Krashen provides the example of Armando, a Mexican-born man living in the US who learned to speak Hebrew fluently simply from exposure to the language over the course of twelve years working at an Israeli restaurant. Krashen reports that Armando “had never learned to read Hebrew, never studied Hebrew grammar, had no idea of what the rules
of Hebrew grammar were, and certainly did not think about grammar when speaking," and yet nevertheless spoke the language with enough facility to pass as a native speaker when recorded (2000, p. 22). Although now virtually indisputable, this notion of language acquisition via assimilation of meaningful input ran directly counter to the "drill and kill" approach of the established audiolingual method.

Krashen himself did not immediately describe a replacement praxis that would reflect his theories. He instead preferred to focus on case studies of people who, like Armando learn a language without instruction at all. However, it is implied that the classroom experience should be structured to provide L2 learners with this input and allow acquisition to occur according to its natural order. Such a view is reflected in Rivers' claim that "students...learn to create meanings from what they hear, without undue attention to details of morphology and syntax" (1986, p. 4). Perhaps Krashen's most controversial characterization of SLA was the assertion that output, or anything produced by the learner in the target language, does not in any way contribute to the acquisition process. With this Krashen had completely discarded every component of instruction advocated by the audiolingual method. Praxis would have to evolve in acknowledgement of, if not acquiescence to, such an assault.

The Natural Approach

An early, and consequently very influential, pedagogical approach developed with this theoretical background was Terrell's Natural Approach (1977). Terrell argued that second language instruction aim for "communicative competence" rather than "perfection in structure and phonology" (p. 329). This position was notable for its shift in emphasis toward the sociocultural context of language learning, a stance further reflected in her definition of L2 competence: that “a student can respond … without errors that are so distracting that they interfere drastically with communication” (p. 326). Making the implicit claim that this communicative competence is acquired by participation in a communicative context, Terrell proposed that "most if not all classroom activities should be designed to evoke real communication...[since] it is only in the classroom that the student will have a chance to exercise any natural ability to acquire the language" (p. 330). Since output is a necessary component of any communicative interaction, it is here that Terrell breaks from Krashen's theory of SLA.

As far as providing a pedagogy, the Natural Approach seems more intuitively appealing than the simple exposure-to-input setup implied by Krashen. Indeed, Terrell goes so far as to make the claim that “Explanation and practice with form is essential if we expect any improvement in the output of students’ developing grammars” (p. 330), although she does make the qualification that this be done outside the classroom setting as homework. It seems that Terrell's conception of the acquisition process is based upon the premise that a learner acquires what he practices: thus, practicing communication leads to communicative competence, and practicing grammar leads to grammatical output. Such praxis, in order to be effective, would depend upon the interface between explicit learning and natural acquisition. Acceptance of Krashen's postulated division of acquisition and learning, however, remained pervasive; and even today sufficient research is not amassed to falsify this hypothesis. Consequently, although the Natural Approach took a significant step toward integrating the sociocultural context of language into the classroom, further work was needed to adequately address this concern.

Progressing Instruction

Perhaps the most significant step toward integrating language instruction with meaningful interaction was VanPatten’s development of the Processing Instruction method (1987), also notable for its attempt to reconcile teaching practices with the body of academic opinion and research. This outline for teaching foreign language aims to integrate the instruction of formal elements such as grammar and syntax into a communication-focused classroom setting, as VanPatten (1982) explained: "We want to practice form, but we don't want the students to know that; we want them to use Spanish to exchange information" (p. 406). To this end, Processing Instruction (PI) involves modifying the input L2 learner receive in order to draw attention to a specific formal element that might not otherwise be salient, while ensuring that the input is still meaningful and presented in an appropriate, socially relevant context. The results are, as VanPatten refers to them, “structured input activities,” and comprise the primary means of grammar acquisition within Processing Instruction (1987 p. 160). This method is illustrated in the following sample curriculum provided by Wong (2000). It is difficult for many students of French as a second language to learn proper use of the subjunctive, since in most cases, the grammatical “meaning” conveyed by the subjunctive verb is
redundant: in the sentence “Il est bon que nous allions en France,” the subjunctive idea of “opinion” is already conveyed in the phrase “Il est bon,” so the learner does not need to process the subjunctive form of “allions” in order to understand the meaning of the sentence. In this case, then, Wong suggests using sentence-completion activities. Thus, provided with the cue “Il est bon que nous...” students would have to choose between “...allons en France” and “...allions en France.” The second subjunctive option is correct, since both it and the cue phrase convey opinion (p. 248-9). The aim of such structured input is to draw students’ attention to the specific form of subjunctive verbs, which they might not otherwise notice.

In this way, PI is able to maintain the focus on meaningful input while also incorporating formal instruction. The efficacy of this method is supported in a 1993 study by VanPatten and Cadierno, which compared PI to traditional methods of grammar instruction. Each group of students—processing instruction, traditional instruction, and no instruction—was given pre- and post-tests consisting of both comprehension-interpretation tasks and written production tasks. VanPatten and Cadierno found that while processing instruction and traditional instruction resulted in comparable improvement on production activities, “processing instruction was superior to the other two instructional types vis-à-vis the interpretation test” (p. 51). Both PI and traditional instruction improved significantly more compared to the no-instruction control group; data such as this reinforced the impetus for a reconsideration and remediation of elements of Krashen’s initial SLA theory. Thus, VanPatten attempted to codify a curriculum progression that allows for “input plus interaction and negotiation” (1987, p. 160).

**Sociocultural Approach**

Despite the meaning-focused, socially contextualized conception of SLA and foreign language instruction methods provided by the Processing Instruction approach, some scholars, namely Firth and Wagner in their 1997 article, argued that

The imposition of an orthodox social psychological hegemony on SLA... prioritzes explanations of phenomena in terms of underlying cognitive processes over descriptions of phenomena...It views communication as a process of information transfer from one individual's head to another...At best it marginalizes, and at worst ignores, the social and contextual dimen-

sions of language. (p. 288)

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There is no “correct” grammar or syntax or vocabulary

They called for the locus of the language acquisition process to be shifted from the individual learner’s cognition to the sociocultural context which makes use of language as a tool of mediation. Consequently, the acquisition of language as characterized by Firth and Wagner is driven by “negotiated meaning—meaning conjointly established in an apparently non-problematic way” (p. 290). A transcribed excerpt from dialogue between a native English speaker (NS) and an ESL speaker (NNS) illustrates this idea:

NS: Are you a student in Japan?
NNS: No I am not (...) I am worker
NS: You're a worker what kind of work do you do?
NNS: uh I'm a /oSs'/ (...) /oSs'/
NS: official!
NNS: Official of () (pu-) public
NS: Ah you work for the government (p. 293)

As is typical in native-nonnative speaker interactions, the interlocutors adapt their language as they speak to arrive at mutual comprehension. There is no “correct” grammar or syntax or vocabulary, only the meaning agreed upon moment-by-moment over the course of the interaction. That is, “language learning is essentially a social enterprise, in which meaning is first co-constructed by interlocutors before being internalized by the learner” (Lafford, 2007, p. 737). It is through this process of natural, communicative interaction, seeking meaning within a social context, that language is acquired.

Widening the context of the SLA process to include not only the individual learner and instructor, but also the entire social environment, is problematic for a traditionally structured classroom. Indeed, taking the Sociocultural Approach seriously has enormous implications for pedagogy. Savignon contends:

It would be inappropriate to speak of a teaching ‘method’ in any sense of the term as it was used in 20th century. Rather, [one must take] an approach that understands language to be inseparable from individual identity and social behavior... The norms and goals for learners appropriate in a given setting, and the means of attaining these goals, are the concern of the learning community. (2007, p. 217)

In such a context, student-student interactions become just as valid sources of interactive input as the
teacher or the textbook. Consequently, suggest Lantolf and Johnson, the role of the instructor would necessarily evolve:

When L2 teachers embrace the notion of classroom activity as creating opportunities for development, their attention...shifts to what is being accomplished in the activity and whether or not what is being accomplished is working to build L2 learners’ capacity to generate meaning through, and therefore successfully function in, the relevant languaculture. (2007, p. 888)

With the contextualization of SLA taken to its fullest extent, a foreign language classroom operating according to this approach would be truly communicative in a sense that most SLA scholars and researchers could agree upon.

Discussion
Defining “Communicative Approach”

Despite the prevalent use of this term “communicative” to describe the textbooks and curricula commonly employed in foreign language programs, there is, as VanPatten points out in a 1998 article, a “considerable gap” between what scholars and researchers mean by “communicative” and how the term is employed in practice. The scholarly debate over the relative value of classroom techniques such as structured input activities and peer-to-peer conversation has, for the most part, resolved itself as described in the present work. Indeed, as Serviewon notes, “so-called communicative language teaching has become a buzzword in discussions of the practice and theory of second and foreign language teaching,” having a “seemingly worldwide” appeal. Nevertheless, the standard method of instruction in most classrooms across all levels of instruction has remained strongly colored by the traditional strategy of memorizing and drilling grammar and vocabulary in order to improve proficiency (2007, p. 208). These seemingly conflicting aims—accuracy of output at the expense of meaningfully contextualized interaction—are demonstrated in the preface of a Spanish textbook, quoted by VanPatten (1998), which claims that “the text...can be adapted to individual teaching situations and goals—among them, a proficiency orientation and teaching for communicative competence” (p. 926). This textbook’s claim of being teachable with either an emphasis on proficiency or on communicative competence is inconsistent with the findings of applied linguists as described in the present work.

The reason for this confusion, VanPatten explains, is that the profession has sought “to somehow make the new focus on communication and learning-as-communication ‘fit’ into the existing audio-lingual pedagogy” by teaching along a sequence from mechanical practice to meaningful practice and finally to communicative practice (p. 930). The reluctance of curriculum designers to turn away from familiar methods is understandable but unfortunate, since it would seem that the majority of L2 learners are not benefitting from the most academically sound pedagogical approaches.

Conclusions and Future Case Study

The implementation of a truly communicative classroom approach to SLA can only come about, as Serviewon proposes, through “the empowerment of language teachers both as practitioners and theory builders” (2007, 218). One might hope that, in time, foreign language programs would evolve to reflect the body of socio- and neuro-linguistic research and theory in order to truly teach to SLA as it occurs via the complex interactions of the individual learner within a broader cultural context. Drawing on an improved dialogue between research and classroom praxis, foreign language teachers can better enable their students to attain the communicative competence necessary to actually use the L2 in a meaningful way.

Author Reflection

As a student of several languages, I find the process of language acquisition and instruction to be of great interest. When the opportunity arose, then, for me to explore more deeply the broad field of SLA, it was the interaction between acquisition research findings and classroom methods that most intrigued me. To that end I decided to conduct a review of the existing literature in this area, which comprises my first such study. Because of the vast body of work that exists on this topic, it was a daunting task to sift through and find those landmark studies that have been consistently referred to over the past few decades. Perhaps the most useful skill I learned throughout my research process is how to select articles that together form a coherent picture in overview of the field. Another challenge of this particular type of research was finding a way to organize the information I aggregated in such a way as to be meaningful and interesting without leading toward a specific thesis. This has been an important project for me personally as I continue to hone my research skills.
References


Epic Love

Tradition and Chastity in Book III of The Faerie Queene

By Susan Peinsipp

Britomart, the central knight of Book III, the Knight of Chastity, is the only female knight to have her own book in Edmund Spenser’s Faerie Queene. Spenser is using Britomart to expand the female tradition which, though it has a foundation in the ancient epics and romances, has not previously received serious treatment. Spenser uses tree imagery to illustrate how he is building up this tradition. Britomart is a female knight in a typically male role; as such, her quest is for empire through love and lineage rather than through war. She is the allegorical representation of chastity, which is a sexual responsibility to get married and have children to carry on the empire. Love is the moderator for it is steadfast and does not easily give into temptations. Spenser uses Book III to grow the female tradition in literature and to define chastity.

Book III of Edmund Spenser’s The Faerie Queene is “The Legend of Britomart or of Chastity”. The book opens with Sir Guyon, from Book II, and Prince Arthur coming across a strange knight. Sir Guyon fights the strange knight and is defeated. This knight is actually Britomart, the female knight; after Sir Guyon and Prince Arthur part company with her, Britomart’s story is slowly revealed. She is questing disguised as a knight in order to find her love Arthegall whom she saw in a magic mirror. After seeing the vision, she fell into love-sickness and was cured by Merlin with the knowledge that she is going to be the mother to a new nation. The rest of the book follows various other characters, Florimell, Belpheobe and Amoret. Britomart re-enters in the end to rescue Amoret from Busirane. Britomart does not finish her original quest to find Arthegall. Britomart is the only female knight to have her own book, and she is the first knight not to complete her quest by the end of the book.

Spenser (1552-1599) was a self-made man, starting his education at the Merchant Taylor’s school as a “poor scholar” and then attending Pembroke Hall, Cambridge, working to pay his tuition. He received an education founded on logic, rhetoric, Latin, and “the major classical authors such as Cicero, Aristotle, Plato, Virgil and Horace” (Rambuss 18). While in school, Spenser formed a close friendship with Gabriel Harvey and Sir Phillip Sidney. Spenser never relied on his poetry for his living; after Cambridge, Spenser entered into his first secretarship with the Bishop of Rochester. After leaving, he found a new position as the private secretary for Lord Grey de Wilton, the Lord Deputy of Ireland. Spenser had other secretarships in Ireland until he received 3028 acres of land and the title of gentleman (Rambuss 29).

The few times that Spenser returned to his beloved England were for The Faerie Queene: one time to oversee its publication, another to present it to Queen Elizabeth. The Faerie Queene was written glorifying Queen Elizabeth and it was Spenser’s attempt to return home to England as a court poet. Instead his estate in Ireland was burned and taken over by Irish rebels; Spenser returned to England for the last time and died in England. He is buried in Westminster Abbey in the Poets Corner next to Chaucer. Spenser is honored as “the prince of poets” (Rambuss 33).

The Faerie Queene is a complicated text; “Spenser not only entwines epic and romance, two genres which have different historical, formal and political implications, but he builds into the very structure of the poem layers of figurative, symbolic and allegorical meanings.
What is sometimes called the allegory of the poem is in fact an interweaving of several allegories with literary symbolisms of several kinds" (Wofford 107). The many allegories layered on top of each other create an interesting tapestry with political and religious implications. Not only does Spenser layer his allegories but he also tackles different literary ideas, virtues, and cultural conventions. Each book in The Faerie Queene follows a central knight that represents a virtue. Spenser stated that his intentions were “to fashion a gentleman or noble person in virtuous and gentle discipline” (Spenser 8). Most importantly, The Faerie Queene is a blend of epic and romantic traditions. Romance differs from the epic, for “in romance, time is occasionally allowed to turn back, death is not always the absolute limit, and consequences do not always need to be faced” (Wofford 114). The romantic tradition is allowed to bring in magic which breaks the constraints of the epic tradition. Within the romantic and epic traditions, though, women are not usually written about, except for a few lines. Spenser is allowing for a female tradition with The Faerie Queene through the blending of epic and romantic traditions.

Spenser has to follow a tradition. As T.S. Eliot illuminates in his essay, “Tradition and the Individual Talent,” "No poet, no artist of any art, has his complete meaning alone. His significance, his appreciation is the appreciation of his relation to the dead poets and artists. You cannot value him alone; you must set him, for contrast and comparison, among the dead” (Eliot 4). Even though Spenser is trying to make his mark with an English epic, he still is tied to influences from past works. In order to understand Book III, it must be placed within the traditions that influenced Spenser. Spenser’s "intention is aesthetic: to emulate, in the sense of both to imitate and, if possible, to surpass the other "poets historicall," Homer, Vergil, Ariosto, and Tasso.” (O’Connell 22). Homer, Vergil, Ariosto and Tasso are some of Spenser’s influences, his predecessors. He is not only copying them but trying to go above and beyond their works. Yet he will never be completely free from their influence, for they create the tradition in which Spenser writes.

Spenser most likely studied the classical authors throughout his education; “Spenser’s debt to the Italian poets for characters, episodes, and the romance structure of his poems is well known, but studies of his imitation of Vergil have not fully considered his debt to the Roman poet for the historical dimension of The Faerie Queene” (O’Connell 36). Spenser was influenced heavily by Italian poets who, before him, had combined epic with romance. This influence is easy to see, but his debt to the Roman poets is more obscure. It is difficult to say how much Homer and Vergil had to do with Spenser’s writing. Though, in his Letter to Raleigh, Spenser says they influenced him a great deal.

The many allegories layered on top of each other create an interesting tapestry with political and religious implications

Along with the Italian and Roman poets, the legends of King Arthur very obviously had influence on Spenser; “Arthurian material had become associated with romance and chivalry, and this side of the tradition centered upon such ahistorical concerns as love and the marvelous. Ariosto, Tasso, and Malory would work in Spenser’s imagination to develop this side of his Arthurian sources. And Renaissance mythography and the traditions of iconography would add further complexity to his intentions” (O’Connell 37). Taking all of his influences and putting them into his work makes Spenser's work complicated by its layers of influence; “Some of this multiplicity can be seen in the complex union of genres that the poem creates. Spenser would have seen his poem as a version of ‘heroical poetry’ (as Sidney calls it in his Defense of Poetry), and he identified it with classical epics such as The Iliad, The Odyssey, and especially The Aeneid, with romance epics such as Ariosto’s Orlando furioso and Tasso’s Gerusalemme liberata (Jerusalem Delivered), and with Arthurian romance” (Wofford 106). Spenser is following the traditions laid down before him by the past authors and poets. But within these traditions there are not many female heroes, so Spenser has to break away from the tradition in order to create his female protagonist, Britomart.

Spenser is separating from the old traditions to expand on the female tradition. The female tradition consists of a reversal of epic norms: Spenserian romance consists of a pattern of deliberate reversals of epic norms calculated to elicit awareness of the scope of Christian paradox, to prepare for a revelation of truths held to be beyond the capacity of Virgil to envision. In book 3 Spenser transfers the role of dynastic hero from male Aeneas to female Britomart and substitutes the narrative matter of love for the matter of war... Love, we are to discover once again, is not finally an impediment to the establishment of empire; love... is rather empire’s most basic element. (Fichter
The Carthage Vanguard

156-157)

The traditional norm is to have a male hero and the subject is war. Instead, the female tradition has a female hero and its subject is love. This is especially noted in Book III, for Britomart is on a quest for love and her love will bring forth an empire. By working with the female tradition, Spenser is allowing for the definition of chastity to be changed as well. If Spenser is going to try and expand the female tradition he must have a foundation with the past; “the past should be altered by the present as much as the present is directed by the past. And the poet who is aware of this will be aware of great difficulties and responsibilities” (Eliot 4). Spenser’s works are shaped and influenced by the past as much as they are breaking away from the tradition of the past.

The few women that have been written about in the old epics form their own tradition (though not as in-depth or as strong as the male heroic tradition); for “feminine heroes... did not merely love faithfully but actively pursued their loves by showing their worthiness. Such women were found in the pages of chivalric romance: in Spenser, but also in Montemayor’s Diana, Ariosto’s Orlando Furioso, The Boke of Huon of Bordeaux and the Amadis cycle of romances” (Trull 152). There are many other romantic epic poems preceding Spenser creating the tradition that he follows, “The existing order is complete before the new work arrives” (Eliot 4). The female knights love, their knightly virtue is their love. Britomart fits within the female tradition the earlier texts create:

The female knight seeks renown, and finds it; but hers is a powerful version of female agency. Her body is shielded by armor, and though she is known for both beauty and martial prowess, she presents an impervious and undifferentiated exterior to the world, retaining the status of private subject behind that barrier. She is public without seeking approval, without revealing her body or her femininity, and thus could never be accused of self-commodification: rather than pandering to the crowd, she unhorses and roundly beats almost every knight she encounters. Her cross-dressing and her martial role allow the female knight to be unaffected by the public gaze and to maintain a reserve of privacy and its privileges. (Trull 152-153)

The female knight is able to complete her quest by donning armor. Her armor protects her and her love; hiding her femininity, the female warrior finishes her task by appearing male. Britomart follows this description of the traditional romantic female knight. She takes on the armor to go find her love and is able to defeat

One example of how Spenser overcomes having female knight in a traditionally male role is where “Britomart assumes the role of desiring subject, rendering Arthegall the object of her own gaze and fantasies in a reversal of the usual Petrarchan pattern” (McManus, 126). Traditionally in romantic epic the male is the subject desiring the female object, and then the subject goes on a quest or task to prove his love or worth to the object. Britomart is not fashioned after the “classical, lifelong amazons Camilla and Penthesilea but instead... Englishwomen who ‘took up arms for a particular cause’” (McManus, 138). Spenser is using Britomart to change the traditions created before him with the works of Homer, Vergil, Ovid, Malory, Ariosto, and Tasso, etc. By changing that tradition Britomart “finds herself pulled from a protofeminist myth of female autonomy toward a more traditional destiny that makes her the vessel of an epic genealogy” (Berry xiv). Britomart is the start to an expansion of a female literary tradition and a changing definition of chastity.

Analysis

Spenser is using Britomart, not only to create a history for England, but to expand the female literary tradition. He has a problem: “That I in colourd shows may shadow itt,/ And antique praises vnto present persons fit” (Spenser III.Proem.3.8-9). Spenser is trying to use the “antique praises” and apply them “vnto present persons.” But it is not working, for he “may shadow itt” or it will be flawed. Spenser is breaking away from the “antique praises” using Britomart. Her quest starts, “revealed in a mirror-playne,/ Wherof did grow her first engraffed payne,/ Whose root and stalke so bitter yet did taste,/ That but the fruit more sweetness did contayne” (Spenser III.ii.17.4-7). Love is a tree growing within Britomart. The love she feels for Arthegall is painful now since they are not together, but someday it will bear the fruit of a new lineage and a new nation. The family tree that Spenser is forming starts with Britomart; she is the beginning of a genealogy for England. The image of a tree can be used to map family history but it can also be used to depict literary history. One author’s work builds on another and so forth until there is a tree and different aspects of the works can be traced throughout. Spenser is writing in the tradition-tree of the epic poetry
of Homer and Virgil as well as romantic poetry. These poems are the old generation, “First rooting tooke; but what thing it mote bee/ Or whence it sprong, I can not read aright” (Spenser III.iii.16.6-7). These texts are the foundation for the tradition, and it is impossible to trace their roots since they came from an oral tradition thus rendering them impossible to read. Britomart is suffering under these old texts; she needs a new tradition in order to flourish.

Britomart is a new generation dying for the old; her potential to grow and flourish is wasting. Glaucce asks Britomart why “ne doest spred/ Abroad thy fresh youths fairest flowre, but lose/ Both leafe and frute” (Spenser III.ii.31.6-8). In the epic tradition, leaves are used as a symbol for the generations of mankind; one withers and dies to make room for the new. Britomart is waning, slowly dying because of her love-sickness. The old tradition would have her suffer since “Scarse doe they spare to one or two or three,/ Rowme in their writes” (Spenser III.i.ii.1.7-8). For women, the “race and royall sead” (Spenser III.i.ii.33.4) come from the Romans and the old epic poets; Britomart has been “deepe engraffed” (Spenser III.i.ii.18.3) from them. Engrafting is when part of the original tree is taken and planted elsewhere so it grows into a new tree. It still comes from the old tree just not from a seed. Britomart is engrafted from the tree of antiquity to start her own:

For so must all excellent things begin,  
And eke enrooted deepe must be that Tree,  
Whose big embodied braunches shall not lin,  
Till they to heauens hight forth stretched bee.  
For from thy wombe a famous Progenee  
Shall spring, out of the auncient Troian blood,  
Which shal reuiue the sleeping memoree  
Of those same antique Peres, the heuens brood,  
Which Greeke and Asian riuers stayned with their blood.  
(Spenser III.i.ii.22.1-9)

Merlin tells Britomart that she will mother a new Rome, England, but she is also mothering a new literary tradition. Her roots are in Roman blood which came from the Trojans and she is starting new. Troy was great; after it fell Rome rose up and it was great. England rose out of Rome which makes it great as well:

The glory of the later world to spring,  
And Troy againe out of her dust was reard...  
But a third kingdom yet is to arise,  
Out of the Torians scattered ofspring,  
That in all glory and great enterprise,  
Both first and second Troy shall dare to equalize.  
(Spenser III.i.ii.44.2-9)

Britomart takes Merlin’s words to heart when she explains to Paridell of a new empire rising out of Rome similarly to how Rome rose out of the ruins of Troy. The new empire will be just as great as the old ones. England will be as great as Rome and Troy, except as Merlin stated, without end. Not only is England springing from the old but also the new literary tradition that Spenser is trying to produce. Britomart is speaking about the new tradition that Spenser is writing. Homer was part of the Trojan tradition, Virgil was the Roman tradition stemming from Homer, and Spenser is the engrafted English tradition taken from the older traditions and planted new.

Many of the ancient poets do not spend time on women in their writings save only a few lines. Spenser, on the other hand, finds women worthy subjects of poetry. Queen Elizabeth had to manage being a female monarch in a male society, just as Britomart has to manage being a female hero in a tradition dominated by male heroes. Spenser laments “Where is the Antique glory now become,/ That whylome wont in wemen to appeare?” (Spenser III.i.ii.1.1-2). He goes on to reference women that the ancient poets mention but never really explain. Spenser finds these women “Well worthie stock, from which the branches sprong,/That in late years so faire a blossome bare” (Spenser III.i.ii.3.6-7). The only way for Britomart to survive in literature is for Spenser to develop the female tradition with his writings. The branch that Britomart’s tradition-tree comes from is the branch of female warriors on the larger tree of antiquity. Part of Britomart’s tradition is how her quest is untraditional; it breaks customary questing conventions.

Spenser’s first two knights, the Redcross knight and Sir Guyon, each receive their quest in a traditional manner. The Faerie Queene, Gloriana “kept her Annuall feaste xii dayes, vppon which xii seuerall dayes, the occasions of the xii seuerall adventures hapned... being vndertak-en by xii seueral knights” (LR 50-52). On the first day the Redcross knight was given his adventure. On the second day Sir Guyon was given his adventure. On the third day Sir Scudamour was given his adventure “but being vnable to performe it by reason of hard Echnaunt-ments, after long sorrow, in the end met with Britomart-tis, who scoured him, and reskewed his loue” (LR 77-78). The knight on the third day failed where Britomart was able to succeed. Already her story is different since it comes about “rather as Accidents, then intendment”
However, looking in a mirror Britomart is both the subplaced in front of it, an outer surface, and transparent in her auizing of the vertues rare,/ Which thereof spoken be seen, particularly foes that are invading or treasons starts its transition from reflective to transparent: "Tho the mirror; The king can see the enemies to the king-

dom, and Britomart can see Arthegall. She was not given her quest in the same way as the knights preceding her; instead she finds her own quest in a different way. Finishing Sir Scudamour’s quest was not the end goal of her quest.

Britomart’s quest starts untraditionally when she gazes into her father’s magic mirror and sees Arthegall, “By straunge occasion she did him behold/ And much more straungeley gan to loue his sight” (Spenser III.i.18.1-2). It is a property of glass to be both reflective and transparent; reflective in that it shows what is placed in front of it, an outer surface, and transparent in that it reveals what is inside, not only what is inside the glass but what is inside of itself. The magic mirror was made by Merlin, it “round and hollow shaped was,/ Like to the world it selfe and seemed a world of glass” (Spenser III.i.19.8-9). This particular magic mirror is a sphere, similar to a crystal ball, where images of the world can be seen, particularly foes that are invading or treasons within. The “glassy globe” is the world, “It virtue had, to shew in perfect sight,/ What euer thing was in the world contained,/ Betwixt the lowest earth and heauens hight,/ So that it to the looker appertaynd” (Spenser III.i.19.1-4). The mirror has the power to show the world, specifically to the kingdom, the dangers inside and out. By knowing the threats and guarding against them, the kingdom is happy and safe (Spenser III.i.21).

There is a side digression from the mirror to the glass tower that Ptolomæe built for his love Phao. Phao could lurk “from all mens vew, that none might her discourse,/ Yet she might all men vew out of her bowre” (Spenser III.i.20.4-5). In this glass tower, Phao has the power to see out without being seen within. She has the ability to view the world without the knowledge of the world. The king has the ability to view the world and know the dangers to his kingdom without being seen and the enemies have no knowledge of being seen. But the mirror only shows the dangers pertaining to the person looking into the mirror; The king can see the enemies to the kingdom, and Britomart can see Arthegall.

The magic mirror is similar to the glass tower where the woman can look out and see the men in the world. However, looking in a mirror Britomart is both the subject doing the looking and the object being looked at. Initially Britomart sees her physical reflection in the mirror, “Where when she had espied that mirrhour fayre/ Her selfe awhile therein she vewed in vine,” (Spenser III.i.22.5-6). Upon reflecting on virtues and trying to think of the virtues she herself possesses, the mirror starts its transition from reflective to transparent: “Tho her auizing of the vertues rare,/ Which thereof spoken were, she gan againe/ Her to behinke of that mote to her selfe pertaine” (Spenser III.i.22.7-9). Britomart first sees her physical self but then her thoughts turn inward to virtues. Spenser asks, “Who wonders not, that reads so wonderous worke? (Spenser III.i.20.1). It is natural to look at this mirror and to wonder at the beauty of the mirror and the self. Britomart is transitioning from an outer worldview to an inner world. The mirror reveals her thoughts, for as she thinks upon her inner self the mirror shows her inner self. She idly wonders who she would marry someday and “Eftsoons there was present-ed to her eye/ A comely knight, all arm’d in complete wize” (Spenser III.i.24.1-2). Arthegall is an internal reflection of Britomart. Britomart is the subject viewing Arthegall the object. Arthegall is described as a “par-

amour” (Spenser III.i.45.2), or an object of love. By referring to Arthegall as a paramour it supports him as the object. Traditionally, the man sees the woman and his quest is started with the vision of the woman, to win the woman object. His quest is usually to perform a task or find something in order to prove his worthiness of the woman’s love and to gain her love in return.

This is not the traditional instance of passionate love at first sight. Viewing Arthegall in the mirror does not cause Britomart to take up arms to go find him. Instead she “liked well, ne further fastned not,/ But went on her way” (Spenser III.i.26.2-3). Britomart just thinks that the image of Arthegall is nice and goes about her life. She does not realize that she has fallen in love. Even when she “now did quaile:/ Sad, solemne, sowre, and full of fancies fraile” (Spenser III.i.27.4-5), Britomart thought it was not loue, but some melancholy” (Spenser III.i.27.9). As Britomart falls into the love sickness from viewing Arthegall she does not realize it at first. But later she understands that her vision of Arthegall is “only shade and semblant of a knight,/ Whose shape or person yet I neuer saw,/ Hath me subiected to loues cruel law” (Spenser III.i.38.3-5). Britomart realizes that what she saw in the mirror and fell in love with is just an image, not a real person yet. Arthegall is often referred to as “shade” (Spenser III.i.38.3), and Britomart did “vew his personage” (Spenser III.i.26.1); the repetition of describing Arthegall as an image reminds that he is not real yet. Britomart does not even know his name until after she visits Merlin. When she asked the Redcross knight to describe Arthegall “Yet him in eue-

rartie part before she knew,/ How euer list her knowledge fayne” (Spenser III.i.17.1-2). Britomart knew what Arthegall looked like since she had seen him in the mirror. She learns his name from Merlin, but he is still an image to her, not a real person. Here she is looking for confir-
mation that Arthegall is indeed real. She went chasing after an image; something that she is not entirely sure is real. She is faithful to Arthegall, a quality of love, without knowing that he exists.

Britomart is transitioning from an outer worldview to an inner world.

After the untraditional beginning to her untraditional quest, Britomart follows the female hero’s tradition of taking on armor as a means of protection. Typically, armor is passed down from father to son or is taken by a victor from a loser. Britomart’s father, King Ryence, “had gotten a great pray/ of Saxon goods, emongst the which was seene/ A goodly Armour, and full rich aray,/ Which long’d to Angela, the Saxon Queene” (Spenser III. iii.58.5-8). Britomart is inheriting the armor from Angela as well as taking the armor as victor. King Ryence obtained the armor as part of plunder; he did not defeat Angela. He used it as a monument “Of his successe and gladfull victory” (Spenser III.iii.59.4). The king was the victor; Britomart took the armor from him thus making her the victor. After taking the armor, she arms herself with weapons, “Both speare and shield of great power, for her purpose fit” (Spenser III.iii.60.9). The armor and the spear will protect Britomart as a woman, just as her chastity protects her. She is following the tradition of the female knights and inherited the armor as a figure for that tradition.

There are few other warrior women who came before Britomart. Glaucé, Britomart’s nurse, gives Britomart examples of other traditional warrior women; “Which haue full many feats adventourus,/ Performd, in paragone of proudest men:/ The bold Bunduca, whose victorious/ Exploys made Rome to quake, stout Guen- dolen,/ Renowned Martia, and redoubted Emmilen.” (Spenser III.iii.54.5-9). The women that Glaucé uses are English women and their history is given in Book II, with the exception of Emmilen. These women all took up arms for a cause but they are not the Amazon warrior women of antiquity:

Her harty words so deepe into the mynd Of the yong Damzell sunke, that great desire Of warlike armes in her forthwith they tynd, And generous stout courage did inspire, That she resolu’d, vnweeting to her Syre, Aduent’rous knighthood on her selfe to don, And counseld with her Nourse, her Maides at-tire To turne into a massy habergeon,

And bad her all things put in readinesse anon. (Spenser III.iii.57.1-9)

The words of Glaucé have persuaded Britomart to become a knight. These words sunk deep into Britomart’s mind and it seems like she makes a traditional logical masculine decision of using knighthood and war to prove courage. But, love is rarely logical and from the diction of the passage the decision is more emotional than logical. The words instantly kindled a great desire which ties back to Britomart being struck by Cupid’s arrow. There are many images of hearts (“harty” and “courage”) which points to emotion. The first few lines sound like helplessly falling in love —kindling a desire and the desire flamed— rather than a conscious decision. Britomart follows in the female tradition of taking on knighthood to find her love.

Britomart’s book starts off with Spenser putting this female tradition into action. Prince Arthur and Sir Guyon, the knight of temperance from Book II, meet a strange knight. Sir Guyon engages in battle with the mystery knight. The knight defeats Sir Guyon; “Great shame and sorrow of that fall he tooke;/ For neuer yet, sith war-like armes he bore, And shiuering speare in bloody field first shooke,/ He fowned himself dishonored so sore” (Spenser III.i.7.1-4). The “shiuering speare” of Guyon’s is “the weapon of a classical warrior” (Hamilton 290). Britomart defeated Guyon. Her spear has “secret power vnseene” (Spenser III.i.7.8), which is her chastity. Chastity is a private virtue which is why it is unseen. Guyon’s spear is the antiquity which was defeated by Britomart. However, Guyon did not know that Britomart was a woman; if he did “much greater griefe and shamefuller regret/ For thy hard fortune then thou wouldst renew” (Spenser III.i.8.2-3). The epic poems did not have many female heroes; it is a male dominated tradition. Guyon, as a representative of the tradition, would be even more shamed if he knew that he had been defeated by the new tradition which is represented by the female Britomart. The female tradition that Spenser is creating is overtaking the old masculine tradition. Britomart is the female knight in a traditionally male role. As a female hero, the epic poem can be about love instead of war. Love, marriage, and having children to carry on lineage are important as the conquests of war. To create an everlasting empire, lineage is the best way. In the case of war, the empire can expand but with children, the empire can continue throughout history. Just as Spenser is connecting his new tradition with the old one, he is connecting Britomart and Britomart’s book with the books and knights that came before.
Guyon is the knight of temperance and Britomart is the knight of chastity. After Britomart defeats Guyon, “Full of disdainefull wrath, he fierce vprose,/ For to reuenge that fowle reprochefull shame” (Spenser III.i.9.1-2). Britomart’s chastity is the greater virtue because it defeated Guyon’s temperance—temperance being moderation. Guyon does not act temperately after his defeat; instead, he is quick to anger. Later Britomart meets the Redcross knight, the knight of holiness; “she ran apace/ Vnto his reskew, and with earnest cry,/ Badd those same sixe forbare that single enemie” (Spenser III.i.22.7-9). The Redcross knight is being attacked by six knights, and Britomart comes to his rescue, triumphing where he was failing. Chastity has proved stronger than temperance and holiness.

Chastity is a strong virtue; no mortal force can withstand it. Arthur knows “The secrete virtue of that weapon keene,/ That mortall puissaunce mote not withstond:/. Nothing on earth mote always happy beene” (Spenser III.i.10.5-7). There is nothing on the earth that is fortunate enough to stand against chastity. Guyon’s anger is stayed by Arthur, “great hazard were it, and aduenture fond,/ To lose long gotten honour with one euill hond” (Spenser III.i.10.8-9). Guyon has difficulty maintaining his emotions, keeping his passions temperate. Attacking chastity again is not worth losing all the temperance that Guyon has gained through his adventures. Guyon and Britomart are reconciled “through goody temperance, and affection chaste” (Spenser III.i.12.2). It is a mingling of their virtues; temperance and chastity go together even though chastity is the higher virtue. This relationship is also seen with holiness. Before Britomart and Redcross part company “A friendly league of loue perpetuall/ She with him bound” (Spenser III.iv.4.4-5). Chastity is the higher virtue but it is bound with holiness. Temperance and holiness are part of chastity because chastity is the highest virtue. Cultivating chastity is important because it means being temperate and holy as well. Being chaste means balancing passions. It is temperate in that it is bad to go lusting after everyone and it is holy in that it leads to children within marriage and is not virginity. Chastity has unified the virtues of temperance and holiness in the fact that Britomart has formed alliances and friendships with Guyon and Redcross.

Chastity is a balance of different aspects. It is defined in part by temperance and holiness. Chastity must balance passion with temperance and sensuality with holiness. When the Redcross knight asks Britomart why she is traveling disguised as a knight, she “had no power/ To speake a while... with hart-thrilling throbs, and bitter stowre... did quake,/ And every dantie limbe with horror shoke,/ And euuer and anone the rosy red,/ Flasht through her face” (Spenser III.i.5.1-7). Britomart is struck with passion; this is her inward emotional struggle made visible outwardly. The description of her passion is similar to Malecasta’s lust in Canto i. Then “At last the passion past” (Spenser III.i.5.9). Britomart gets a hold on her emotions enough to tell her story to Redcross. Chastity is a form a restraint in that it has controlled the sensual passion.

Chaste love leads to marriage which leads to having children. The Redcross knight tells Britomart about Arthe gall, and she is overjoyed to hear him speak so highly of her love; “The louing mother, that nine monethes did beare,/ In the deare closet of her painefull syde,/ Her tender babe, it seeing it safe appeare,/ Doth not so much reioyce, as she reioyced theare” (Spenser III.i.11.6-9). Britomart’s love for Arthe gall is greater than a mother’s love for her child. Britomart is a “noble Virgin” (Spenser III.iii.61.1) yet the end of her quest is to find her love and “From those two loynes thou afterwards did rayse/ Most famous fruites of matrimoniall bowre” (Spenser III.iii.3.6-7). The end goal of the new chastity is not to stay the virgin maiden forever but to be joined in marriage and have children. Part of chastity is moderation between virginity and lust:

For shee was full of amiable grace,  
And manly terror mixed therewithal,  
That as the one stird vp affections bace,  
So th’other did mens rash desires appall,  
And hold them bacce, that would in error fall;  
As hee, that hath espied a vermeill Rose,  
To which sharpe thornes and breres the way forstall,  
Dare not for dread his hardy hand expose,  
But wishing it far off, his ydle wish doth lose.  
(Spenser III.i.46.1-9)

Britomart arouses love in others but her power as a knight of chastity keeps them back. There is a balance between the ones who are lustful and the ones who see the beautiful rose but are afraid. The lustful ones are condemned for their rash desires. So are the ones that are too afraid to love for fear of getting hurt. The middle ground is chaste love; from this love comes marriage and children.

Britomart is the allegorical representation of chaste love. Her quest is based on love; “To seeke her louer (Loue far sought alas)/ Whose image shee had seene in Venus looking glas” (Spenser III.i.8.8-9). The love that
propels the quest is chaste and not lustful, even though it was seen in Venus’s looking glass. Venus is known to be excessively loving but chastity is constant and steadfast:

The whiles faire Britomart, whose constant mind,
Would not so lightly follow beauties chace,
Ne reckt of Ladies Loue, did stay behind,
And them awaited there a certaine space,
To weet if they would turne back to that place:
But when she saw them gone, she forward went,
As lay her journey, through that perlous Place,
With stedfast courage and stout hardiment;
Ne euil thing she feard, ne euill thing she ment.
(Spenser III.i.19.1-9)

Chastity does not lightly turn to follow whatever may catch its fancy but continues forward. The consistency of Britomart’s love is important. She is faithful to Arthegall even though she does not know that he exists. He is just an image she saw in a mirror. Britomart believes that Arthegall is real, she has faith in the unknown. Her quest is incomplete at the end because she has not found him yet. Their union will create an empire that will never fail through their children and their children’s children. The continuation of their empire depends on the continuation of their lineage. Their empire will be everlasting and consistent like Britomart’s love.

Love is active. Britomart’s passive ignorance is becoming active knowledge. In canto ii, Britomart was passively in love and ignorant of Arthegall. Her passiveness caused her to begin to waste away; it was only the knowledge of Arthegall’s reality that caused her to get better. Britomart has decided she is going to actively find her love. Now Arthegall is the one who is unknowing of Britomart, “vnweeting to her Syre.” Britomart decides to become a knight in order to find Arthegall. It is as if she is changing clothes, like being a knight is something she can put on or take off. She is putting on knighthood and changing “her Maides attire” for “massy habergeon.” Arthegall is an internal reflection of Britomart. She saw him in a mirror; her decision to take arms and find him is an internal decision. There were no outside factors giving her the quest. Merlin and Glaucé influence Britomart’s decision but ultimately the decision was hers to make. Britomart’s quest breaks with the traditional questing structure. No longer does Britomart choose to be the passive ignorant woman, but she chooses to take up arms to become a knight and she so chooses in a way that is similar to falling in love. As the knight of chaste love, Britomart balances temperance and holiness with passion. She is faithful to the image of Arthegall that she saw in the mirror without knowing that he exists. Britomart starts wandering Fairyland in order to find Arthegall.

After Britomart parts with the Redcross knight, she “kept on her former course,/ Ne euer dofte her armes, but all the way/ Grew pensiue through that amorous discourse” (Spenser III.iv.5.1-3). Britomart stays on course, thinking about Arthegall; “So forth she rode without repose or rest,/ Searching all lands and each remotest part,/ Following the guyaunce of her blind-ed guest,/ Till that to the seacoast at length she her ad-drest” (Spenser III.iv.6.6-9). She continues to wander, trying to find Arthegall. Wandering is traditional to the romantic poetry. The knight will wander until he finds his quest and fulfils it. Britomart’s “blind guest” is Cupid, the cause of her love for Arthegall. It is her unfulfilled love that keeps Britomart physically wandering, but her mind is straight, focused on her love for Arthegall.

Traditional to the romantic epic is the wandering of the hero to complete the quest. Britomart does not start in Fairyland; instead she comes from Britain, “in Deheubarth that now South-wales is hight” (Spenser III. ii.18.4). She has to travel into Fairyland in order to find Arthegall, “He wonneth in the land of Fayeree (Spenser III.iii.26.3). After Britomart finds him, “From thence, him firmly bound with faithfull band,/ To this his natuie soyle thou backe shalt bring” (Spenser III.iii.27.6-7). After Britomart has found Arthegall, they will get married and return from Fairyland back to Britain. Britomart is physically wandering but she is on course to find Arthegall. She is wandering all over Fairyland but “Her louers shape, and cheualrous aray;/ A thousand thoughts she fashioned in her mind” (Spenser III.iv.5.5-6). Britomart stays on course, her constant mind thinks of her love as she searches for him.

Britomart’s wanderings take her to the sea. Pausing from her physical wanderings she watches the sea “That gainst the craggy clifts did loudly rorem/ And in their raging surquedry disdained,/ That the fast earth affront-ed them so sore./ And their deouring couetiz restraynd” (Spenser III.Iv.7.5-8). The sea becomes a representation of Britomart’s mind. She is starting to have doubts; the sea is the force of love crashing against the solid earth of her mind. Britomart is starting her internal wandering. Before, she had a constant mind; she was always fixed on finding Arthegall. But now she is giving in to her “long trial of the inward grieve” (Spenser III.i.54.3). Like the waves wearing away at the shore, Britomart is wearing
away from her unsatisfied love. Nature is being reflected within Britomart's mind as she compares herself to a boat; “Huge sea of sorrow, and tempestuous grieve,/ Wherin my feeble barke is tossed long” (Spenser III.iv.8.1-2). Britomart is the boat and her love is the sea, causing her much trouble. She laments, "Why doe thy cruel billowes beat so strong,/ And thy moyst mountains each on other throng,/ Threatening to swallow vp my fearefull lyfe?” (Spenser III.iv.8.1-2). Britomart is having doubts. The sea is going to swallow her and she will drown. She does not know if she will make it for she is "Far from the hoped hauen of reliefe" (Spenser III.iv.8.3). Her physical wanderings have taken their toll on her mental consistency. She doubts if she will ever find Arthegall which is causing her uncertainty in herself and love:

For els my feele vessel crazd, and crackt
Through thy strong buffets and outrageous blowes,
Cannot endure, but needs it must be wrackt
On the rough rocks, or on the sandy shallowes,
The whiles that loue it steres, and fortune rowes,
Loue my lewd Pilott hath a restless minde
And fortunate Boteswaine no assurance knows,
But sailw withouten staires, gainst tyde and winde:
How can they other doe, sith both are bold and blinde?
(Spenser III.iv.9.1-9)

Britomart is lamenting her position. She is having doubts about her love. Her boat cannot withstand the beating of the sea; it is cracking and breaking. Love is steering and fortune is rowing. Both are considered blind virtues, so Britomart is afraid of crashing. Love is connected to fortune therefore it is at mercy to the whims of fortune. If Britomart accepts this as the definition of love she places herself at the whims of fortune as well. It also would force her to abandon the notion that her love is "the straight course of heauenly destiny,/ Led with eternall prouidence" (Spenser III.i.ii.24.3-4). Her lamentations capture the threats to love. If Britomart does not believe that her love is led on a straight path by providence, then her mind is no longer constant and she is at the mercy and wanderings of fortune.

Britomart does not accept the notion that love is tied to fortune. She has placed her lamentations and doubts in the ocean:

As when a foggy mist hath ouercast
The face of heauen, and the cleare ayre en-grost
The world in darkness dwels, til that at last
The watry Southwinde from the seaboord coste
Vpblowing, doth disperse the vapour lo’ste,
And poures it selfe forth in a stormy showre;
So the fayre Britomart hauing disclo’ste
Her cloudy care into a wrathfull stowre,
The mist of griefe dissolu’d, did into a ven-gence power.
(Spenser III.iv.13.1-9)

The fog is clearing from the ocean and the fog in Britomart’s mind is clearing as well. Her mind was cloudy with doubts but then it becomes clear as she continues on her course. She sees Marinell riding across the shore to attack her. Britomart runs him through; “That through his threesquare scuchin percing quite,/ And through his mayled hauberque, by mischaunce/ The wicked steele through his left side did glaunce... He tumbled on an heape, and wallowed in his gore” (Spenser III.iv.16.4-9). Then Britomart rides off leaving Marinell dying in the sand. Marinell’s name connects him with the sea; he is the son of a sea nymph. He is a physical representation of the sea and Britomart’s doubts. By wounding him she has done away with her doubts. She "stayd not him to lament,/ But forward rode, and kept her ready way” (Spenser III.iv.18.1-2). Britomart had her moments of doubt, but she refused to accept the notion of love steered by fortune. She continues on her way to fulfill her love.

Conclusion

The fulfillment of Britomart’s love will be the end of her quest where she will marry Arthegall and have many children creating a new empire for England. Traditionally, quests for empire are taken on by men and accomplished through war. Spenser finds women worth subjects for epics. He uses the image of a tree to illustrate his intentions of expanding on female tradition not commonly found among the ancient epic poems. Britomart’s quest is an untraditional quest for love. Her quest starts off untraditionally by viewing Arthegall in the mirror, and then she falls into love-sickness. With the knowledge of her destiny she takes on armor to become a knight and wanders to find him. The end goal of her quest is love or to find Arthegall. Chastity is a com-
ponent of love; Britomart represents chastity and love. Chastity is defined as a balance between virginity and lust, and love is the moderator. Spenser is using book III to expand the female epic tradition and define chastity.

Author Reflection

I found The Faerie Queene by accident in the library. Many professors were encouraging me to do a Shakespeare play for my thesis, but I was not too keen on the idea. I was in the library doing research for a Shakespeare essay and this text caught my eye because, at the time, Spenser was located near Shakespeare. The title intrigued me; I had never heard of The Faerie Queene or Edmund Spenser before, so I checked it out and read it. The text is challenging yet engaging. In my opinion, the best part about the text is that I find something new each time that I read it.

I hope someday The Faerie Queene will be taught as a class. It is canonical in British literature. Parts of Book I were in an anthology of British Literature I had for a class but it was skipped over in favor of other authors. One reason I would like to see Spenser taught in class was that I struggled initially to grasp the complexity of the text. I had to read a lot of secondary literature and talk to many professors before I could even start analyzing the text. Having an introduction to Spenser in a class would have been helpful. Another reason is due to the complex nature of the text, I would have liked to see what other students have to say about it. It is difficult to find someone who has read The Faerie Queene, understands it and wants to converse about it. Every time I read it I feel that I find something new. Even though I found The Faerie Queene on my own by accident, it has been a rewarding experience to work with the text and I look forward to future study with it.

References


Antipsychotics and Schizophrenia

An analysis of pharmacotherapy and the importance of persistent communication with the patient

By Kyle Brotkowski

Schizophrenia is a severe mental illness characterized by positive and negative psychotic symptoms in addition to cognitive and emotional deficits. Current treatment options often involve one of two antipsychotic classes: neuroleptic and atypical agents. Despite the proven efficacy of these antipsychotics, both classes have been shown to cause dangerous side effects that include extrapyramidal side effects (EPS), tardive dyskinesia (TD), increased risk of diabetes, and abnormal metabolic functioning. Additionally, various cognitive deficits, depression, and suicidal impulses have been found to persist after successful treatment with antipsychotic agents. As a result, proper management of the illness requires a carefully tailored program of cognitive-emotional therapies and pharmacotherapy that meets the goals of the patient and balances efficacy with side effects. One treatment option, for instance, includes the patient's family as a way to encourage understanding and form a strong support network, which leads to decreased hospitalization rates and increased adherence to supplemental or future treatment programs. In this strategy, communication between the patient and the psychiatrist is crucial and should be used as a tool to dynamically eliminate treatment options that no longer work and offer new opportunities for the patient as symptoms change over time.

Schizophrenia is a complex mental illness known for its characteristic psychotic symptoms, affecting approximately 0.5 to 1% of the world’s population (Gonzalez-Burgos, Fish, & Lewis, 2011). These symptoms are characterized by a combination of auditory and/or visual hallucinations, paranoia, confusion, and irritability. In addition, less visible symptoms include apathy, decreased ability to experience pleasure, and decreased motivation (Rivas-Vazquez, Blais, Rey, & Rivas-Vazquez, 2000). Overall, the treatment of schizophrenia has involved careful examination of the complex interactions between neurotransmitter imbalances and receptor systems to create antipsychotics. These antipsychotics actively work to counteract the observed chemical imbalances through antagonism of a variety of receptors associated with psychosis. Every antipsychotic possesses an affinity to these receptors unique to its chemical structure, and most of these drugs generally fit into two categories: conventional and atypical. Conventional antipsychotics, also known as neuroleptics, are thought of as the first generation of antipsychotic agents, exhibiting reduction in psychotic symptoms at the cost of extrapyramidal side effects (EPS) that produce muscle spasms, twitching, and sudden rigidity, among other motor-related abnormalities. Atypical antipsychotics, the newer and more specific antipsychotic agents, distinguish themselves from conventional antipsychotics by demonstrating similar or improved antipsychotic effects with simultaneous reduction in parkinsonian-like EPS when compared to the conventional agents. However, recent studies have found high correlation between atypical antipsychotics and metabolic syndrome (Shirzadi & Ghaemi, 2006; Moore, 2011). Shirzadi and Ghaemi (2006) describe metabolic syndrome as a group of risk factors that increase the risk of diabetes, hypercholesterolemia, hypertension, abdominal obesity, and...
dyslipidemia. As a result, Moore (2011) suggests that physicians and patients discuss the benefits and side effects of each antipsychotic agent to allow the patient to determine whether the suggested antipsychotic is worth the possible side effects.

Despite promising improvement, previous studies have observed that conventional antipsychotics do not simply eliminate psychotic symptoms, they also interfere with the brain and generate unpleasant and sometimes dangerous side effects (Moore, 2011; Rivas-Vazquez et al., 2000; Tollefson et al., 1997; Dixon et al., 2010; Lehman, et al., 2004). Analysis provided by Rivas-Vazquez et al. (2000) suggests that these side effects are one of the main reasons that non-compliance with treatment therapies relying on antipsychotics is so common. As a result, atypical antipsychotics were developed to maximize antipsychotic efficacy while minimizing other side effects. Recent studies and analyses have shown that atypical antipsychotic agents demonstrate significantly lower rates of EPS (Rivas-Vazquez et al., 2000; Moore, 2011; Lieberman, Tollefson, Tohen, Green, Gur, Kahn, et al., 2003; Tollefson, et al., 1997), but also cause mild-to-severe metabolic and cardiac side effects (Beumont, 2000; Nasrallah, 2008; Pearson, 2012; Antai-Ootong, 2004; Shirzadi & Ghaemi, 2006). Considering the dangers of both classes of antipsychotic agents, psychiatrists and patients should discuss the risks and determine the best option (Moore, 2011). However, focusing solely on pharmaceuticals as a solution to psychosis remains a flawed system; patients in need of antipsychotics would greatly benefit from the involvement of a therapist to teach them healthy coping methods and to observe the effects of the prescribed antipsychotics (Rivas-Vazquez et al., 2000; van der Meer, van’t Wout, & Aleman, 2009).

This paper aims to provide an explanation of the symptoms and cognitive deficits found in patients with schizophrenia, along with a comparison of various antipsychotic agents. Additionally, conclusions will be drawn to demonstrate the importance of using both the proper antipsychotic agent and a highly personalized form of talk and cognitive therapies. These tailored forms of therapy focus on adherence to antipsychotic treatment schedules, education about schizophrenia, healthy emotional expression (with constant access to a therapist), and general social skills. Marcinko and Read (2004) state that 25-50% of patients treated with antipsychotic agents still suffer from significant psychotic symptoms. Therefore, an effective therapy for patients with schizophrenia involves a combination of personalized therapy and the appropriate antipsychotics in order to maximize normal emotional and physical functionality while minimizing the chances of noncompliance with treatment, suicide, depression, and substance abuse.

### Deficits and Symptoms of Schizophrenia

People with schizophrenia experience a wide range of positive psychotic symptoms (i.e. auditory and/or visual hallucinations, paranoia, confusion, and irritability) and negative psychotic symptoms (i.e. blunted emotions, apathy, decreased ability to experience pleasure, and decreased motivation), which are modulated via administration of antipsychotic drugs (Rivas-Vazquez et al., 2000). Additionally, various cognitive deficits have been observed in patients with schizophrenia, many of which involve self-reflection and relationship-building with others. For instance, Lysaker et al. (2013) explored metacognition in schizophrenia, identifying several forms of abnormal thought processes that manifest as a result of psychosis. For example, people with schizophrenia have been shown to mistake their own behavior as being under the control of an external force, failing to recognize their actions as a direct result of their own cognition. As a result, even deliberate actions may cause a sense of paranoia and hallucination due to the delusion of being controlled by someone else. Another finding by Lysaker et al. (2013) suggests that persons with schizophrenia demonstrate poor metamemory (the evaluation of one’s own memory), rating their ability to remember events lower than that of controls. However, distinct claims made by patients with schizophrenia about past events are more likely to be false or imagined memories, indicating a failure to recognize internal mistakes despite more critical, negative evaluations of one’s own abilities. When asked to complete a memory test involving word lists as an indirect form of metamemory testing, patients with schizophrenia were far more confident than controls in their answers in giving both correct and incorrect answers (Lysaker et al., 2013).

In addition to memory difficulties, people with schizophrenia suffer from emotional deficits and abnormalities that persist after treatment with antipsychotic agents. A study by van der Meer et al. (2009) explains how many people with schizophrenia suffer from a blunted affect and alexithymia, which translates to “no words for feelings.” Forty-four healthy subjects and thirty-one patients diagnosed with schizophrenia participated in the experiment on emotion regulation and expression. The results suggest that patients with schizophrenia utilize emotional suppression far more frequently than healthy individuals and suffer from high levels of alexithymia. In other words, patients with schizophrenia experience
great difficulty in identifying and expressing their emotions and mental state at any given time, leading to a flat affect and emotional suppression despite a normal ability to feel emotions (Lysaker et al., 2013; van der Meer et al., 2009). Given this information, it is reasonable to suspect that the inability to express emotion is one of the main reasons why schizophrenia is often comorbid with depression. Unfortunately, van der Meer et al. (2009) also showed that persons with schizophrenia who were on a stable antipsychotic schedule had constant levels of alexithymia, which remained independent of the fluctuations of psychotic symptoms. As a result, it appears that alexithymia may be untreatable with current antipsychotics, requiring an additional outlet such as a talk therapist to help express and explore the suppressed emotions.

The Mechanisms of Psychosis

The above psychotic symptoms and cognitive deficits are thought to be a result of hyperactivity in the dopaminergic system combined with glutamate hypactivity, which has been linked to high anxiety levels and several other mental disorders. Wiley (1997) presents an examination of N-methyl-D-aspartate (NMDA) antagonists and their influence on the symptoms of schizophrenia. NMDA receptors bind to glutamate, the most ubiquitous of the excitatory neurotransmitters, causing sodium and calcium to flow into the cell and an increase in cellular excitation. Wiley (1997) explained that drugs acting as NMDA antagonists such as phencyclidine (PCP) and dopamine agonists such as amphetamine and cocaine can generate paranoid psychotic-like symptoms very similar to schizophrenia when administered at high doses for long periods of time. Additionally, the administration of NMDA antagonists in high, short-term doses has been shown to create temporary schizophrenic-like symptoms in non-patients and intensify the psychotic symptoms in patients with schizophrenia. Despite this, NMDA antagonists have been suggested to provide anti-anxiety effects similar to those found in benzodiazepines, which are one of the primary drugs used in the treatment of anxiety disorders via indirect agonism of gamma-aminobutyric acid (GABA) receptors. However, despite such high anxiety levels in persons with schizophrenia, an alternative to NMDA antagonists must be prescribed for anxiety in order to avoid aggravating the symptoms of schizophrenia (Wiley, 1997). Currently, the efficacy of using benzodiazepines as an alternative for anxiety in schizophrenia patients is unknown, and recent experiments have reported inconclusive results on long-term treatment effectiveness. However, short-term sedation effects have been reported, which may be useful for quickly decreasing agitation and anxiety in patients (Dold, Li, Tardy, Khorsand, Gilles, & Leucht, 2012).

Given the significantly involved treatment methods needed to combat the emotional and cognitive abnormalities present in many schizophrenic patients, there has been a major effort by researchers to determine early warning signals and critical periods of physiological change caused by the illness. A network analysis by Chandrasekaran and Bonchev (2012) has proposed several encoding genes and signaling pathways contributing to the symptoms of schizophrenia. Multiple established lists of schizophrenia-related genes were examined from various sources and analyzed for inter-relatedness. The results were then compared to existing experimental data to determine relevance. A dominance of mitogen-activated protein (MAP) kinases, among other signaling pathways, were found to have significant involvement with schizophrenia though specific details about their involvement are currently not known. Furthermore, abnormal functioning in signal transduction was determined to be the most significant factor in the development of schizophrenia, followed by protein amino acid phosphorylation, response to glucocorticoids, and Ras protein signal transduction. The analysis also determined the high involvement of 22 genes that encode transcription factors, protein kinases, and cell receptor proteins for ligands and phosphatases (Chandrasekaran & Bonchev, 2012). These data suggest considerable alterations in brain plasticity, modification of glutamate receptors, and antagonism of dopamine receptor signaling pathways. Consequently, the identified genes appear to alter normal brain development and responsiveness to stimuli on a molecular scale, leading to the cognitive and emotional deficits as seen in schizophrenia patients. However, experimenters have yet to identify any specific event that causes the relatively sudden appearance of psychotic symptoms.

Despite lacking knowledge of specific neurological events that cause psychosis, experimenters have compiled information on neurochemical risk factors for schizophrenia, identifying compounds that signal dopaminergic receptor hyperactivity and glutamatergic receptor hypoactivity. Csernansky and Newcomer (1994) offer a review of several possible hypotheses for the development of psychotic symptoms in schizophrenia and their related neurochemical signals. One such hypothesis states that deficits in the ability to transport developing neurons to their final proper location in the brain via glial filaments leads to improper brain development
and neuronal densities. These hypotheses involve a neuroanatomical approach to the pathogenesis of schizophrenia in addition to the molecular signal-transduction approach as stated above. Emphasis on detecting fluctuations in dopamine, serotonin, and glutamate neurotransmitter systems is one of the main focuses of the analysis, along with identifying the level of practicality of the suggested neurochemical indicators of schizophrenia. For instance, the analysis of monoamine oxidase (MAO) activity, which oxidizes dopamine and serotonin (among other monoamine neurotransmitters), may roughly translate to dopamine concentrations in the brain. However, the low activity of MAO that would generally suggest the high concentration of dopamine found in schizophrenia may be accounted for by gender, race, and environmental factors that can greatly complicate the study.

Utilizing these markers as high risk indicators makes it possible to detect schizophrenia in its early stages of pathogenesis, allowing doctors and therapists to plan for and actively resist comorbid depression and self-harm in the patient. One possible indicator for high schizophrenia risk, [3H]spiperone, is a common ligand used in studies of brain dopamine D2 receptors, the same dopamine receptors that have been correlated with high EPS in neuroleptics (Rivas-Vazquez et al., 2000; Csernansky & Newcomer, 1994). Yet despite being a ligand for D2 receptors, the binding of [3H]spiperone to D2 receptors does not match the predicted concentration of D2 receptors in the brain (Wodarz, Fritze, Komhuber, & Riederer, 1992). Alternative neurochemical signals include examining serotonin 5-HT2 receptors in platelets, which cause the platelets to undergo a conformational change when serotonin binds (Stahl, Ciaranello, & Berger, 1982). Csernansky and Newcomer (1994) argue that this conformational change is characteristic of the binding event and can be used reliably as long as no medical conditions that influence platelet production and functioning are present.

Antipsychotic Agents: Importance of the Cost-Benefit Analysis

The use of conventional antipsychotics began in the early 1950s with the synthesis of chlorpromazine. Conventional antipsychotics were used as calming agents or sedatives for patients, and demonstrated impressive antipsychotic characteristics that inhibited both positive and negative psychotic symptoms. However, patients placed on the medications began to develop very serious EPS (such as muscle spasms, parkinsonian symptoms, restlessness, and sudden rigidity of muscular movements) that made taking the drugs extremely unpleasant. The efficacy of the drugs depended on their affinity for binding to specific dopamine receptors in an antagonistic manner (binding to the receptor without activating it, ensuring that the receptor cannot be activated due to competitive inhibition). However, in addition to high affinity for dopaminergic receptors, the conventional antipsychotics also have a high affinity for alpha adrenergic, muscarinic-cholinergic, histaminergic, serotoninergic, and GABAergic receptors, which has been suggested to promote EPS (Rivas-Vazquez et al., 2000).

The efficacy of the drugs depend on their affinity for binding to specific dopamine receptors in an antagonistic manner

Conventional antipsychotics came to be known as neuroleptics due to the characteristic motor twitches and abnormalities associated with taking the drugs. Rivas-Vazquez et al. (2000) and Tollefson et al. (1997) report that about 50-75% of patients treated with neuroleptics develop these symptoms, and that EPS are likely the leading cause of noncompliance with antipsychotic treatments. In some cases, patients develop tardive dyskinesia (TD), characterized by rapid, involuntary, and jerky movements of the face, arms, legs, and core. Tardive dyskinesia is thought to be caused by a hypersensitivity to dopamine due to prolonged antagonism of the dopaminergic receptors, which in some cases is irreversible. This hypersensitivity is likely caused by the insertion of additional dopaminergic receptors into the cellular membrane in order to increase the chances that dopamine binds. Increased density of dopaminergic receptors in the cellular membrane returns the cell to its normal amount of activation. However, further up-regulation of the dopaminergic receptors or reduction in the amount of dopaminergic antagonism will raise dopamine-binding activity above the original baseline and exacerbate TD symptoms (Tollefson, et al., 1997; Beumont, 2000).

In response to the side effects of conventional antipsychotics, a series of atypical antipsychotics were created to maximize inhibition of both positive and negative symptoms while minimizing EPS. The new form of drugs succeeded in matching the criteria for atypicality: a strong affinity for D1 and D4 dopamine receptors in the mesolimbic and mesocortical pathways. Simultaneously, atypical agents needed a weak affinity for stria-
tial D2 receptors, where antagonism of the receptors had correlated with increased EPS despite marked improvements in antipsychotic efficacy. Additionally, newer atypical antipsychotics demonstrated higher affinity for mesolimbic dopamine receptors than nigrostriatal dopamine (also known as extrapyramidal dopamine) receptors, and a higher affinity for muscarinic receptors that reduce EPS.

A series of atypical antipsychotics were created to maximize inhibition of both positive and negative symptoms while minimizing EPS.

Atypical medications such as olanzapine (Zyprexa) have demonstrated equivalent or greater antipsychotic effects when compared to neuroleptics, showing significantly improved anti-depressant characteristics and adherence to treatment with relatively low side effect risks (Tollefson et al., 1997; Rivas-Vazquez et al., 2000; Lieberman, et al., 2003). Olanzapine has a high affinity for serotonin, D2, muscarinic, and H1 histaminergic receptors, with a lower affinity for D1 and alpha-adrenergic receptors. The mild side effects of Olanzapine (drowsiness, weight gain, dry mouth, and restless leg syndrome) should be much greater due to high affinity for D2 receptors (Rivas-Vazquez et al., 2000), however their severity varies greatly between atypical agents and their causes are not entirely understood. A more common and recent antipsychotic, quetiapine (Seroquel) exhibits higher binding for serotonin receptors and lower D2 receptor affinity, requiring high doses of quetiapine to be prescribed before the antipsychotic effect is noticeable. Just as Tollefson et al. (1997) examined a comparison between olanzapine and haloperidol, Borison, Arvanitis, and Miller (1996) demonstrated that quetiapine shows similar efficacy to haloperidol with a significantly lower risk of negative symptoms occurring. Like olanzapine, quetiapine has relatively few undesirable symptoms (drowsiness, weight gain, and low blood pressure).

When the proper binding profile criteria are met, antipsychotic agents are considered atypical, indicating decreased risk for EPS and TD. Yet despite the marked decrease in EPS, atypical antipsychotics have been found to cause mild to severe metabolic side effects. Using a meta-analysis on the effects of individual receptor activity, Nasrallah (2008) suggests that serotonergic, histaminergic H1, and muscarinic M1 and M3 receptor antagonism contribute to high risk for weight gain and diabetes. Additionally, the author notes, that these symptoms may be exacerbated by an existing poor diet, sedentary lifestyle, and genetic predisposition. These data are supported by several other studies, which add excessive weight gain, hypertension, lipid abnormalities, and cardiovascular problems to the list of side effects correlated with atypical antipsychotics (Shirzadi & Ghaemi, 2006; Antai-Ootong, 2004; Pearson, 2012).

Psychiatrists prescribe more atypical agents (Nasrallah, 2008), though, due to their success in treatment-resistant patients and relatively mild side effects when compared to neuroleptics. About one third of patients resistant to antipsychotics responded with decreased psychotic symptoms when given an atypical agent, compared to a five percent success rate in resistant patients given conventional antipsychotics (Rivas-Vazquez et al., 2000). Moore (2011), in contrast, asserts that studies have failed to show that atypical antipsychotics demonstrate a significant efficacy improvement when compared to neuroleptics. Moore elaborates, stating that the choice of antipsychotic should be determined by the patient and therapist together after identifying the risks and benefits of all choices. Lieberman et al., (2003) also present a randomized double-blind study of olanzapine and haloperidol that fails to identify a significant difference between the atypical and neuroleptic agents. However, the results presented by Lieberman et al. directly conflict with a second study by Tollefson et al. (1997), in which the experimenters examined the efficacy of the antipsychotic agents and reported a significant decrease in negative symptoms, EPS, and rate of relapse in patients given the atypical agent olanzapine. Regardless of the comparison between atypical and neuroleptic efficacy, the suggestion made by Moore (2011) to offer the patient several options after interactively weighing the pros and cons of each choice has been adopted as common practice as evidence grows to suggest giving patients relevant education and choices increases treatment compliance.

Recent technological advances combined with a greater understanding of cell biology have given rise to improved antipsychotics with fewer side effects. Rivas-Vazquez et al. (2000) stated that in two atypical antipsychotic agents, clozapine and quetiapine (described above), the rate of EPS in patients taking the medication was not significantly different than a similarly administered placebo. Additionally, the experimenters explained that despite the initial high cost for the medication, atypical antipsychotics have been correlated with fewer hospital visits and lower medical costs overall. As a result, the atypical agents greatly encourage patients with schizophrenia to continue therapy, reinforcing
their compliance with marked improvements in cognition, emotional expression, and psychotic symptoms. Yet antipsychotic agents, whether conventional or atypical, represent only a fraction of the necessary treatment most patients with schizophrenia require for a healthy management of the illness.

**Psychosocial Therapy: Treating the Persistence of Symptoms**

Rivas-Vazquez et al. (2000) conclude their review of conventional and atypical antipsychotics by explaining the critical role therapists play in the treatment of persons with schizophrenia. Specifically, they assert that psychologists must perform regular assessments of the cognitive abilities of the patient, making sure to adjust antipsychotic dosage and treatment strategies in order to properly fit the needs of the patient. This broad overview seems to reflect the thoughts of many psychologists, who agree that there is strong evidence to support the hypothesis that patients with schizophrenia will greatly benefit from some form of tailored therapy in addition to the antipsychotic medication they are given (Lehman et al., 2004; Lysaker et al., 2013; Rivas-Vazquez et al., 2000; van der Meer et al., 2009). While treatment methods vary greatly, attempts have been made to create a unified set of guidelines based on previous experiments that identify the most effective forms of therapy. These guidelines aim to assist the patients in demonstrating improvements in emotional expression, psychotic symptoms, and cognitive function. One such attempt, called the Patient Outcomes Research Team (PORT), has been consistently updating and publishing analyses on current forms of treatment in addition to suggested antipsychotic doses (Lehman et al., 2004; Dixon et al., 2010). Each suggestion includes a short rationale that cites a variety of experiments and their results. Other meta-analyses and literature reviews provide more in-depth information on specific treatment methods such as emotion regulation strategies, family interventions, education, social skills, and forms of token economy in a hospital setting.

After determining the correct and most effective dosage of atypical antipsychotics, a comprehensive treatment strategy for the patient must be created. Regardless of the chosen form of treatment, the patient should be educated on the nature of their condition. Education should extend to the risks and benefits of taking the antipsychotics, with the majority of the focus stressing the importance of adherence to the pharmacotherapy. As both positive and negative symptoms are inhibited via the antipsychotics, patients become more compliant and tend to benefit to a greater degree than when splitting effort between combating the psychotic symptoms and therapy (Rivas-Vazquez et al., 2000). Furthermore, the patient’s family should be encouraged to participate in the treatment and education process. Lehman et al. (2004) propose that incorporating family and close friends into the treatment process helps schizophrenia patients cope with the symptoms of their illness.

Family intervention creates a network of emotional support and understanding for the patient, increasing patient-family relationships, reducing the rates of hospitalization, and promoting further adherence to the treatment program. Most family interventions last a minimum of about nine months, with some programs extending to three years. However, Bellack and Mueser (1993) stress that family involvement must only be used when the family adapts a supportive and understanding attitude. Failure to encourage the patient or to acknowledge the burden of care by the family has been correlated with greater rates of psychotic relapse over the period of treatment (Brown, Birley, & Wing, 1972) regardless of the severity of pre-treatment psychotic symptoms (Halford & Hayes, 1991). Parker, Johnston, and Hayward (1988), on the other hand, debate this finding, stating that there is no correlation between a negative family environment and psychotic relapse. Regardless, family intervention depends on the cooperation of the family and their ability to communicate effectively with the patient. Lam (1991) explains other important variables for successful family interventions in addition to a supportive family structure. The suggestions include focusing on improving familial communication and breaking down goals into small, manageable, and flexible steps that can be achieved with relative ease. Considering these suggestions, psychologists design a treatment program that includes the entire family in the learning process. Since family intervention does not include any sort of treatment beyond the family dynamics, the treatment options generally extend to social skills training and dynamic problem solving (Bellack & Mueser, 1993). The methods of social skills training, among others utilized in family interventions will be described below.

**Specific Treatment Therapies as a Supplemental Solution**

Skills training sessions encourage patients to develop appropriate social skills and independence. Bellack and Mueser (1993) argue that social skills training...
(SST) is the most promising and thoroughly studied form of psychosocial treatment available for schizophrenia patients. The authors state that patients with schizophrenia experience persistence of social impairments, even after successful treatment of positive and negative psychotic symptoms with antipsychotic agents (Mueser, Bellack, Douglas, & Morrison, 1991; Bellack & Mueser, 1993). Varying SST programs exist, including a repeated motor skills model, which involves asking the patient to reenact a social script and commit it to memory. This model, while viable in highly specific situations, fails to prepare patients for dynamic interactions that are subject to veer from the course of pre-memorized scripts. Nevertheless, a study by Lehman et al. (2004), who utilized an altered SST method focusing on dynamic problem solving, suggests that the inclusion of skills training may lead to a significant decrease in psychotic symptoms. Additionally, a similar study by Liberman, Massel, Mosk, & Wong (1985) found that with a guided SST program, patients were found to exhibit fewer psychotic symptoms and an increased level of comfortable social adjustment. The SST programs functioned in the cited studies as a guided breakdown of social interactions, teaching patients the basic components of normal exchanges between people before combining them into a smooth conversation. Unfortunately, no significant difference in psychotic relapse was found between groups of varying SST program length at a one-year follow-up examination reported by Liberman et al. (1985). Hogarty et al. (1991) found similar relapse in a controlled study of individual SST, family education, SST and education, and antipsychotic agents without psychotherapy. The effects of SST were found to be statistically insignificant at 24 months, but offered benefits for the patients for up to 21 months after training. As stated by Bellack and Mueser (1993), the fact that statistical significance was not reached at 24 months ignores the findings that for 21 months, patients with schizophrenia achieved a greater sense of comfort and social ease, in addition to decreased psychotic symptoms. As a result, the authors argue that further studies should be performed in an effort to identify the maximum benefit to SST duration ratio. It is hypothesized that periodic, yet short SST duration may provide stable retention of therapeutic benefits with minimal interruption of the daily lives of the patients.

Emotional and cognitive therapies tend to take an active approach with regard to the patient's mental well-being and cognitive abilities. In an examination of emotion regulation strategies in patients with schizophrenia, van der Meer et al. (2009) concluded that emotion therapy could assist patients with schizophrenia in becoming more aware of their emotions, giving them the power to identify and express them in a healthy manner. As a direct result of this, patients would be less likely to suppress their emotions and feel isolated from others. It is therefore reasonable to suggest that emotional release could greatly decrease negative psychotic symptoms such as blunted affect, depression, and anhedonia. Lehman et al. (2004) also report a significant reduction in hallucinations, delusions, and depression following emotional therapy consistent with the findings of van der Meer, van’t Wout, and Aleman (2009). Furthermore, Lysaker et al. (2013) explain the importance of emotional therapy, stating that the noted cognitive deficits in patients with schizophrenia leave the patients without an appropriate coping method for the physical and emotional disturbances they experience. The therapeutic strategies listed above all include some form of access to a therapist, support network, or positive encouragement. Emotional therapies should play an integral role in all therapeutic methods for the benefit of schizophrenia patients as a synergist with antipsychotic treatment.

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**Emotion therapy could assist patients with schizophrenia in becoming more aware of their emotions**

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Another form of intervention should be considered for patients with a high risk for repeated hospitalizations or noncompliance with treatment: assertive community treatment. Assertive community treatment incorporates practitioners from several different disciplines into a team that oversees the program, using each of their unique perspectives to manage treatment for the high-risk patient. A set of nurses, social workers, and therapists make up the team, which maintains very frequent contact with the patients to ensure that they are improving. Patients are given positive support in their efforts to adapt to the community, and continual contact with the team psychiatrist is encouraged (Lehman et al., 2004). Guidelines revised in 2010 by the Schizophrenia Patient Outcomes Research Team (PORT) report that assertive community treatment programs significantly reduce the amount of hospital visits, homelessness, and length of hospitalization in patients with schizophrenia, making it valuable for high-risk patients (Dixon et al., 2010). Additionally, the guidelines cite several studies that show increasing support of the efficacy of assertive community treatment. Overall, PORT guidelines report a 37% reduction in homelessness, significantly higher employment rates, significantly longer periods of...
Employment, and decreased substance abuse (see Dixon et al., 2010, for review).

Conclusion

To outline an acceptable form of treatment for patients with schizophrenia, all of the above information must be considered. As a mental illness that demonstrates serious cognitive deficits in memory and emotional expression, combined with both positive and negative psychotic symptoms, schizophrenia is a heavy burden for any affected patient. These symptoms stem from a hyperactivity of dopamine and hypoactivity of glutamate (Wiley, 1997), which were historically modulated by the advent of conventional antipsychotics. However, extended use of conventional antipsychotics have been shown to cause very serious extrapyramidal side effects that make it extremely unpleasant to remain on the medication (Beumont, 2000; Rivas-Vazquez et al., 2000; Lehman et al., 2004; Dixon et al., 2010). Previous studies suggest that these EPS are among the main reasons that persons with schizophrenia tend to abandon their antipsychotics, leading to an increase in symptom severity over time (Beumont, 2000; Rivas-Vazquez et al., 2000). In response, more advanced classes of antipsychotics have been created to maximize antipsychotic efficacy while minimizing EPS with great success. These newer atypical antipsychotics no longer fit the category of neuroleptics and greatly improve treatment compliance among patients. Unfortunately, due to the receptor-binding profile of atypical agents, patients risk mild to serious metabolic and cardiac side effects that vary in severity between drugs. Among the side effects identified are diabetes, hypertension, glucose and lipid disorders, excessive weight gain, and long-term cardiovascular damage as a result of the preceding side effects (Antai-Ootong, 2004; Nasrallah, 2008; Shirzadi & Ghaemi, 2006; Pearson, 2012). As a result, Moore (2001) and Dixon et al. (2010) strongly suggest educating patients on their illness, the possible treatment options, and the side effects of all antipsychotic candidates. Furthermore, the authors suggest that the patient’s psychiatrist seek constant feedback on the emotional state and physical well-being of the patient. Rivas-Vazquez et al. (2000) argue that psychiatrists should tailor a specific psychotherapy to fit the patient’s needs and goals in addition to prescription of antipsychotic agents. Regardless of therapy style, whether it is family intervention, assertive community treatment, or skills training, it is imperative that the emotions of the patient are a main focus. Emotional therapy has been shown to decrease psychotic symptoms significantly, reduce hospitalization rates, benefit cognitive functioning, and improve overall quality of life for patients (Lehman et al., 2004; Lysaker et al., 2013; Rivas-Vazquez et al., 2000; van der Meer et al., 2009). Addressing the emotional needs of the patient should be considered a high priority at all times due to the persistence of memory issues, emotional suppression, and depression after treatment with antipsychotic agents (Lysaker et al., 2013; van der Meer et al., 2009).

Future Directions

Despite identifying several promising treatment options, it still remains clear that antipsychotics and cognitive therapy must continue to improve in order to further decrease the number of treatment-resistant patients with schizophrenia and overall psychotic symptoms in patients with schizophrenia (Beumont, 2000). There are a number of patients that remain resistant to even the newest atypical antipsychotics, leaving a significant amount of people without the much-needed relief from their psychotic symptoms (Rivas-Vazquez et al., 2000). Marcinko and Read (2004) report that 25% to 50% of patients that consistently take their prescribed medications suffer from significant persistent psychotic symptoms. The remaining 50% to 75% of patients that do experience relief from symptoms, however, struggle with high levels of depression and risk of suicide (van der Meer, van’t Wout, & Aleman, 2009).

The identification of possible neurochemical signals or genes similar to the meta-analysis by Csernansky and Newcomer (1994) may give psychiatrists much needed time to actively prepare against schizophrenic symptoms. Early risk identification could help psychiatrists build a foundation of social and cognitive skills that would be instrumental in a patient’s resistance to the cognitive deficits of schizophrenia. Furthermore, research should continue to expand the number of treatment options available to patients in order to give greater flexibility to psychiatrists in tailoring the appropriate program. Guidelines by PORT provide a very comprehensive assessment of treatment options currently available for patients (Dixon, et al., 2010; Lehman, et al., 2004). Lysaker et al. (2013) recommend integrating multiple programs into one and encouraging a strong community among patients so that they can share their feelings with someone experiencing similar emotions and struggles. Treatment options such as SST incorporated into a family intervention model, for instance, would provide structured support for the patient in a familiar and comfortable social context. Guided SST and education with
the help of family support, therefore, should prevent the patient from experiencing feelings of ostracism or social awkwardness unless in the presence of a highly negative family environment (Mueser et al., 1991; Bellack & Mueser, 1993). In any case, treatments must continue to expand and adapt while retaining the ability to become incredibly specific on a person-by-person basis in order to alleviate the mental despair caused by schizophrenia.

Author Reflection

I have been interested in schizophrenia for about seven years now. I remember the first time I researched it; I had to do a simple five page research paper my freshman year of high school. Of course back then, I hadn’t anticipated that I would be writing my thesis on the subject. I had a lot of fun researching and writing this paper. Schizophrenia is such a complex, unpredictable disorder – when I was trying to narrow down my thesis topic, I realized that I could find references for almost anything that I could think of. Since I really enjoy molecular biology, I decided to look into antipsychotic drugs. From then on, I spent my time reading about the different drugs, how they worked, and the impact they had on patients. The entire writing process was difficult, stressful, time-consuming, but ultimately very rewarding. It is amazing to consider how much work has gone into researching schizophrenia and how much there is that we still don’t know about the disorder.

I think research experiences like these are important for undergraduate students. For any student considering going on to a graduate school, it is imperative to understand how to properly construct a well-researched argument and defend it. Furthermore, being able to distinguish between poorly-supported articles and quality, well-supported articles is a great skill to have. I am glad to have had the support of Dr. Seymoure and Dr. Radwanski while writing my thesis. Without their guidance, I am quite confident that I wouldn’t have learned nearly as much as I did about schizophrenia and how to write a proper scientific literature review.

References


Effect of Oxycodone on the Development of *Lucilia sericata* (Diptera: Calliphoridae) in Wisconsin versus Arizona

By Nicole Devine

This proposed study will examine the effect of oxycodone on the development of *Lucilia sericata* blowflies of the Dipteran order and Calliphoridae family in Wisconsin versus Arizona. The research will be conducted in order to aid in determination of Post-Mortem Interval estimates in oxycodone overdose cases. The research is going to be conducted by feeding *Lucilia sericata* from both Arizona and Wisconsin oxycodone injected pork loin and saline injected pork loin as the control of the experiment. The results of the experiment are anticipated to show that the *Lucilia sericata* excreted the oxycodone more quickly in the Arizona blowflies in the warmest temperature conditions. It is anticipated from this study that insects reared in higher temperatures while feeding on oxycodone comparatively process drugs more quickly than those reared in habitats with lower average temperatures while feeding on oxycodone. In oxycodone, overdose cases where insects are used for Entomotoxicology purposes, there will always be a deviation from standard Post-Mortem Interval calculations of the insects studied without drugs.

How does oxycodone alter the development of *Lucilia sericata*, also known as common green bottle flies or sheep blowflies, in the Midwest (Wisconsin) versus the Southwest (Arizona) and how long does it take for the insects to eliminate the drug through their Malpighian tubules using cytochrome P450’s in those two different climates? The objective of this research project is going to be to use that information to help determine the Post-Mortem Interval (PMI), or how long it has been from the time a person died until the time he or she is found dead in oxycodone overdose situations. In drug overdoses, it would be beneficial for the families of victims to know how long a person has been dead from the prescription drugs, especially since the time of death estimate of most medical examiners is limited (Greenberg and Kunich, 2002). If the body is over two days old, then the medical examiner is unable to estimate the time of death using traditional methods of toxicology (Greenberg and Kunich, 2002).

Oxycodone or related opioids can come in liquid or tablet form, oxycodone usually in the form of the brand name OxyContin®, and are commonly prescribed to treat moderate to severe pain. The chemical structure of oxycodone is shown in [Figure 1](#). Other opiates include: morphine, Vicodin, codeine, methadone, heroin, and fentanyl, and can all cause effects similar to oxycodone. Opioid drugs have the potential to be dangerous and addictive, and their use is often cautioned with warning labels. For example, OxyContin® has been required to have the “black box” label on it since July 2001 (Monthei, 2009). The “black box” label is the strongest warning for an FDA approved product (Monethi, 2009). Oxycodone overdose specifically is the leading cause of overdose death in the United States of America (CDC, 2013).

Oxycodone works as an analgesic agonist, stimulating opioid receptors, known as mu (µ) receptors or kappa (K) receptors and inhibiting adenylyl cyclase, which is the enzyme that combines with adenosine triphosphate (ATP) in order to synthesize cyclic adenosine monophosphate (cAMP) (Bowen, 2003). The production of
cAMP is important because it plays a role in internal cell signaling (Bowen, 2003) and is also involved in activation of protein kinases, gene transcription proteins, and gene transcription (Trescot et al, 2008).

The difference between acute usage of oxycodone and chronic use is that during acute use of oxycodone, the cAMP system is inhibited but during chronic use it is upregulated, which causes the opioid dependence and reason why people become addicted to it (Zhong-Hua et al., 2003). Oxycodone also does not have a ceiling effect, meaning that increasing intake of the drug will not eventually result in a plateau of its effectiveness, so more of the drug will result in less pain (U.S. National Library of Medicine, 2013). When the opioid receptors are activated by an opioid agonist, as shown in [Figure 2] with the opioid morphine, the cAMP levels are decreased due to the inhibition of the adenylyl cyclase, which in turn blocks pain neurotransmitters including glutamate, substance P, and calcitonin gene-related peptide (Trescot et al., 2008).

Opioid receptors have also been found to been located in insects, such as in a praying mantis in a study that tested if when shocked with electrodes, morphine was found to help ease the pain of the insects (Zabala et al., 1983). In a later study, it was found that a specific kind of insect cells, sf9 cells, could express a closed human µ-opioid receptor, even though the insects did not possess receptors themselves (Zhong-Hua et al., 2003). The opioid receptors that were placed into the insect sf9 cells were used to determine the mechanisms of opioid tolerance and dependence in the insects (Zhong-Hua et al., 2003). Once oxycodone interacts with the µ receptors, it blocks the transmission of pain messages to the brain of humans (Kalb, 2001).

In the past, using the insects on a decomposing corpse to estimate time-of-death situations has been done by exploring the effects of drugs on fly colonization and oviposition behavior or on the rates of development of the insects that feed on the drugs (Murthy and Mohanthy, 2010), which is known as Entomotoxicology. One of the main goals of Entomotoxicology is to determine the Post Mortem Interval (PMI) of victims, which commonly defined as “time from death to the discovery of the corpse (Verma and Reject, 2013). Scientists utilize insect analysis to help estimate the PMI by examining...
ing the insects present on the corpse and determining how far along in development they all are. If the insects present on the corpse are in a more advanced state of development, then the body has been there for a longer period of time (Verma and Reject, 2013).

The genus Calliphoridae and the genus Lucilia of the Dipteran order are the most represented in forensic investigations. Insects of each of those groups are commonly known as blowflies and are the first to colonize a corpse and lay their eggs, usually a few minutes following death (Gautam et al., 2013). There are five stages of postmortem decomposition that include: fresh (autolysis), putrefaction, black putrefaction, butyric fermentation, and dry decay (Cox, 2009). The first stage lasts between 36 and 72 hours, depending on ambient temperature, before putrefaction begins (Cox, 2009). During autolysis, the first stage, molecular changes occur in the bodies cells causing release of amylase, lipase, and tripsinogen digestive enzymes from the pancreas and pepsinogen enzyme and hydrochloridc acid from the stomach (Cox, 2009). The blowflies are attracted to the odor produced from the enzymes and acids (Gautam et al., 2013) and feed on the liquids produced with their sucking mouthparts.

The other way to use insects to calculate PMI is when immature flies are analyzed after being removed from a corpse (Verma and Reject, 2013). Insects feed on corpses, ultimately digesting any drugs or toxins the person had digested prior to his or her death (Gautam et al., 2013). The drugs and toxins remain in the cuticle, the waxy skin-like layer, of the larvae of the insect or their empty pupal cases (Gautam et al., 2013). The presence of the toxin on the insect can be used to adjust the post-mortem interval (PMI) estimation of the corpse (Tracqui, 2004).

Without using Entomotoxicology, PMI estimations have the potential to be three to four days away from being precise, based on whatever particular drug a person has consumed (Introna et al., 2001). Estimating PMI can be difficult, as there are multiple other factors that determine how the insects are affected. Those would include: variance of ambient temperature, geographic location of the insects, indoor or outdoor exposure, sun or shade, time of day and season, humidity, rain, and changes with substrate (sand vs. soil vs. concrete) (Verma and Reject, 2013). There have been studies on insect development performed in Uttar Pradesh, India in the summer compared to in the winter, and the bodies decayed faster and had a faster succession of insects in the summer than in the winter (Verma and Reject, 2013). These differences between the seasons are a good starting point for testing how insect metabolism is affected by habitat change, as will be done in this proposed study.

Drugs or toxins can be found in insects when the rate of absorption is greater than the rate of elimination of that drug or toxin, but it is not known how exactly larvae bioaccumulate or eliminate those drugs or how the drugs affect the development of the larvae (Gautam et al., 2013). Before doing an entomotoxicological experiment with any insect, it is important to understand the basic life cycle or stages of development of that insect. There has to be something to compare the insects to once an experiment is performed. The insect species that will be used in this study, Lucilia sericata, is a member of the Dipteran order and the Calliphoridae family. As a member of the Dipteran order, Lucilia sericata as a species fits the model for Dipteran development and timing of development.

In one experiment, Calliphora vicina larvae, members of the Calliphoridae family like Lucilia sericata, were collected from the muscles of suicide victims that died as a result of antidepressant drug overdoses and analyzed to see how long it took drugs to be eliminated from their systems (Sadler et al., 1995). The chemicals used for this analysis (amitriptyline, trimipramidine, temazepa, and trazodone) were all similarly sized, antidepressant drugs with similar properties (Sadler et al., 1995). Due to the chemical similarity, these chemicals were eliminated from the insects at similar rates (Sadler et al., 1995). This is important to note for the proposed study because it gives evidence to the fact that compounds that are structurally similar to oxycodone will be eliminated from insects at a similar rate. Research from this study on Calliphora vicina also showed that insects hold drugs in their foregut, which is an expanding pouch where food is stored (Sadler et al., 1995). Since the drugs

<table>
<thead>
<tr>
<th>Life Cycle</th>
<th>Timing</th>
<th>Description</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggs</td>
<td>1 day</td>
<td>1-2mm</td>
<td>Located around the body’s natural orifices, such as the nose, eyes, anus, penis, vagina, and in any wounds</td>
</tr>
<tr>
<td>Larvae-1st instar</td>
<td>1-2 days</td>
<td>2-5mm</td>
<td>Located around the body’s natural orifices, such as the nose, eyes, anus, penis, vagina, and in any wounds</td>
</tr>
<tr>
<td>Larvae-2nd instar</td>
<td>2.5 days</td>
<td>10-11 mm</td>
<td>Located around the body’s natural orifices, such as the nose, eyes, anus, penis, vagina, and in any wounds</td>
</tr>
<tr>
<td>Larvae-3rd instar</td>
<td>4-5 days</td>
<td>14-17 mm</td>
<td>Located around the body’s natural orifices, such as the nose, eyes, anus, penis, vagina, and in any wounds</td>
</tr>
<tr>
<td>Pre pupae</td>
<td>8-12 days</td>
<td>11-12 mm</td>
<td>Larvae become restless and start to move away from the body, crop organ is gradually emptied of blood, and internal features are gradually obscured by the larva’s enlarged body</td>
</tr>
<tr>
<td>Pupa</td>
<td>14-18 days</td>
<td>14-18 mm</td>
<td>Presence of empty puparia an indication that the person in question has been dead for approximately 20 days</td>
</tr>
<tr>
<td>Adult Flies</td>
<td>Emerges from pupa after 4-7 days</td>
<td>New generation</td>
<td>Small adult flies</td>
</tr>
</tbody>
</table>
were not found to bioaccumulate throughout the life of the larvae, it was hypothesized that there might be some kind of inducible mechanism in which the insects process the drugs (Sadler et al., 1995). It is unknown how to tell how much of a drug was present in a corpse’s system at time of death just based on entomological evidence alone (Dayananda et al., 2013) and scientists still have many questions about how that is accomplished.

In humans, substances within the liver called cytochrome P450’s make toxic substances such as oxycodone non-toxic (Trescot et al., 2008). The Malpighian tubules in insects are equivalent to the liver and kidneys in humans. The cytochrome P450’s are enzymes that are responsible for metabolizing chemicals produced inside organisms along with chemicals the organisms consume, toxins, and medications (Trescot et al., 2008). Metabolites of the drug include oxymorphone and noroxycodone (Monthei, 2009). The drug is metabolized to oxymorphone by the 2D6 pathway, a common cytochrome P450 pathway, and noroxycodone through a process called glucuronidation that adds glucoronic acid to the drug to make it more water-soluble, leaving it with less than 1% of the analgesic power of the original drug (Trescot et al., 2008). The cytochrome P450 that makes up the 2D6 pathway, CYP2D6, is blocked by the oxycodone, which is what causes the pain relief (Kalso et al., 2005).

A common hypothesis for the elimination of drugs is that the drugs are eliminated through the Malpighian tubules of the insect, even after the insect is in the post-feeding stage and no longer receiving new drugs to be digested (Gosselin et al., 2011). The Malpighian tubules act in a way that the liver and the kidneys do in humans, in that they aid to detoxify and eliminate wastes. Like the kidneys of humans, the Malpighian tubules act as the primary organs of excretion for insects (Chung et al., 2008). There are a variety of specific solute transporters in humans that selectively remove unwanted compounds using transport mechanisms (Neufeld et al., 2005). One of those would be the transport mechanism for organic anions on the basolateral surface of kidney tubules that is able to transport hydrophobic molecules with a full or partial negative charge at physiological pH, 7.3 to 7.4 (Neufeld et al., 2005). In insects, the role of the Malpighian tubules is similar to that of the kidney tubules, given that they help transport both water and solutes (Neufeld et al., 2005). The Malpighian tubules also have the ability to perform a cation transport (Rheault and O’Donnell, 2004), which is particularly helpful for the cation of this study, oxycodone (Takashi et al., 2008). The process is similar to that of anion transport, but the molecules are hydrophilic with a full or partial positive charge instead (Rheault and O’Donnell, 2004).

Insects transporting opioid drugs such as morphine have also been known to use a multi-alkaloid transporter (Rheault and O’Donnell, 2004), which is used to transfer nitrogen-containing drugs across the Malpighian tubules of the insect. More specifically, it was determined that drugs are metabolized in insects in the Malpighian tubules using cytochrome P450, a main component of the Malpighian tubules (Chung et al., 2008), in addition to glutathione-S-transferase enzymes (Parry et al., 2011). There is much more known about how cytochrome p450’s work in mammals and plants compared to what is known in insects (Chung et al., 2008). However, it is known that p450’s are involved in the synthesis of the hormone 20-hydroxyecdysone (20H) from plant sterols in the Drosophila melanogaster species, a Dipteran commonly known as fruit flies (Chung et al., 2008). Also, in those flies, CYP314a1 is responsible for catalyzing the conversion from ecdysone to 20H using the Malpighian tubules (Chung et al., 2008). There are 17 different cytochrome p450’s detected in the larval Drosophila tubules (Chung et al., 2008). Fifteen of them are expressed in whole tubules, CYP28d1 is expressed in the lower tubule and ureter, and CYP6w1 is expressed only in the main and the transitional segment (Chung et al., 2008). Figure 3 shows the spatial patterns of the cytochrome p450’s in Malpighian tubules of Drosophila melanogaster. Data from an experiment with the fruit flies shows that P450’s that are specifically expressed at only the larval or adult stages of insect development are more likely to be the ones that are useful for detoxification processes. In this experiment, the larvae of Lucilia sericata will be studied in order to determine if that is also the case for them.

In one study conducted on larva of the order Lepidoptera, butterflies, two different types of cytochrome P450’s were used in order to metabolize allelochemicals in one of the subfamilies of the order, Papilo polyxenes, the black swallowtail butterfly (Xianchun et al., 2003). The butterflies were known to use two cytochrome P450 enzymes, CYP6B1 and CYP6B3, in order to protect

Figure 3: Patterns of cytochrome p450’s in Malpighian tubules of Drosophila melanogaster. Graphic Courtesy of Chung et al.
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Hypothesis

Drugs in victims may affect the metabolism of flies that we use to assess time of death; drugs bring variability into the established developmental timeline of insects. It has been shown in previous experiments what oxycodone does to fly development and how temperature affects flies, but it is not known how fly development is affected if the flies are raised in one specific climate compared to being raised in another while either feeding on pork loin injected with saline or pork loin injected with oxycodone. The fly species that have been studied in the past were Lucilia sericata and Phorma regina. This experiment is going to use Lucilia sericata as its model and focus on that species in Wisconsin and Arizona.

It is hypothesized that insects that are native to and develop in a warmer climate, Arizona, are going to metabolize the drugs more quickly by eliminating them from their systems using cytochrome P450’s, through their Malpighian tubules faster than insects that are not adapted to living in a warmer climate. Entomologists have theorized that if drugs are not constantly being supplied to an insect, the larvae’s system will eventually completely excrete of the drug (Murthy and Mohanthy, 2010). The insects that are not adapted to living in the warmer environments will run out of the oxycodone more quickly because they are adapted to a higher temperature. The question is how much faster do the insects develop and does it vary depending on the original climate of the insects? The question will be addressed by focusing on temperature conditions in Wisconsin and Arizona to see how insects eliminate oxycodone through their Malpighian tubules using the cytochrome P450’s in those two areas.

Specific Aim 1: Temperature

It is known that insects develop at a faster rate when temperature increases (Monthei, 2009) and that when many maggots are feeding on a decomposing animal, specifically a pig, at once, the development of the insects may speed up due to the overall temperature increase (Cianci and Sheldon, 1990). The metabolism of drugs in the insect could speed up due to the fact that the ambient temperature is higher or because of the increased insect presence.

Drugs in victims may affect the metabolism of flies that we use to assess time of death...
In order to determine insect ages in forensic cases, accumulated-degree days (ADD) or accumulated degree hours (ADH) are used (Monthei, 2009). The ADD is found by determining the minimum and maximum temperature threshold for a specific insect, the minimum temperature being when insect development can begin to occur and the maximum being the highest temperature where insect development can still occur (Monthei, 2009). In order to know how insects are affected by temperature because when the temperature of the environment is either lower or higher than an insect can handle, the insect will stop developing. The temperature where growth and development cannot occur, because it is too low for development, is called the base temperature (Monthei, 2009). It is found in the lab by looking at growth rate at set temperatures (Monthei, 2009).

For example, looking at the ADD of the species Lucilia Sericata, during the normal life cycle of Lucilia sericata, at a temperature of 21°C eggs take 21 hours to hatch and require four days of larval development, at 27°C they take 18 hours to hatch and require three days to develop (Anderson and Kaufman, 2011).

In a 2001 study, The growth and development process of the larvae and pupae of the blowfly species Lucilia sericata were studied at 10 different temperatures (Figure 4), and the results of the experiment helped produce what is called the isomegalen-diagram (Figure 5), which shows larval length at different temperatures and an isomorphen diagram (Figure 6), which shows all of the different stages of development of the blowflies from when the eggs are laid to when they hatch (Grassberger and Reiter, 2001).
sects respond to changes in temperature in general. This is important because that is what the research question for the proposed study is looking at, along with how oxycodone affects insects in two different zoogeographic regions, the Southwest and the Midwest.

The first specific aim of this experiment is going to be to establish how Lucilia sericata responds to changes in temperature in Wisconsin compared to Arizona. The goal of this study is to determine how insects respond to drugs in different temperatures, but in order to do so a baseline needs to be established for how insects respond to changes in temperature in general. This is important to know because a member of the Lucilia sericata species in the Midwest might react differently to temperature than a member of that species that lives in the Southwest. It is key that the labs in which the insects are studied have the same light conditions and temperature of the location where the sample was collected in order to get the most accurate and precise results (Gosselin et al., 2011). In order to do so, it is imperative to understand the average temperatures of both states and their common climates. Wisconsin has warm summers and cold winters, high amounts of precipitation, and average annual temperatures ranging from 4ºC to 10 ºC (Advameg, Inc., 2010). Temperatures in Wisconsin usually average from 8ºC to 13ºC in January and can be about 20ºC in July (Advameg, Inc., 2010). Arizona, on the other hand, has more dry heat and less rainfall, causing temperatures to range from 6ºC to 19ºC in the month of January and 27ºC to 41ºC in the month of July (Advameg, Inc., 2010). Arizona is warmer than Wisconsin most of the time, which needs to be taken into consideration when evaluating the Lucilia sericata blowflies from Arizona versus those from Wisconsin. Insect temperature sensitivity is known as Q10, meaning that with each change in ten degrees Celsius there is a change in rate of insect development (Lake et al. 2013). For Q10, each 10-degree increase in temperature causes the metabolism rate to double. Taking this common occurrence into account, it is estimated that insects without any oxycodone will respond to changes in temperature with a doubling of metabolism rate for each ten-degree increase in Celsius temperature. The temperature that the insects in this study will start at will be 10ºC. If the ambient temperature is less than 40 degrees Fahrenheit (~4.44ºC), flies cannot lay eggs (Verma and Reject, 2013). Then the same temperature scheme of the study on 2001 performed by Grassberger and Reiter on Lucilia sericata will be used for testing; 15ºC, 17ºC, 19ºC, 20ºC, 21ºC, 22ºC, 25ºC, 28ºC, 30ºC, and 34ºC, in addition to 38ºC to account for the upper temperature limits of Arizona.

The hypothesis for specific aim 1 is that the insects that from Arizona will develop at a faster rate than the insects that are studied from Wisconsin. Since the average temperatures in Arizona are almost ten degrees warmer than those in Wisconsin, the estimation is that the insects from Arizona will have a metabolism rate, without the oxycodone, of almost two times that of their Wisconsin counterparts, based on the Q10 assumption stated previously.

### Specific Aim 2: Oxycodone

There have been studies done in the past where oxycodone was injected into pigs and then the development of the forensically important insects, Phormia regina and Lucilia sericata, that colonized them were analyzed. In one study, Phormia regina was analyzed (Monthei, 2009). The pigs were given oxycodone hydrochloride (3mg/kg by weight) and their blood was taken before they were injected with the drug and after. Once the pigs died, insects were collected from them for seven days (Monthei, 2009). The Kolmogorov-Smirnov test was used for analysis, which is a nonparametric test that compares the control (saline injected pigs) and the treatment variable (oxycodone injected pigs) in order to determine if there is a statistical significant difference between them. It was discovered that the third instar Phormia regina were longer in length, after the same amount of time had passed, than the maggots feeding on pigs that had not been injected with oxycodone (Monthei, 2009). There was also a significant difference in time with respect to larvae on the pig itself from the...
emergence of the larvae from the egg to the completion of the second instar, being faster for the insects on oxycodone (Monthei, 2009). That study showed that oxycodone speeds up the development of Phorma regina. Since Phorma regina is also a member of the Dipteran order, it is likely that Lucilia sericata will have a similar effect.

The second specific aim of this experiment is to determine how quickly do insects eliminate oxycodone through their Malpighian tubules using cytochrome P450’s, based on previously mentioned temperature conditions in the Midwest in comparison to those in the Southwest. This specific aim will add validity to other past experiments that have determined how long it takes a specific drug to exit an insect’s system. In order to get enough data in a four-year period, the insects will feed on pork loin specifically from Arizona and Wisconsin, due to the fact that a lot of the past studies in the field have been done on pigs. There will be three groups of injected pork loin that the Lucilia sericata insects will feed in. The first group will be injected with a low dose of oxycodone, the second with a lethal dose of oxycodone and the third group will be injected with a saline solution to act as a control.

Lucilia sericata will first be analyzed in order to determine the post-mortem interval of the body by taking length and width measurements of the larvae and comparing them to what would be a normal size of an insect at the third instar of insect development at a particular temperature. The third instar larvae will be closely monitored with a dissecting microscope and measured using an eyepiece micrometer.

How quickly do insects eliminate oxycodone through their Malpighian tubules using cytochrome P450’s?

Next, liquid chromatography will be performed on the insects to test for the presence of the drug to see the amount present in an insect at a specific temperature in Wisconsin versus one in Arizona. The presence of the drug will be percentage based, not overall presence based so that there is an even comparison between the two insects. If this is done at a few different intervals, each temperature previously referenced, then it can be determined which insect processed the drug faster.

The final way that the insects will be analyzed for this specific aim is by dissecting the Malpighian tubules of the Lucilia sericata before the addition of the drugs, using what is known as the Ramsay Assay, by dissecting them out of the insects under insect saline, adding oxycodone to the saline, and then adding the tubules so that the volume of the drug could be measured (Parry et al., 2011).

Methods

Insects will be purchased as maggots and grown in the lab. Once obtained, the insects are washed with deionized or tap water and frozen for storage at a temperature ranging from negative twenty to four degrees Celsius (Dayananda et al., 2013). When the insects are ready for analysis, they are taken out of their storage facilities, washed again, dried, crushed into smaller pieces, and then stored at 650 degrees Celsius for a day so that the next time they are studied, they will be mixed with a 70% HNO3 solution and a process known as acid digestion will be performed on them (Dayananda et al, 2013).

The way that insects are going to be analyzed in this specific experiment is threefold. First they will be measured and observed under a dissecting microscope. Next, testing of the Malpighian tubules of the insects to determine the rate of secretion of the oxycodone will occur. Finally, the liquid chromatography aspect of the experiment will occur.

When it is time for the insects to be tested, first they will be looked at comparatively under a dissecting microscope (George et al., 2009). Researchers in the past have made the observation that the prepupa change from orange to dark brown when becoming full pupae and growth comparisons were made at each larval stage (George et al., 2009). It is also helpful to note when insects have changed in size in both length and width as

![Figure 7: How larval length and width will be measured Graphic Courtesy of George et al., 2009](image)
a result of the drugs. This is demonstrated in [Figure 7]. This part of the analysis will focus on measuring the insects in millimeters and documenting their physical appearances in order to compare them to what is considered normal for an insect.

The next step will be for the insects to have their Malpighian tubules analyzed to determine the rate at which they processed the drugs. This will be done by using the Ramsay Assay, dissecting them under insect saline containing (in mmol L⁻¹) 117.5 NaCl, 20 KCl, 2CaCl₂, 8.5 MgCl₂, 10.2 NaHCO₃, 4.3 NaH₂PO₄, 8.6 HEPES (4-(2-hydroxyethyl) piperazine-1-ethansulfonic acid), 1 cAMP, 20 glucose, and 10 glutamine to determine if they grew longer during development (Parry et al., 2011). Once the Malpighian tubules are dissected, they are going to be placed onto a saline droplet already containing the oxycodone under paraffin oil in a petri dish. The ends of the tubules are going to be tied to insect pins (Parry et al., 2011). The diameter of the secreted droplets will be measured using an eyepiece micrometer after 60 minutes (Parry et al., 2011). The volume will be calculated by doing a simple volume calculation of (πd³/6), with the units being nanoliters (Parry et al., 2011). From there, the secretion rate is calculated by dividing the volume of the secreted droplet and amount of oxycodone, by 60 minutes, and the measured length of the tubule according to the eyepiece micrometer (Parry et al., 2011). This analysis will determine the overall secretion rate of the oxycodone in the insects.

The third analysis technique, liquid chromatography, will involve the Lucilia sericata insects going through a process in which they will be homogenized into a solution. Methods for this part of the experiment will be adapted from Gosselin et al. 2010. First a larvae specimen is placed into a 100-µL water containing disposable vial. Then the samples will be ground into power using a homogenizing machine known as a Precellys 48 for 30 seconds at 4000 rotations per minute. After that the samples will be put into a glass vial with 400µL of water and 500µL of saturated ammonium chloride buffer with a pH of 9.2. Next, 4mL of chlorobutane will be added and shaking will be carried out for 10 minutes. After an initial centrifugation, the clear organic layer of that solution will be transferred to a vacuum centrifuge and evaporated to dryness. Then the samples will be added back together in 500µL of aqueous mobile phase. The liquid chromatography can begin after that uses a gradient of 0.1% aqueous formic acid and another gradient of methanol/0.1% aqueous formic acid mixture at a flow rate of 250µL per minute. The total analysis time will be 15 minutes, and 20µL of the extract will be put into the chromatography machine total.

Liquid chromatography is used regularly for analysis of drugs, like oxycodone (De Bocek et al., 2002), so that is what will be used in this case. In two cases in Poland, liquid chromatography was used in order to test for the presence of drugs and other foreign metabolites (Skowronek et al., 2011). The larvae were sampled from all over the cadavers, but after looking at the liquid chromatography analysis, the conclusion from the both of them was that the most useful place to find larvae for toxicological analyses was the muscles (Skowronek et al., 2011). In this experiment, that is why the larvae will be feeding from pork loin.

**Anticipated Outcomes / Discussion**

The experiment performed in this study is similar to others that have been done, but different due to the testing of one species of insect that is native to multiple different climates. Since the experiment is a novel idea, it is key to rely on similar experiments that look at the effects of temperature and the effects of oxycodone and combine the two ideas to form expectations. The findings of this study will be crucial to understanding Entomotoxicology, and data generated will add to the existing body of evidence by showing how changing the climate can also affect the way an insect responds, changing PMI.

The effects of opioids on insect development in the past have produced varying results. For example, the morphine opioid was found to speed up the rate of development of Sarcophagidae flies, a family within the Dipteran order, but slow down the rate of development of Lucilia sericata in another study (Monthei, 2009). Since the results have varied, it could be expected that the rates of development of the insects could be unchanged, increase, or decrease. It might be possible that the insect is able to eliminate the drug quickly enough through its Malpighian tubules, causing the insect’s development to be unaffected by the drug (Parry et al., 2011).

It might also be possible that the feeding and post-feeding stages of the insects will vary like in Gosselin et al., 2010, in which the insects that were still in the feeding stage were excreting out more of the metabolite of methadone than its metabolite EDDP and the insects in the post feeding stage were excreting out more of its metabolite. That could be due to the rate that the insects process the drugs. In the current study, the Lucilia sericata are expected to be more likely to have a higher presence of oxycodone than either oxymorphone or noroxycodone, its metabolites while the insects are still
feeding, and the vice versa for the post-feeding insects. The insects from Arizona are expected to have a lesser amount of oxycodone than the insects in Wisconsin however, due to the fact that the increased temperature where the Arizona insects are reared is hypothesized to make them metabolize the drug faster.

There is a control group of Lucilia sericata blowflies for both Wisconsin and Arizona in this study that have not been feeding on pork loin without any oxycodone. Instead, they will have been feeding on pork loin injected with saline. This will be useful to see how the Lucilia sericata develop when feeding on cadavers on a more general basis.

It is hypothesized that the rate of development of the Lucilia sericata feeding on oxycodone in Arizona will be faster than the rate of development of Lucilia sericata in Wisconsin due to the fact that the Arizona insects are acclimated to a warmer climate, and insect rates of development increase with increases in temperature. The oxycodone is expected to increase the rate of development of the insects, evidenced by a study showing larvae completing the second instar stage more rapidly after feeding on oxycodone (Monethi, 2009). Therefore, the insects that were not feeding on any oxycodone are expected to be the slowest to develop for both Wisconsin and Arizona. Wisconsin Lucilia sericata without the oxycodone are going to develop the slowest out of all four populations studied. This is going to be shown both by the initial qualitative observations of the insects under the dissecting microscope, and also the quantitative secretion amounts determined using the Ramsay Assay on the Malpighian tubules of the insects. The oxycodone will come out of the Malpighian tubules at a faster rate for the insects from Arizona than those from Wisconsin. The liquid chromatography will show the amount of drugs present in each insect. Using the three different tests of insect development on the Lucilia sericata blowflies, it will be determined how exactly oxycodone alters the development of the blowflies.

One of the ways that data will be presented in this experiment is by using a graph like George et al., 2009 [Figure 8], which shows the differences between day 4 and day 7 of larval measurement. For this experiment the goal would be to do this similar graph for each of the temperatures studied. Figure 8 shows that there is a slight increase in length and width in the three days of morphine treatment, but through statistical analysis performed by researchers of the study it was found that there was no significant difference between the mean replicate lengths and widths when comparing the 4 day and 7 day larvae. The results of this experiment are expected to be different than those of this morphine study, due to the fact that oxycodone is a different drug and insects will respond differently to it. Cytochrome P450's within the Malpighian tubules of the insects respond to every drug differently, therefore the way metabolism occurs and its speed for morphine is not going to be identical for oxycodone.

Data could also be presented in this experiment like the way it was done in Sadler et al., 1995 (Figure 9). The experiment was performed using drug-laden muscle from three suicides in order to determine how the insects of the study, those of the Calliphora vicina species, responded to four antidepressant drugs, amitriptyline, temazepam, and a combination of trazodone and trimipramine (Sadler et al., 1995). A graph could be made to show what happens with the oxycodone, how much it is able to eliminate each day. This would be accomplished quantitatively by using liquid chromatography. This study by Sadler et al., 1995 was very similar to the current study due to the fact that the drugs were injected into the muscle and then the larval age in days was determined, as shown in the graph.

Parry et al., 2011, from which use of the Ramsay Assay for this experiment was adapted from, shows that Malpighian tubules can be analyzed in order to determine excretion rates of a drug and that the cytochrome P450's are involved in the drug metabolism. That idea will be used in generation of the results of this experiment. Figure 10 shows one of the graphs from that experiment, which was used to show the differences in morphine secretion rate between the second instar and the third instar of the insects in the study. This kind of graph could also be generated for this experiment, but will be more specific to the location of the study, either Wisconsin or Arizona, and will have specific temperature values on it. The Parry et al., 2001 study examined
the effect of the morphine on the 2nd instar and 3rd instar larvae, while this current study plans to focus on just the 3rd instar larvae. Looking at the secretion rate of the drug will be for the same purpose however; to determine the speed of drug metabolism and the overall effectiveness of the cytochrome P450's in the Malpighian tubules of doing their job to metabolize drugs.

The results of this experiment should provide an answer to the hypothesis that insects that are native to and develop in a warmer climate are going to metabolize the drugs more quickly by eliminating them from their systems through their Malpighian tubules faster than insects that are not accustomed to living in a warmer climate and not acclimated to the conditions there. From the expected results, it will likely be necessary to fail to reject the hypothesis. An alternative hypothesis that arises from this experiment is that the combination of the oxycodone and the temperature is what causes such a quick release of the oxycodone, but without a high enough temperature the oxycodone may not be released as fast.

**Conclusion**

Oxycodone will change the shape of the Lucilia sericata blowflies, possibly creating more fat pockets within them, and excrete out of the Malpighian tubules of insects at different rates based on where those insects are natives. Insects that are native to warmer places are going to secrete drugs and toxins out of their systems faster than those native to colder places. This will have an effect on the Post-Mortem Interval estimates for oxycodone overdose cases in areas of different climates where the same insects are studied.

There were a few limitations to this study. In the past, rabbits and pigs were injected with drugs post mortem and then insects feeding on them were analyzed. In this experiment, pork loin was used. The problem with all of these options is that using an animal model is not the same as using a human due to the fact that animals have different metabolites present in their systems that animals do when drugs are consumed (George et al., 2009). For purposes of this experiment, use of the pork loin with the oxycodone is valid, even though pigs have slightly different oxycodone metabolites, in order to determine if oxycodone always has a speeding up larval development effect. Use of muscle has been found to be effective as a testing subject in past studies. Another limitation of this study is that there are a multitude of restrictions on what can and cannot be done at a crime scene when it comes to insects being removed from the body (Campobasso and Introna, 2001). Only the insects that are clearly visible can be taken off of the corpse, and even then a lot of care must be taken in order to not damage the corpse (Campobasso and Introna, 2001).

This experiment... move[s] the field forward by showing how to better estimate PMI by assessing the role of insect metabolism of drugs like oxycodone that speed up the rate of development of forensically important insects...

This experiment is a significant advancement specifically in the field of Forensic Science. Not only does it move the field forward by showing how to better estimate PMI by assessing the role of insect metabolism of drugs like oxycodone that speed up the rate of development of forensically important insects, but it also strengthens the information that has already been shown about how drugs affect larval development by adding in concept of zoographic region analysis that has not been done before. Now that this information is available for Wisconsin and Arizona, entomotoxicologists will need to go out and obtain similar information from...
other geographic regions using oxycodone and then moving on to other drugs.

**Author Reflection**

Undergraduate research is very important for students to partake in. When entering the working world, it is essential to know how to research for any discipline one decides to enter into. Doing extensive research as an undergraduate can give students that extra experience they will need to excel in not only academic research, but also research on any other aspect of life. Students can learn helpful tips and tricks as an undergraduate that will apply to them when they become graduate students or professionals, or possibly for something as simple as buying a car or renting a hotel. Everything in life requires research.

For my specific thesis, I choose to do research that would combine my two favorite disciplines, biology and criminal justice. Entomotoxicology was the perfect fit. It gave me a way to have a topic that was interesting for me in biology, while still satisfying my criminal justice curiosities. In the future, I am interested in becoming a forensic scientist. I want to work for the Illinois State Police as an evidence technician or the Madison Police Department to begin and then see where the career path takes me.

**References**


De Boeck et al. (2002). Recent Applications of LC-MS in Forensic Science. 19-25.


Gosselin et al. (2010). Quantification of methadone and its metabolite 2-ethylidene-1,5-dimethyl-3,3-diphenylpyrroline in third instar larvae of Lucilia sericata (Diptera:Calliphoridae) using liquid chromatography-tandem mass spectrometry. Journal of
Analytical Toxicology. 34 (7): 374-80.


DNA’s Interaction with, Binding to, and Movement through Outer Membrane Protein A during Induced Cell Competence in *Escherichia coli*

By Angela Fuller

The goal of this research is to focus on the structure and functions of outer membrane protein A (ompA) in order to determine a model for the mechanism of the uptake of DNA into *Escherichia coli* (E. coli) cells. This study will investigate ompA’s expression, pore size, and interaction with DNA during transformation conditions. This will be done by observing the protein in vivo and in vitro to determine if an interaction between ompA and DNA is possible. The anticipated results of this study are that ompA expression is up-regulated during transformation conditions, ssDNA is able to pass through the ompA pore, and DNA and ompA interact during induced cell competence. This research will aid in the better understanding of the structure and function of ompA in E. coli cells. The conclusions drawn from this research will have a significant impact on the fields of biochemistry and microbiology because it will lead to procedural improvements that will increase the productivity and effectiveness of the research being conducted in this field.

This study will focus on developing a model for the mechanism of how extracellular DNA enters bacterial cells under inducing conditions. There are models known for the mechanism of DNA uptake of some bacterial species, such as Helicobacter pylori but the model is still unknown for other bacteria such as *Escherichia coli*. A possible model for the mechanism of how extracellular DNA enters *Escherichia coli* under inducing conditions will be developed and tested through this research. It is important to determine how extracellular DNA can enter cells because the success of DNA transfer into a cell can affect the evolution of a species and potentially turn non-pathogenic bacteria into pathogenic, harmful bacteria. The development of a model for *Escherichia coli* may lead to applications of the model in many other species of bacteria and to determine a procedure that could stop DNA uptake from occurring, blocking the pathway to pathogenicity. The goal of this study is to focus on one specific outer membrane protein, ompA, in *Escherichia coli* and its interactions with DNA that could lead to the development of a model for how DNA enters the bacteria cells.

**Transformation**

Extracellular DNA can enter bacteria cells through the transfer of genes from one cell to another known as horizontal gene transfer (HGT), in contrast to the transfer of genes through inheritance. One of the known mechanisms for HGT is transformation (Figure 1). Transformation is the uptake of extracellular DNA into a cell from its environment and the incorporation of that DNA into its genome (Madigan, 2012). There are three main stages involved in transformation. The first stage is the adsorption and binding of extracellular DNA to
the cell surface. The second step is the passage of DNA across the cell membrane and it is the limiting step because more DNA is bound to the outside of the cells than is taken up and incorporated into the cell. The ability of a cell to perform this second step is known as cell competence. The third step is the establishment of the internalized DNA into the cell’s genome (Roychoudhury, 2009). This study will focus on the first two steps of transformation that are important to understanding how extracellular DNA enters into bacterial cells.

Figure 1: Bacterial Transformation occurs when DNA is released from a bacterial cell during cell lysis and is taken up by another bacterial cell: Shown above is the transformation of an antibiotic resistance gene into a recipient cell’s genome Graphic Courtesy of Furuya and Lowy, 2006

Organisms that can undergo transformation naturally are known as naturally competent organisms. Some species of bacteria that are characterized as naturally competent include Micrococcus, Haemophilus, Bacillus (Aich, 2012), Vibrio cholera, and Helicobacter (Seitz, 2012). Helicobacter pylori (H. pylori) are known to use the type IV pilus of the type IV secretion system (T4SS) for transporting DNA across their cell membrane. Type IV pili are protein composed filaments, 6 nm in diameter, that are anchored in the cell membrane, extend from the cell’s surface, assist cells in adhesion, and can facilitate gene transfer in some bacteria (Madigan, 2012). H. pylori are gram negative bacteria, they have an inner and outer cell membrane and a layer of peptidoglycan that is between 7-8 nm thick that is located in the periplasm, the space between the membranes. Although H. pylori are gram negative bacteria, their use of the type IV pilus is more similar to the mechanism used by gram positive bacteria, that have a peptidoglycan layer that is 20-80 nm thick (Seitz, 2012). The mechanism involving the type IV pilus will not be studied further here because this research will focus on the gram negative bacteria, Escherichia coli, which have type IV pili, but have not been shown to rely on them to transfer DNA into the cells during transformation.

The ability of bacteria to undergo transformation naturally is important to both pathogenic and non-pathogenic bacteria. Some of the known benefits of natural competence in pathogenic bacteria are that it contributes to the spread of antibiotic resistance, distributes toxic phages, and facilitates the transfer of pathogenicity islands (Seitz, 2012). Pathogenicity islands are genetic units that contribute to the virulence of a pathogen by containing genes that code for virulence factors, that aid in the cell’s ability to colonize a host, and incorporating those genes into the genome of a non-pathogenic bacterium (Hacker, 2000). An example of a pathogenicity island is the LEE island that encodes many genes which allow enterohemorrhagic Escherichia coli, EHEC, to attach to the mucus of the intestine and secrete toxins. These pathogenicity islands are found in the virulent strain of Escherichia coli but not in the non-pathogenic laboratory strain (Griswold, 2008). Some of the benefits of natural competence for non-pathogenic bacteria are contributing to their ability to adapt to their environment more quickly and making it more likely that they will be able to survive harsh conditions. Although natural transformation in bacteria is important, this study will focus on bacteria that cannot take up extracellular DNA under normal cellular conditions.

**Induced Cell Competence**

Some bacteria that are not naturally competent can obtain the ability to transform by undergoing artificially-induced competence. Cell competence is the ability of a cell to take up DNA from its environment. This involves the adherence of DNA to the cell surface and the entrance of DNA into the cell, the first two steps of transformation. Artificially-induced cell competence relies on a treatment of log phase bacteria to temporarily allow them to take up extracellular DNA. Log phase is the second stage of bacterial growth when the growth rate of the bacteria is increasing exponentially until the number
of cells begins to outnumber the available nutrients so the growth rate levels off and the cells enter the stationary phase. The stages of bacterial growth are shown in Figure 2. There are multiple protocols that have been developed for this artificial induction. This study will focus on competence, the combined first two steps of transformation because DNA cannot be incorporated into a cell’s genome before it has entered the cell.

The process of competence is dependent upon the structure of the bacteria’s cell membrane. The outer and inner membranes of E. coli cells are both phospholipid bilayers that have different protein compositions because of their different functions for the cell. The outer membrane is more selective about what particles it lets pass through than the inner membrane because it is exposed to the extracellular environment. The peptidoglycan layer is a polymer of two types of sugar residues and various amino acids that forms a crystal lattice, mesh-like layer. It adds structural strength against pressure and helps maintain the structure of the cell. As stated previously, gram negative bacteria have thinner peptidoglycan layers than gram positive bacteria. These differences in cell wall structure likely have an effect on the different mechanistic pathways that facilitate transformation in gram positive versus gram negative bacteria, which makes many possible mechanisms for the ability of E. coli to take up extracellular DNA not logical focuses of this research.

The most common method used to induce bacterial competence was developed by Mandel and Higa (1970). Their technique depended on the presence of calcium ions, added to gram negative Escherichia coli (E. coli) cells in 5% calcium chloride solution, and a process of chilling the cells at 4°C and incubating the cells at 37°C. Their study showed that the cells that were made competent, in the presence of calcium ions, took up both linear and hydrogen-bonded circular DNA with the same efficiency. It has since been hypothesized that exposure to calcium chloride assists the process of DNA adsorption and that the heat-shock procedure, incubation of cells at high temperatures, facilitates the penetration of the DNA into the cell cytosol (Panja, 2008). The Mandel and Higa (1970) study was the first study to determine a successful protocol for inducing competence in bacteria cells. Many other studies have focused on improving these methods to increase the transformation efficiency (TRE). One of the studies that has been done used various cations in place of calcium and microwaves (e.g. 180 Watt) in place of heat shocks. A large variety of these modifications were tested by Roychoudhury, et al. (2009). Another technique that is often used is electroporation. This involves shocking the cells with electricity for a short period of time in order to disrupt the cell membrane for enough time so DNA can enter the cell. Electroporation will not be used in this study because it has been shown to cause more cells to die during the induction process and is more expensive than the calcium chloride method.

In the study by Roychoudhury, et al. (2009), many possible improvements to the Mandel and Higa (1970) protocols were tested and analyzed in order to determine the most efficient method to induce competence in E. coli. It is important to optimize the TRE because transformation is a very inefficient process to begin with and increasing the efficiency of the procedure will increase the power of observed experimentation. According to their results, the TRE was greatest when the log phase (Optical Density 600 = 0.1) cells were treated with ice-cold 0.1 M calcium chloride and triple alternate
cycles of heat and cold shock (90 sec-42°C/15 min-0°C). There was not a large observed increase in TRE between the cells treated with two alternating cycles and three alternating cycles so the Roychoudhury, et al. (2009) study concluded that a saturation effect occurred. Therefore, the protocol using triple alternate cycles of heat and cold shock will be used in this study because it is the most optimized version of the common protocol.

**Model Needed For Transformation of E. coli:**

Currently, there is no model of the mechanism for how extracellular DNA enters the periplasm, the intermembrane space, during transformation in E. coli cells (Panja, 2008). It is important to develop a model because it could lead to further improvements in the protocols that would increase the TRE of the process. A medically relevant laboratory practice that would benefit from an increase in TRE in E. coli cells is the production of insulin for diabetic patients using the bacteria’s machinery to make the protein. Humulin, human insulin, is produced this way by genetically modifying E. coli cells with recombinant DNA technology. The humulin gene is linked to the β-galactosidase gene so production of the protein can be easily turned on in the cells because the β-galactosidase enzyme controls transcription of the genes (Tof, 1994). By increasing the TRE of the humulin process, the amount of cells and gene templates used in the transformation process could be decreased, yielding a more efficient protein manufacturing process. An increase in TRE would also make it easier for scientists to complete research projects which include the use of gene expression elements. For example, an experiment that relies on the transformation of E. coli with a specific gene in order to test the gene’s effects on another protein in the cell would be much more efficient if less of the research time needed to be spent on getting the bacteria to successfully transform. Obtaining a better understanding of how transformation works in this bacteria would allow more time and money to be spent on other aspects of the research that actually lead towards learning something novel instead of just investing many of the resources into setting up the experiment.

The development of a model could also lead to the study of transformation in other non-naturally competent bacteria and lead to the development of a model for those species as well. This may lead to the use of other non-naturally competent bacteria in more gene expression research projects and the study of rapid evolution within a species. There are some risks that arise when a non-naturally transformable bacterial strain is made competent because the rapid evolution of a bacterial species is not always beneficial to humans and can sometimes be dangerous. EHEC, one pathogenic strain of E. coli, is an example of a bacterial strain that has been developing antibiotic resistance and has become more dangerous to humans because of transformation and increased exposure to antibiotics (Tadesse, 2012). A better understanding of how competence works would be beneficial and could even result in the elimination of the risks that are present now. Determining the model for competence in non-pathogenic E. coli could lead to the development of a way to inhibit pathogenic E. coli cells from taking up DNA from their environment and slow down the process of evolution or stop it completely so it is less likely for a more deadly strain to evolve.

A medically relevant laboratory practice that would benefit from an increase in TRE in E. coli cells is the production of insulin for diabetic patients using the bacteria’s machinery to make the protein.

Nonpathogenic E. coli were the tested subject of both the Mandel and Higa (1970) and Roychoudhury, et al. (2009) studies. E. coli are not naturally competent because they do not carry the genes that code for the proteins/protein complexes that are responsible for the binding and uptake of DNA in naturally competent cells. There are many porins, pore forming proteins, in the outer membrane of E. coli that act as the site of transport of hydrophilic molecules but usually keep macromolecules like proteins and DNA out of the periplasm and the cell
The usual function of these molecules can be altered to allow macromolecules like DNA through when they are exposed to heat or unnatural conditions. The conditions of inducing cell competence used by Roychoudhury, et al. (2009) may affect the porins in E. coli enough to allow DNA to pass through them. This study will focus on identifying a porin that is essential to the mechanism of DNA uptake in a nonpathogenic strain of E. coli that has been made artificially competent. Although they are not naturally competent, E. coli have been shown to successfully undergo transformation when competence is induced artificially. This ability has been very important for research projects, studies, and the use of transformation in labs to manufacture proteins.

Outer Membrane Protein A:

The outer membrane protein A (ompA) of E. coli may be the key to understanding the mechanism of induced competence DNA uptake. OmpA is a highly expressed and evolutionarily conserved outer membrane protein in E. coli (Smith, 2007). This means that ompA is present in high levels in the cell can has remained essentially unchanged throughout the evolution of the E. coli as a species. This protein is a monomer that has two major domains, a C-terminus and an N-terminus. The last 154 residues of ompA are known as the C-terminus. This domain anchors the protein in the periplasm and may play a role in increasing membrane integrity (Pocanschi, 2013).

OmpA is present in high levels in the cell can has remained essentially unchanged throughout the evolution of the E. coli as a species

The C-terminus will not be the focus of this study because it is not exposed to the outside environment of the cell where DNA adherence is likely to take place. The N-terminus is the first 171 residues of ompA and has been studied for over 30 years and there is still uncertainty regarding its structure and function (Pocanschi, 2013). It folds into an eight-stranded transmembrane beta barrel whose strands run antiparallel through the membrane. This structure is very reliant on hydrogen bonds for stability. The eight strands are connected by four large hydrophilic loops at the outer surface of the membrane and three small turns that protrude into the periplasm (Smith, 2007). The outer portion of the N-terminus may also display some of the characteristics of a gated or controlled ion channel (Sun, 2013). The structure of the N-terminus of ompA is shown in Figure 3. This domain of the ompA protein will be tested as the key to the mechanism of induced cell competence in E. coli because there is a great deal of structural information already known about it and it has the greatest likelihood of the two domains to interact with extracellular DNA.

![Figure 3. The N-terminal domain of OmpA, visualized based on data collected from crystallization and x-ray diffraction by Pautsch and Schultz (1998): This is a ribbon representation with the β strands drawn in blue and a sketch of the surrounding lipopoly-saccharide outer membrane layer.](image-url)
tein C (ompC) as having a possible role in the DNA uptake mechanism. This study will not focus on ompC but further research of that protein may also lead to the development of a model for the adherence and transport of extracellular DNA into E. coli cells. The ompA protein was chosen as the focus of this study over ompC because there was more previous research that supported the hypothesis that ompA is involved in the DNA uptake mechanism of E. coli cells.

The overarching question of this study is: what is the mechanism that facilitates cell competence in E. coli cells? Can a model be developed that explains the mechanism of cell competence, and could this model be used to study competence in the future? This study will focus on determining if ompA is involved in this mechanism by testing its expression during induced cell competence, its structure and pore size, and if DNA binds or interacts with it.

Hypothesis:

The N-terminus of the ompA protein in E. coli cells is involved in the DNA uptake mechanism by interacting with extracellular DNA during induced cell competence by CaCl2 exposure and three cycles of a heat shock followed by a cold pulse.

Specific Aim 1:

The first specific aim is to determine if ompA expression is up-regulated in E. coli cells during competence-inducing conditions in comparison to its expression during normal extracellular conditions for E. coli colony growth. The hypotheses for this experiment are that ompA expression will be up-regulated in E. coli cells during competence-inducing conditions, or ompA expression will be down-regulated in E. coli cells during competence-inducing conditions, or ompA expression in E. coli cells will not change during exposure to competence-inducing conditions.

A Western Blot will be performed using the protocol developed by Davidson College (2001). First, the E. coli proteins will be separated by SDS-PAGE on 16.5% gels (Negoda, 2010). Then, the proteins will be transferred to nitrocellulose blotting paper. The target protein, ompA, will be tagged with a specific antibody/enzyme. The tag that will be used is mCherry, a red fluorescent protein reporter (Verhoeven, 2013). The tagged protein will be incubated in developing solution and measured to obtain the amount of ompA that was expressed. The levels of ompA produced during various cell conditions will be compared to the expression of ompA during normal cell conditions. The proteins will be collected from E. coli cells that have been exposed to the treatments described in Table 1. The protein will also be observed using fluorescence recovery after photobleaching (FRAP), that measures the movement of the fluorescent proteins throughout the lipid bilayer in living cells.

The data collected measuring the amount of ompA present will be analyzed by SPSS using an ANOVA test in order to determine if there is a significant difference in ompA expression between cells in normal cellular conditions and the various stages of treatments that are used to induce cell competence. If there is an increased expression of ompA during induction conditions, then there may be a correlation between the post-transcriptional control of ompA and the uptake of extracellular DNA into the cell.

<table>
<thead>
<tr>
<th>Treatment 1</th>
<th>Treatment 2</th>
<th>Treatment 3</th>
<th>Treatment 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>5% CaCl2</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Chilled at 4°C, then thawed</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Incubated at 42°C</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>No treatment</td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Table 1: Treatments of E. coli cells for Analysis of OmpA Expression during Induced Cell Competence Conditions

Specific Aim 2:

The second specific aim is to determine if the pore of the N-terminus of ompA can allow DNA to pass through it during induced cell competence in E. coli. The hypotheses for this experiment are that...
the ompA pore is large enough for dsDNA to pass through, or the ompA pore is too small for dsDNA to pass through, or the ompA pore is large enough for ssDNA to pass through, or the ompA pore is too small for ssDNA to pass through.

The data found in other studies that have used X-ray crystallography, X-ray diffraction, and NMR will be analyzed and compared to determine the structure and β barrel pore size of the N-terminus of ompA. The structure of ompA crystallized in a detergent that mimics the cellular condition of lipids (Gu, 2010 and Pautsch and Schulz, 2008) will be analyzed using the Chimera program. The effects of high temperatures and highly ionic environments on the pore size of ompA will also be tested by crystallizing the protein in varying conditions. The structural data will be compared to findings of Negoda et al. (2010) to determine if DNA passage through ompA is possible. The pore size(s) determined by these procedures will be compared to the size of various forms of DNA that may enter the cell during induced cell competence.

Specific Aim 3:

The third specific aim is to determine if extracellular DNA can bind to and interact with the N-terminus of ompA at any times during cell exposure to DNA. The hypotheses for this experiment are that extracellular DNA interacts with ompA during the log phase of growth, or extracellular DNA interacts with ompA during induced-competence conditions, or extracellular DNA interacts with ompA in both induced-competence and log phase conditions, or extracellular DNA interacts with ompA only under extreme conditions that could lead to cell death, or extracellular DNA never interacts with ompA.

First, interactions between DNA and ompA will be observed in vitro. The potential interactions will be observed by affinity chromatography. The purified ompA protein will be tagged with a fluorophore or observed by fluorescent tryptophan amino acids. Then, the tagged protein solution will have either ds or ss DNA added and the binding or interaction of the DNA with the protein will be observed and the ratio of interaction analyzed.

The interactions between DNA and ompA will also be observed in vivo (in situ). First, ompA expression will be induced to increase the amount of protein in the outer cell membrane. Then, the cells will be exposed to excess dsDNA fragments/plasmids or ss DNA fragments. Possible interactions at different stages of the cell cycle and under various conditions will be observed by electron microscopy.

If it is observed that DNA does interact with ompA, especially if the DNA is observed to be moving through the ompA β barrel, then the results will support the hypothesis that the N-terminus of ompA is involved in the DNA uptake mechanism of E. coli cells under the conditions the interaction was observed.

Anticipated Results:

The anticipated results for specific aim one are that up-regulated ompA expression will be observed during treatment one, treatment two, treatment three, or treatment four; or down-regulated during treatment one, treatment two, treatment three, or treatment four; or that there will be no observable change in ompA expression during any of the treatments. The results will be determined based on the amount of protein that was obtained from the western blot for each treatment in comparison to the control test. The control test was the protein obtained from a culture of cells that were not exposed to any induced competence conditions. It is expected that there will be the greatest increase in ompA expression for treatment three. This is because the results of the study done by Roychoudhury, et al. (2009) showed that the greatest optimization of the TRE occurred when calcium chloride exposure, heat shock, and cold shock were all used to induce competence. An increase in ompA expression would be a consistent result of the TRE optimized treatment.

The anticipated results for specific aim two are that the β barrel pore of ompA may be large enough for dsDNA to pass through, large enough for ssDNA to pass through, too small for dsDNA to pass through, or too small for ssDNA to pass through. As dsDNA is two nm in width, it is expected that the
The pore of ompA must be at least two nm wide in order to possibly allow dsDNA to pass through. According to the structure of the N terminus, determined by Pautsch and Schulz, (1998) the pore of ompA is too small for dsDNA to pass through but large enough for ssDNA to pass through. Although, according to a review article by Smith et al., (2007) it is possible that ompA has two conformations of pore size, one that is an eight stranded transmembrane β barrel with the C-terminus in the periplasm (Pautsch and Schulz, 1998) and another that is a sixteen stranded transmembrane β barrel that has the C-terminus incorporated into the pore structure and was formed when the temperature was increased (Negoda, 2010). This sixteen stranded transmembrane β barrel pore would be large enough for both ss and dsDNA to pass through. Based on the more recent results obtained by Pautsch and Schulz (1998) through crystallography, it is expected that only ssDNA will be able to pass through the ompA pore.

...the pore of ompA is too small for dsDNA to pass through but large enough for ssDNA to pass through

There are four main anticipated results of specific aim three. One anticipated result for specific aim three is that extracellular DNA interacts with ompA of log phase cells that are in induced competence conditions of CaCl2 during the heat shock step. Another anticipated result is that extracellular DNA interacts with ompA during both induced competence conditions and under normal cellular conditions but either with a higher rate of interaction under the induced competence conditions or with no change in rate of interaction between conditions. A third anticipated result is that extracellular DNA only interacts with ompA under extreme conditions that would normally result in cell death. The fourth is that extracellular DNA never interacts with ompA. The expected result for this specific aim is that extracellular DNA interacts with ompA when the cells are under induced competence conditions because the cation exposure and increased temperature will encourage complexes to be formed in order to better protect the cells from these unnatural conditions. If the results of specific aim two show that DNA is able to pass through the ompA pore, then a greater amount of interaction of the DNA and the protein will be seen in the data collected from this specific aim.

Discussion:

If the results for specific aim one show that ompA expression is up-regulated during induced competence conditions, it can be concluded that the presence of ompA is linked to the ability of a cell to undergo artificial transformation. This may be because the increase in ompA helps to facilitate the movement of DNA into the cell. It may do this by either moving it directly through its own pore, increasing DNA adherence to the cell membrane, or by loosening the lipid membrane structure. If the lipid membrane structure is loosened it will make it easier for macromolecules like DNA to pass through the membrane. This correlation between the competence conditions and the increased expression of ompA could be studied in future research to try to find an explanation for the relationship if it does not affect the ability of DNA to enter the bacteria. Determining the relationship between ompA expression and competence conditions could lead to finding new functions of ompA. If ompA is up-regulated during induced competence conditions, then it may be logical that other outer membrane proteins are also up-regulated under these conditions.

If the results for specific aim two show that the ompA pore is large enough for ss or dsDNA to pass through, then there is strong evidence to suggest that DNA can travel through ompA during induced cell competence. This could be the beginning step in the process of determining the mechanism of DNA uptake during transformation in E. coli. If the size of the pore will only allow ssDNA through, then the protocols for inducing cell competence could be altered so that ssDNA predominates as the form DNA takes as it enters the cell to increase the amount of DNA that could enter the cell by the ompA pore. Another conclusion that could be drawn from this result is that ompA is not the entrance site of DNA into the cell during transformation because dsDNA needs to be used in order for the DNA to not degrade under the artificial conditions. Further re-
search will be needed to determine if ompA plays a direct role in the uptake of extracellular DNA. Even though this research may not be conclusive regarding the transport of DNA through the β-barrel pore, it will lead to a better understanding of the structure of ompA and how that structure affects its functions.

If the results for specific aim two show that the ompA pore is large enough for ss or dsDNA to pass through, then there is strong evidence to suggest that DNA can travel through ompA during induced cell competence.

If the results for specific aim three show that DNA interacts with ompA, then the evidence suggests that ompA is either the entrance site for DNA during transformation or that ompA facilitates adhesion of DNA to the cell membrane. The distinction will be made by comparing the type of DNA/ompA interaction observed with the results from the other two specific aims. If ompA is determined to be the entrance site for DNA during transformation then further research will develop a model for how this interaction occurs. If ompA is shown to facilitate adhesion of DNA to the cell membrane, then that information will be used to support the possibility of another, nearby entrance site for the DNA. Even if ompA is not directly involved in the mechanism of DNA uptake during transformation, more will be learned about the structure and function of ompA that will expand what is known about the significant E. coli protein. Another protein that could be studied using the same specific aims discussed above and would yield more information regarding the transformation mechanism in E. coli cells is ompC (Aich, 2012). The determination of this new information regarding ompA’s role in the mechanism of DNA uptake during transformation will lead to the development of a mechanistic model for E. coli that will have applications in many other species of bacteria and may aid in determining a procedure that could inhibit DNA uptake, blocking the pathway to pathogenicity.

Even since the procedure of treating bacterial cells with the CaCl2 method became usable the mechanism for DNA uptake is still unknown. The results of this experiment are important and useful for finding an explanation for the role of ompA during induced cell competence. The results will lead to a better understanding of whether DNA interacts with ompA and what form of DNA is most efficient for successful DNA uptake into the cell. The better understanding of ompA and E. coli gained from this research could also be used to further improve the protocols of Roychoudhury, et al. (2009). One of the limitations of this research is that it only focuses on one specific outer membrane protein. In reality, the enormous variety of outer membrane proteins should all be evaluated for their potential effect on the mechanism of transformation.

The determination of how extracellular DNA enters cells is important because the success of DNA transfer into a cell can affect the evolution of a species and can lead to a non-pathogenic strain of bacteria becoming into a pathogenic strain.

The data can later be compared to that of studies involving other outer membrane proteins and complexes of E. coli such as ompC (Aich, 2012) in order to derive the entire mechanism behind successful DNA uptake into a cell during induced cell competence. This comparison will combine the information determined for ompA with similar information about other proteins that can lead to the determination of the transportation mechanism. Further directions for this research include: testing DNA interaction with mutated ompA, testing ompC using the same methods to determine if it has a role in induced cell competence, testing the competence inducing techniques described above in other various strains of E. coli, and using the knowledge gained about ompA's structure to determine more about its other functions in E. coli cells, including its role in the pathogenesis of enterohemorrhagic E. coli that could lead to the development of a way to inhibit pathogenic E. coli from transforming and becoming antibiotic resistant. This study is the
first step in a vast amount of research that needs to be done in order to better understand one of the most common biochemistry and microbiology procedures, induced cell competence and transformation.

**Conclusion:**

The data collected through this research will aid and lead to the development of a model for the mechanism of DNA uptake during transformation in E. coli or to a better understanding of the ompA protein and the importance of its functions to the cell. The determination of how extracellular DNA enters cells is important because the success of DNA transfer into a cell can affect the evolution of a species and can lead to a non-pathogenic strain of bacteria becoming into a pathogenic strain. The development of a model for E. coli may lead to applications of the model in many other species of bacteria and to the determination of a procedure that could stop DNA uptake from occurring, blocking the pathway to pathogenicity. OmpA’s expression, pore size, and interaction with DNA during transformation are the essential focuses of this research that may lead to the determination of the mechanism that facilitates the movement of DNA through the outer cell membrane in E. coli. The determination of this mechanism will have a significant impact on the rest of the fields of biochemistry and microbiology because it will lead to procedural improvements that will increase the productivity and effectiveness of the research of these fields.

**Reflection:**

This thesis article was written as partial fulfillment of the degree of Bachelor of Arts in biology. It took a year of researching, writing, and revising to complete the thesis. The general idea for this research began during a biochemistry lecture. The author found it fascinating that there was not much known about the mechanism that makes the extremely important process of transformation possible. Her previous experience working with bacteria during a microbiology course and through independent research also drew her to this topic. The author would like to acknowledge Dr. Paul F. Martino and Dr. Elaine Radwanski for helping and encouraging her throughout the process of writing this thesis. As a senior biology and music major at Carthage College, the author hopes to continue to work and conduct research in the fields of microbiology and biochemistry and earn a graduate degree in the future.

**References:**


Variation in tick populations between invasive and native vegetation

By Beth Klein

Ticks are a growing nuisance to public health. Environmental factors may influence the distribution and abundance of ticks in a particular region. The objective of this research is to determine the effect of invasive vegetation on tick populations. Invasive vegetation is predicted to have a higher population of ticks than native vegetation; according to previous studies, woody shrubs may be expected to harbor the most ticks, followed by herbaceous and wetland plants. If ticks are more prevalent amongst invasive vegetation, then tick-borne disease potential is directly proportional to the amount of invasive plants in a given area. Ticks were collected from woody shrubs, herbaceous plants, and wetland plants on and nearby the Carthage College campus in Kenosha, Wisconsin. Three innovative methods were used to collect ticks: dragging, flagging, and stomping through plots with a cloth. Ticks were scarce in the samples; the majority of ticks found were collected from plants in or nearby what appeared to be deer beds. Ticks do not appear to choose plants for questing based on species or life form, but rather the presence or previous presence of a host. Further studies could investigate more tick-friendly areas with more available hosts and less human impact.

A(n) invasive species is defined as a non-native species introduced to an ecosystem and whose introduction causes harm to the environment and its native species (USDA, 2006). Though they are not an invasive species, ticks (family: Ixodida) exhibit many characteristics of invasive species. First, ticks have no natural enemies, so they thrive without fear of predation (Sonenshine et al, 2002). Second, ticks have a wide host range, allowing them to adapt to any environment with vertebrae present (Klompen, 2005). To add to their list of advantages, ticks can reach reproductive maturity in as little as one year and could produce thousands of viable offspring in one reproductive event. The parasitic nature of ticks causes harm to their hosts directly and indirectly. Tick bites cause pain, blood loss, and in some cases, an immune reaction. Indirect consequences stem from the tick’s ability to maintain microbial agents in its body, which could then be transferred to the host during the tick’s feeding (Sonenshine et al, 2002).

To add to their list of advantages, ticks can reach reproductive maturity in as little as one year and could produce thousands of viable offspring in one reproductive event

Tick-borne illnesses are a major source of concern for public health and disease control. Some common tick-borne diseases include Babesiosis, Rocky Mountain Spotted Fever, and Southern Tick-Associated Rash Illness (CDC, 2013). The most publicized and common tick-borne disease is Lyme Disease: its incidence rate has risen by an estimated 80 percent in the past two decades.
Lyme Disease is caused by four closely-related bacteria in the Borrelia genus, but is usually attributed to B. burgdorferi. It is a slow-acting disease, often taking weeks for clinical symptoms to appear and months to years for late-stage symptoms to manifest. If the spirochetes reach the bloodstream, they can spread throughout the body and cause problems with joints, the heart, and the nervous system (Sonenshine et al, 2002). Much is still to be learned about ticks and the microbial agents they harbor. A recent study linked Lone Star tick (A. americanum) bites to a red-meat allergy, the relationship of which still unknown (Beck, 2013). Though not all tick-borne infections are preventable, health-care officials recommend the public beware of ticks and to examine themselves after possible exposure to ticks (CDC, 2013).

Evidence already shows that ticks are more prevalent in the invasive shrub Amur Honeysuckle (Allan et al, 2010), other woody shrubs are expected to have the same effect.

Invasive species already cause many problems environmentally, economically, and pathologically, but do not receive much attention because humans do not usually experience their effects directly. If tick populations are larger among invasive vegetation as predicted, then tick-borne disease potential is directly proportional to the amount of invasive vegetation in a given area. This experiment will compare the abundance of ticks amidst invasive vegetation to the abundance amidst native vegetation. From this data, the tick’s vegetation preferences could be determined and possible explanations for that preference could be suggested. From there steps can be taken to control invasive species and reduce the risk of tick-borne illness.

Methods

Tick collections took place on and near the campus of Carthage College in Kenosha, Wisconsin, as well as a field near a subdivision in Pleasant Prairie, Wisconsin. The campus is situated on an arboretum with Lake Michigan to the east and the Pike River snaking through the campus. The deciduous forest on campus consists of Cottonwood, Oak, Basswood, and Maple trees. The invasive shrubs Tartarian Honeysuckle and Common Buckthorn are present in large quantities. A mixture of grasses, cattails, Reed Canary Grass, and Willow trees crowd the riverbed and line the road. The water levels of the river were higher during this study than previous years due to heavy rainfall in the spring. The field near-
by Pleasant Prairie is comprised of grasses, mainly Reed Canary Grass, and scattered shrubs of Dogwood and Honeysuckle.

The study examined plots of seven invasive plants in comparison to non-invaded plots to access tick population differences. Plot sizes for sampling varied depending on the life form of invasive in question. The large invasive woody shrubs Tartarian Honeysuckle (L. tatarica) and Common Buckthorn (R. cathartica) were sampled in three square meter plots. The invasive wetland plants Cattails (T. latifolia), Reed Canary Grass (P. arundinacea), and Phragmites (P. australis) were sampled in two square meter plots. The herbaceous plants Garlic Mustard (A. petiolata) and Purple Loosestrife (L. salicaria) were sampled in one square meter plots. The herbaceous plants Garlic Mustard (A. petiolata) and Purple Loosestrife (L. salicaria) were sampled in one square meter plots because larger monocultures were difficult to find. For each plot of invasives sampled, an area of non-invaded plants at least two meters away but in the same vicinity was sampled with the same plot size. The non-invaded plots contained plants of a similar life form as the invaded plots.

Plot sizes for sampling varied depending on the life form of invasive in question

Three tick-collection methods were used to capture ticks in this study. Many methods have been proposed, critiqued, and recommended based on a plethora of studies. The first method used was the dragging method, by which the investigator dragged a one square meter corduroy cloth atop the plot of vegetation (Falco et al, 1992). Another similar method is flagging, by which the investigator runs a 0.25 square meter corduroy cloth in between, underneath, and around the plot like a flag. The third method is a more innovative way to collect ticks suggested by a peer: the stomping method. The investigator stomped through the vegetation wrapped in a bed sheet and collected any ticks caught on the sheet. This method is thought to have advantage over dragging or flagging because a potential host is attracting the ticks rather than a piece of cloth alone (Ginsberg et al, 1989). For any method, ticks found on the investigator or the cloth after sampling the plot were collected and counted. The methods were performed consistently in the given order because stomping tended to hinder the effectiveness of dragging and flagging. To avoid investigator bias, each method had an assigned investigator throughout the entire project. By using three methods of tick collection instead of one, the study not only maximized the number of ticks collected per plot but also analyzed the reliability of each method.

Results

Ticks were scarce on all days of tick collecting. All ticks found were adult dog ticks (D. variabilis). No deer ticks (I. scapularis) or Lone Star ticks (A. americanum) were collected.

No ticks were collected in the samples on campus [1]. There were thunderstorms in the area the night prior to our collections, so the vegetation was still damp. Three ticks were collected from the samples along Sheridan Road and the Pike River [2]. Three ticks were collected from the plots in the field near Pleasant Prairie [3]. Plots 19 and 20 were sampled to see if Ragweed or Milkweed had any observable tick population.

A total of six ticks were collected in this study [4]. Four ticks were collected from invasives, three of those from Reed Canary Grass and the last from Buckthorn. Four ticks were collected with the stomping method, one tick with the dragging method, and one tick with the flagging method. Four of the ticks were found in or near suspected deer beds.

Discussion

The study found that ticks were scarce in all of the samples, and the hypothesis cannot be fully refuted nor supported. The data refutes the second part of the hypothesis, that woody shrubs will have the most ticks, followed by herbaceous plants and wetland plants. The wetland plants had the most ticks while the shrubs had the second highest and the herbaceous plants had none. The amount of ticks is so small, however, that these differences could be due to random chance, so the entire hypothesis cannot be supported nor disproved.

The data refutes the second part of the hypothesis, that woody shrubs will have the most ticks, followed by herbaceous plants and wetland plants

Other studies have had better luck collecting ticks than this study. Ginsberg et al (1989) collected over 160 adult ticks via the flagging method, while Walk et al (2009) collected and analyzed over 300 adult ticks. Though this project did not seek nymph ticks, Rulison et al (2013) collected over 1,000 nymphs in less than one year. There are a few possible reasons why this study did not collect as many ticks as other studies. First, samples on campus most likely did not find any...
ticks because of the lack of potential hosts on campus and the College’s use of pesticides. Second, ticks are more active during the late months of spring and in October, corresponding to their reproductive cycles. This study took place in July when ticks were less prevalent. Lastly, the weather on the tick-collection days was not ideal for tick questing. Thunderstorms occurred the night before the on-campus collections, and the other days were dry and cool. Ticks prefer moist conditions and warm weather, and on dry days they usually cease questing and remain near a water source (Sonenshine et al, 2002). This is another tentative explanation as to why we found more ticks in wetland plants than other life forms.

The flaws of the methods may have also limited the results. With all of the methods, ticks caught on the cloth could be brushed off before they are counted. This is especially possible with Honeysuckle and Buckthorn due to their dense branches. The stomping method was difficult underneath the dense shrubbery, so the investigator had to “kick” into the bush rather than stomp through it. Though the cloth used for stomping was made from a different, softer material, stomping captured the most ticks of all the methods, so perhaps the softer cloth held onto ticks better than the corduroy.

The majority of the ticks found were in or near suspected deer beds. The beds were formed in wetland grasses nearby a water source, such as the Pike River or a pond in the field, which tentatively explains why Reed Canary Grass is the lead plant in tick collections. The fact that most of the ticks were found by the suspected deer bed suggests that the type of plant does not necessary matter to the tick, but rather the presence or previous presence of a host.

The majority of the ticks found were in or near suspected deer beds

Another aspect of the results that is unexpected is that only dog ticks were collected. It is no surprise that dog ticks were collected at all since their peak season is summer and they are most commonly found in moist meadows and ecosystems with a combination of meadows and forest (Sonenshine et al, 2002; Schultze et al, 2005). What is surprising, however, is that absolutely no deer ticks were collected. Even in the deer beds, no deer ticks were collected nor seen. Studies show that the survival and reproduction of deer ticks may be very limited, if not impossible, without the presence of deer (French Jr. et al, 1992; Duffy et al, 1994). If this is the case, the locations we searched probably did not have a large enough population of deer in the area for deer ticks to survive. It is no surprise that Lone Star ticks were not found in the samples, though Laaser et al (2013) recently found Lone Star ticks are slowly coming into Wisconsin.

Further studies on tick populations could venture into locations further away from civilization where deer and other hosts are more prevalent and human impact is less observed. The tick collection sites examined in this study were in areas of high human disturbance, so an environment unaffected by humans is predicted to be more suitable for the vegetation, animal hosts and ticks alike. With more time for sampling, a larger species diversity, and a larger population of deer or other viable hosts, the relationship between tick populations and invasive vegetation could be further analyzed.

Conclusion

Ticks were scarce to be found in all locations. Half of the ticks collected were found in Reed Canary Grass. Only dog ticks were found, no deer ticks or Lone Star ticks were collected. The hypothesis was not supported by the data, but further research and fieldwork is necessary to support or fully disprove the hypothesis. Any differences observed in tick counts between different plant types or methodologies of collection could be due to random chance. More ticks were found in and around deer beds, suggesting that the presence of a host is what drives ticks to quest in certain plants. The hypothesis could be further explored with more tick-friendly conditions, such as host availability.

Graphics

1. Ticks collected on the Carthage College campus, July 22nd.

<table>
<thead>
<tr>
<th>Site Number</th>
<th>Plot</th>
<th>Plant</th>
<th>Stomping</th>
<th>Dragging</th>
<th>Flagging</th>
<th>Total</th>
<th>Ticks / m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Garlic Mustard</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
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</tr>
</tbody>
</table>
The Carthage Vanguard

2. Ticks collected along Sheridan Road and the Pike River, nearby the Carthage College campus, July 25th.

<table>
<thead>
<tr>
<th>Site Number</th>
<th>Plot</th>
<th>Plant</th>
<th>Stomping</th>
<th>Dragging</th>
<th>Flagging</th>
<th>Total</th>
<th>Ticks / m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Purple Loosestrife</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Reed Canary</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
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<td>4</td>
<td>Reed Canary</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>2</td>
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<td>Non-Invaded</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>6</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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</tr>
<tr>
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<td>0</td>
</tr>
<tr>
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<tr>
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<td>0</td>
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</tr>
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<td>0</td>
</tr>
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<td>13</td>
<td>Cattails</td>
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<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>6</td>
<td>14</td>
<td>Phragmites</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

3. Ticks collected in a field nearby a subdivision in Pleasant Prairie, July 29th.

<table>
<thead>
<tr>
<th>Site Number</th>
<th>Plot</th>
<th>Plant</th>
<th>Stomping</th>
<th>Dragging</th>
<th>Flagging</th>
<th>Total</th>
<th>Ticks / m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Honeysuckle</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Dogwood</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Reed Canary</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Tall Goldemrod</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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</tr>
<tr>
<td>3</td>
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<td>Goldemrod</td>
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<td>0</td>
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</tr>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>Native Grass</td>
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<td>0</td>
</tr>
<tr>
<td>5</td>
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<td>1</td>
<td>0.5</td>
</tr>
<tr>
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<td>10</td>
<td>Native Grass</td>
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<td>0</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>6</td>
<td>11</td>
<td>Reed Canary</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
<td>Native Grass</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>13</td>
<td>Buckthorn</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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</tr>
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<td>15</td>
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</tr>
<tr>
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</tr>
<tr>
<td>10</td>
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</tr>
<tr>
<td>10</td>
<td>19</td>
<td>Giant Ragweed (invasive)</td>
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</tr>
<tr>
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<td>20</td>
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</tr>
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<td>Dogwood</td>
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<td>0</td>
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<td>0</td>
</tr>
</tbody>
</table>

4. Ticks collected from all sites per plant, July 22nd to 29th.

<table>
<thead>
<tr>
<th>Plant</th>
<th>July 22nd</th>
<th>July 25th</th>
<th>July 29th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honeysuckle</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Buckthorn</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Native Grass</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cattails</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Reed Canary</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Native Grass</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Phragmites</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Garlic Mustard</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Purple Loosestrife</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Native Herbaceous Plants</td>
<td>0</td>
<td>0</td>
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</tr>
</tbody>
</table>

Author Reflection

My participation in the SURE program and the Invasive Species Working Group opened up a whole new world of research opportunity for me. I was challenged to be independent in all aspects of my research; researching the literature, developing methods, interpreting data, and presenting my work to others. Though I did not collect many ticks to make definitive conclusions, I still learned all the essentials of research and how much effort and commitment is necessary to complete a novel, independent research project. I presented my research at the Wisconsin Earth and Water Conference at UW-Whitewater and at the Midstates Conference in St. Louis. As any dedicated researcher will confirm, conferences are probably the largest payoff of research, and I took in more in those conferences as a presenter than I ever would have thought. My SURE research led me to pursue independent research over the school year as well as REUs at other schools over the summer. The SURE program and all of its benefits inspired me to continue innovative research as well as make higher goals for myself and my academic future.

References


Myelination Deficit in the Temporo-Parietal Region and the Biological Basis of Dyslexia

By Joscelyn Stefanek

Reading is an important ability for professional and social performance in the modern world. This literature review investigates the studies, which linked reading ability to subtle fiber tract pathways in the temporo-parietal region. The works of Klingberg et al. (2000), Nagy et al. (2004), Beaulieu et al. (2004), Deutsch et al. (2005), and Yeatman et al. (2012) investigated the pathways in comparison to patients with dyslexia. These studies used diffusion tensor imaging that measured fractional anisotropy and myelination during a performance of reading assessment tests. It was observed that increased myelination in these fiber tracts was positively correlated to reading performance. These researchers were able to isolate regions of decreased myelination that are imperative for reading ability; however, the precise significance and function of these fiber tracts remain uncertain. Though fiber tract sections varied across the cumulative works, the positive correlation of fractional anisotropy and reading performance in the temporo-parietal region was supported. These studies provided insight on the biological basis of dyslexia and portrayed a framework for future studies that would enhance learning techniques for individuals developing this vital skill.

Throughout the preceding century, dyslexia has been studied using a comparative anatomical process. The data collected through these studies before the 2000s gave early suggestion that separate regions of the brain might be involved in distinct components of reading ability (Poldrack et al., 2004). After the invention of diffusion tensor imaging (DTI), a technique utilized in magnetic resonance imaging (MRI), the specific magnitude and direction of water diffusion could be viewed in three dimensions (Klingberg et al., 2000). This type of measurement is called fractional anisotropy (FA). This measurement maps out the amount of myelination of an axon versus water movement perpendicular to the direction of axons blocked by the myelin sheath (Deutsch et al., 2005). A higher anisotropy would indicate a unified direction, which suggests increasing white matter. A lower anisotropy would indicate a decrease in a unified direction, thus lower myelination of the axon. This is due to FA being affected by how coherently oriented the myelinated axons are within each section of MRI being measured (Klingberg et al., 2000). DTI allowed neuron myelination to be mapped versus relative activation, which a routine MRI would display. This allowed the measurement of both the location and the nature of any white matter region associated with poor reading ability to be evaluated dually (Klingberg et al., 2000). The invention of DTI allowed studies of dyslexia to exponentially increase within the past decade and alleviate mixed results in the early anatomical studies that only examined regional functioning. DTI enabled the actual myelination of voxels to be measured during stimulation alleviating ambiguity, which allowed the studies of dyslexia to expand beyond the conflicting theories that the comparative, anatomical
Torkel Klingberg et al. at Stanford University conducted one of the first studies using DTI technique on adults. A group comparison of the data, displayed in Figure 1, suggested that poor readers showed significantly lower anisotropy bilaterally in the white matter of the temporo-parietal region (Klingberg et al., 2000). This relationship was not detected in the conventional MRI images they produced; however, upon normalizing anisotropy values, the regions were displayed. This demonstrated that the anisotropy differences were specific to the micro structural features (Klingberg et al., 2000). This indicated that a direct relationship between myelination and fractional anisotropy was plausible. To determine if this was true for the poor readers, the subjects performed the word identification (ID) test. The Word ID test measured the ability to decode isolated words by requiring subjects to translate visual letter strings to auditory sounds (Klingberg et al., 2000). By completing the test, it revealed a direct relationship of word performance and anisotropy. The data also displayed lower overall anisotropy in poor readers versus the control group as well as a cumulative decrease in reading scores (Klingberg et al., 2000). This possibly indicated that the temporo-parietal was significant to the ability to read. Though Klingberg et al. were able to locate a general region, the correlational data did not explain the environmental or developmental factors that could have swayed the results. The participants were examined in adulthood when most of the pruning process and acquisition of reading were complete; thus, the distribution of correlation coefficients could be negatively skewed.

Further experimentation at Stanford attempted to clarify the ambiguities by replicating the study with children subjects. Similar correlational data were observed regarding myelination and reading performance. In addition to the correlational data, reading-processing time was recorded. A negative correlation, displayed in the data on Figure 2, comparing fractional anisotropy and reading time was observed. This supports the concept that axon thickness and myelination are similar and increase conduction speed of action potential (Nagy et al., 2004). This enhanced the correlation of myelination and axonal thickness. Though the data from the DTI itself did not display environmental factors, it was theorized upon completion that the white matter maturation could have been affected by genetic pre-programming or by natural experience (Nagy et al., 2004). This conclusion made by the study was not compatible with the data provided in the experiment. Inferences regarding children studies would not provide insight to make assumptions about the relative contribution of environmental or genetic factors. If a twin study were conducted versus a general child study, the outlying conclusions from the study would have attempted to be addressed.
implementation that attempted to answer the adaptive mechanisms that could have influenced data presented from the work of Klingberg. For this experiment, the volunteers ranged in age from 8.3 to 12.9 years (Beaulieu, et al., 2005). DTI was utilized to acquire data as well as the Word ID test. Similarly, the study displayed the same temporo-parietal region as well as a positive correlation in regards to fractional anisotropy and performance. This study was able to narrow the region further than Klingberg’s work from the general temporo-parietal region to the superior fronto-occipital fasciculus and the anterior internal capsule. Though the regions were narrowed, the study was unable to determine the relative contribution of genetic and environmental factors on this relationship. The correlation, displayed in Figure 3, of an increased myelination, axonal density, tissue microstructure, and the relationship to water diffusion was not fully understood (Beaulieu, et al., 2005). The study suggested investigating cholinergic neurotransmission as a promising direction for an attempt to clarify the nature of those factors (Beaulieu, et al., 2005). It was suggested that the a more unified tissue structure, with a significant amount of white matter, would be more efficient in sending action potential to other brain regions; however, the precise regions in the work of Beaulieu et al. assumed this relationship rather than affirmed the correlation. Though ambiguity remained in the environmental factors regarding the correlation of myelination and reading performance, the relationship of the temporo-parietal in regards to the ability to read was increasingly affirmed.

![Figure 3: Beaulieu et al. Correlational Data of FA Versus Word ID Scores (*p<0.05)](image)

The research of Gale K. Deutsch, and other colleagues, expanded on the DTI imaging of children and data regarding developmental mechanisms in the temporo-parietal region. A positive correlation, displayed in Figure 4, of fractional anisotropy to reading performance was also supported; however, the deviation from the mean was much wider. The higher deviation from the mean in the child study indicated that the pruning process might not have taken maximum effect yet. This was shown in the data regarding the coherence index (CI), which measures the speed and rapid naming ability. It was important to note the time-sensitive processing possibly was facilitated by increased connectivity while rapid naming is a timed measure of information retrieval and automaticity (Deutsch et al., 2005). Thus, it was inferred that the increased anisotropy, axonal organization, and fiber coherence contributed to an increase in the efficiency of processing (Deutsch et al., 2005).

![Figure 4: Deutsch et al. Correlational Data of FA Versus Basic Reading Composite Scores (*p<0.05)](image)

Though the experiments up to Deutsch et al. data displayed the environmental factors over a set period of time, they did not take into account the actual developmental processing that occurs from childhood into adulthood. Pruning is a neurological regulatory process, which facilitates change in neural structure by reducing the number of neurons leaving more efficient synaptic configurations (pruning process). This process occurs over an individual’s lifetime and allows a person to develop strong neural connections. The precise number of neurons and synapses varies per individual. The smaller deviation in the correlational data of Klinger et al. suggested the adaption to
the inability and other synaptic processing that could have developed to alleviate the inhibition in improving the reading skill. In regards to the Deutsch et al. child study, the deviation was wider. This could have been due to less rehearsal of synapses rather than in the early stages of learning how to read. Comparing deviations from both Deutsch et al. and Klinger et al., it can be inferred that the smaller deviation from adulthood is due to consistent rehearsal and pruning, while the larger deviation in childhood is due to the reduced pruning period in occurrence. Cross-analyzing the data from both experiments displays a trend that environmental contributions rationalized, but was not inferred upon each individual experiment that Deutsch et al. or Klinger et al. contributed. To alleviate the ambiguity regarding environmental factors that individual DTI experiments possess, a longitudinal study could be conducted to measure the environmental influence over a set period of time.

The work of Jason D. Yeatman and other partners attempted to explain the environmental factors by conducting a longitudinal study, which examined the development of white matter fascicles and reading processing formation over a period of time. The child study measured the white matter development from volunteers at the age of seven to twelve years for the duration of three years. The study focused on the myelination of the left articulate and the inferior longitudinal fasciculus (ILF). The study inferred that the rate of development of the myelination was positively correlated to the basic reading standard score. The trend, displayed in Figure 5, displayed the above-average readers begin at a considerably lower FA in the left articulate and left ILF while FA increased over time (Yeatman et al., 2012). It was also inferred that below-average readers started at substantially higher FA in the left articulate and ILF while FA decreased over time (Yeatman et al., 2012). This cross-sectional DTI, displayed in Figure 6, outlined the average developmental trajectory for a vast majority of the major fascicles (Yeatman et al., 2012). Though, the study displayed a trend regarding myelination development and the impact of experiences, it did not account for the biological variability for the rate of growth in accordance to pruning. The individual variability in these processes might contribute to variations in cognitive development, which may include the reading ability. Even with the considerable limitations, the longitudinal study of Yeatman et al. enhanced the understanding of the coupling occurring between active developmental processes in the white matter and the cognitive development.

Though the cumulative works throughout the past decade provide insight for reading development, the precise regions that are critical for reading remain ambiguous. Klingberg et al. originally suggested the region was broadly the temporal parietal region. Supplementary works of Beaulieu and other colleagues emphasized small clusters in the anterior callosal tracts, the superior fronto-occipital fasciculus and the anterior internal capsule (Ben-Schachar et al., 2007). The work of Yeatman et al. suggested that the central regions are the left-hemisphere articulate fasciculus and inferior longitudinal fasciculus (ILF) that carry signals important for reading (Yeatman et al., 2012). The articulate fasciculus is a fiber tract region that connects the posterior inferior frontal cortex, which includes Broca’s area, and the lateral temporal cortex, which contains Wernicke’s area (Yeatman et al., 2012). This region is important for the phonological awareness, which is vital to the development of reading ability. The ILF is the primary pathway that carries signals between the occipital lobe as well as the anterior, medial, and inferior temporal lobe (Yeatman et al., 2012). A portion of this region projects the visual word form area (VWFA) in the occipital temporal...
sulcus, which is essential to see words (Yeatman et al., 2012). A chart summarizing the cumulative regions is displayed in Table 1. Though many regions were narrowed, the degree to which each region’s significance is ambiguous and varied for each experiment. Thus, understanding the developmental myelination factors, in regards to reading processing, has yet to be completely understood.

The research throughout the past decade using DTI technique has provided insight in the biological functioning of the white matter regions involved in inhibiting development of reading ability. Though the precise regions remain ambiguous, the correlation of fractional anisotropy, myelination, and axonal voxel direction for reading performance remains supported. Further experimentation may inform the debate as to which pathway is more significant residing in the temporo-parietal. Furthermore, additional experimentation would enhance understanding of the developmental factor regarding myelination and the reading skill. Despite the fact that the fiber tracts of the region are not completely understood, research agrees that decreased myelination is correlated to an inhibition in reading ability.

The cumulative efforts throughout the past decade provided insight for the development of the ability to read; however, discrepancies in the studies were present. Theoretical explanations may provide additional insight to a probable limitation that could have influenced data. The methodological limitation of DTI processing further explains the probable events that could have skewed the normalization data in the experiments.

DTI processing has been a growing technique for voxel orientation; however, methodological limitations of voxel FA analysis prevent specific regions from being completely understood. The statistical power of FA tests varies depending on the white matter region (Ben-Schachar, Dougherty, & Wandell, 2007). For the regions in relation to dyslexia, DTI processing has a low statistical power for a FA statistic (Ben-Schachar, Dougherty, & Wandell, 2007). This is due to the large differences in the shape across people that are not entirely corrected by spatial normalization methods (Ben-Schachar, Dougherty, & Wandell, 2007). Therefore, data retrieved from DTI analysis increase the probability of FA differences when relating the brain regions across individuals. This is due to DTI processing preventing some white matter fascicles from being detectable (Ben-Schachar, Dougherty, & Wandell, 2007). DTI also provides ambiguity for the specific functionality of the gray-matter regions surrounding the voxel FA analysis. This is due to the DTI only displaying fractional anisotropy, which does not explain functionality of each region being measured.
In essence, DTI processing provides insight to myelination and axonal direction, but not in the functionality of the regions vital to understand reading ability.

Conclusions and Future Studies

Understanding the biological nature and development for the fiber tracts connecting the language pathways involved in reading would enhance the treatments that would assist those with dyslexia to improve their reading skill. With increasing knowledge of the nature of these primary regions, medications, teaching techniques, and activities could be developed to enhance the ability of individuals to develop this skill. In order to gain sufficient understanding of these fiber tracts, it is necessary to conduct a study that examines the structural and functional aspects of the temporo-parietal in relation to reading performance. This includes, but not limited to, a longitudinal-based study measuring the myelination development of each significant fiber tract, axonal activation of the primary regions to examine function, and varying assessment tests to measure orthographic, phonologic and speech production concepts of reading ability. A combined “structural, functional and computational model” (Ben-Schachar, Dougherty, & Wandell, 2007, p.268), would be ideal in supplementary studies of dyslexia. In whole, an eclectic examination would enhance the understanding regarding the development of reading and the molecular functionality of the primary regions that assist in its development (Beaulieu, et al., 2005).

Author Reflection

The research for this literature review was prompted from the overall question as follows: What processes in the brain (or lack there of) lead to an inability to read? In pursuit of possible explanations for this question, I struggled initially locating possible explanations. After a week of searching, I stumbled upon the article published by Patoine in 2008, which began to spark the correlation of myelination deficit in the temporal parietal region and dyslexia. I found myself immediately glancing at the author’s references section, which surprisingly contained many of the journals I read and cited in my literature review. The article became the main piece of writing that ignited my journey, which led to the ultimate creation of this literature review as a whole.

Throughout my journey towards this publication, the answer to my initial question was not completely answered. This ambiguity inspired the possible experimental designs, which I cover in my discussion section. In the future I would like to participate in my own research that could possibly shed light on reading ability deficits. This literature review I consider a “stepping stone” for my future career as a Neuroscientist as well as a scholarly work that enhanced my understanding of the mysteries of the neurological pathways that influence how humanity functions.

References


ration of white matter is associated with the development of cognitive functions during childhood. Journal of Cognitive Neuroscience (16:7), 1227-1233.


Yeatman, JD. Dougherty, RF. Ben-Schachar, M. Wandel, BA. (2012). Development of White Matter and Reading Skills. PNAS.
The Effects of Idealized Media Images on Body Dissatisfaction in a Nonclinical Population

By Lauren Burleson

Differences in the impact of idealized media images on individuals within a nonclinical population of males and females were measured through the utilization of the Body Satisfaction Scale (BSS), Sociocultural Attitudes Towards Appearance Scale (SATAQ-3), Eating Attitudes Test (EAT) and Drive for Muscularity Scale (DFMS). Females had statistically higher mean body dissatisfaction scores, and pressure, internalization, and information subscale scores than males. Additionally, there was a significant positive correlation between body dissatisfaction score and behavior score for females only. It was also found that men engaged in weight-management behaviors characterized by a “drive for muscularity” as opposed to females who engaged in behaviors that are thought to help individuals lose the most amount of weight in the shortest amount of time. The hypotheses derived from the compilation of the sociocultural theory, objectification theory, and social comparison theories were generally confirmed.

Researchers have conducted many studies regarding eating disorders and negative body image; these studies claim that exposure to the mass media is to blame for the increase in eating disorders and lack of body satisfaction in today’s society (Grabe, Ward, and Hyde, 2008). Body dissatisfaction is a primary risk factor for eating pathology and negative weight-management behaviors (Corning, Krumm, and Smitham, 2006). The definition of body dissatisfaction refers to dysfunctional ideals and negative feelings towards one’s body shape and weight (Garner, 2002). Body dissatisfaction develops from many factors; however, a major component is the mass media because researchers found that exposure to the mass media leads to increased feelings of body dissatisfaction (Groesz, Levine, and Murnen, 2002). The prevalence of eating disorders is about 1-4% of the population (Ekern, 2013), body dissatisfaction is more common, affecting over three-fourths of women in college (Spitzer, Henderson, and Zivian, 1999). Due to this statistical disparity, it is more crucial than ever to study related constructs (Myers and Crowther, 2009).

While the current literature is focusing on males, there is room for improvement in the literature regarding the comparison of the mass media’s impact on males and females. Therefore, this thesis investigates the differences in the impact of idealized media images on those within a nonclinical population of males and females to clarify the different ways in which the media targets each gender. The hypotheses were derived from a compilation of the sociocultural, objectification, and social comparison theories.

Literature Review

Becker, Burwell, and Gilman (2002) conducted a study that contributed to the development of the relationship between media exposure, body dissatisfaction, and disordered eating. Becker and coworkers (2002) examined the prevalence of eating disorders in Fiji before and after television was brought to the island. Historically, Fijians exhibited preferences for curvaceous body types and healthy diets because it signified wealth and the
ability to manage and provide necessary care for one’s family (Becker and Hamburg, 1996). Therefore, with there being a strong cultural identity on the island, only one case of anorexia nervosa was known of before 1995 (Derenne and Beresin, 2006). However, after television was brought to the island, rates of engagement in dieting behavior went from 0 to 69%, and the appearance of attractive actors on television was self-reported to be the reason why (Becker et al., 2002). This study offered foundational evidence for a correlation between media exposure and corresponding disordered eating and body dissatisfaction.

**Differences of Males and Females**

While the positive correlation between media exposure and disordered eating behaviors is supported extensively (Levine and Harrison, 2004; Cohen, 2006), there is still a growing reason for concern, especially with the fact that individuals as young as seven years old across varieties of race and natural body shape are reporting negative body perceptions (Dohnt and Tiggemann, 2006). Numerous studies validated this correlation; however, males were left out for far too long. Formerly thought to be only a “female problem,” the media is beginning to target males, and researchers started investigating the growing trend of male eating disorder development (Hargreaves and Tiggemann, 2009). There is research supporting the idea that the media is targeting males as much as females, but in a different way, possibly leading to differences in level of body dissatisfaction.

Formerly thought to be only a “female problem,” the media is beginning to target males, and researchers started investigating the growing trend of male eating disorder development (Hargreaves and Tiggemann, 2009)

Cohen (2006) conducted a review of the current research in regards to media exposure and its effects on body dissatisfaction and disordered eating. Looking at male and female comparisons, Cohen (2006) found that “females are more susceptible to these media effects than are males” (p. 68). While this was previously true, Farquhar and Wasyliw (2007) argued that men are now engaging in appearance-based evaluations of self-worth. Therefore, their body dissatisfaction rates are increasing because they are comparing themselves to media ideals. In other words, “men who believe they do not fit the current ideal may be compelled to behave in ways consistent with achieving that ideal...[and] may engage in unhealthy lifestyle approaches that can lead to a range of negative outcomes” (Hobza and Rochlen, 2009, p. 120). This idealized media image that males are bombarded with, and therefore compare themselves to, is a lean, muscular individual with low body fat (Leit, Pope, and Gray, 2001). For females, the “ideal” body type is demonstrated as tall, extremely thin, and little to no body fat (Leit et al., 2001). This is where the media differs in regards to males and females—it is gender specific and targets each one in a unique way.

**Similarities of Males and Females**

Despite the fact that the media caters to each gender differently, the physical and psychological consequences of body dissatisfaction are the same for everyone. For example, body dissatisfaction, which affects both genders, is seen as a precursor to eating disorder development. Therefore, while eating disorders are still more common among females, men are estimated to account for 10-15% of the anorexic and bulimic population (Anorexia Nervosa and Associated Disorders, 2013). Additionally, body dissatisfaction is thought to lead to the engagement in negative behaviors to aid with weight loss and/or muscle development, such as calorie restriction, over-exercise, dieting, using steroids, and smoking (Pope, Phillips, and Olivardia, 2000; Botta, 2003). More specifically, 3.3% of surveyed men performed binge-eating behaviors during their lifetime (Garfinkel et al., 1995), and 5.4% of male adolescents were dependent on exercise (Ricciardelli and McCabe, 2004). Women have also been found to engage in negative behaviors to aid with weight-management. For example, French, Perry, Leon, and Fulkerson (1995) conducted a study in which respondents reported that 11.6% did not eat three meals a day, 5.4% were taking diet supplements, and 4.4% were purposefully vomiting after meals. Furthermore, Thomsen, Weber, and Brown (2002) found that the “two most common adolescent dieting methods [are] restricting calories and taking diet pills” (p. 1). Due to these findings, it is not solely eating disorder development that is of concern with body dissatisfaction; it is instead a group of negative behaviors that can lead to physical and psychological problems regardless of whether or not a diagnosable eating disorder is developed.
The sociocultural model of disordered eating has achieved a lot of support over the years in regards to its application in explaining eating pathology. In other words, sociocultural factors are considered paramount in relation to other variables thought to promote disordered eating (Thompson, Heinberg, Altabe, and Tantleff-Dunn, 1999). Sociocultural theory is now commonly referred to as the “tripartite influence model” due to the fact that the theory states women’s beauty ideals are primarily developed and reinforced based on three contributing factors: family, peers, and the media (Shroff and Thompson, 2006).

In other words, sociocultural factors are considered paramount in relation to other variables thought to promote disordered eating (Thompson, Heinberg, Altabe, and Tantleff-Dunn, 1999)

It is ingrained in women from a young age that appearance is extremely important in regards to how they are treated and respected within society. In fact, “women learn that their worth is equivalent to their appearance” (Tylka and Sabik, 2010, p. 18). Furthermore, as women grow and mature, these beliefs are strengthened to the point of internalization, which is one of the “two primary processes by which sociocultural influence translates to body discontent” (Slevec and Tiggemann, 2011, p. 618). Internalization can vary person to person, depending on how much the individual is exposed to cultural norms, and therefore, how much they believe in them. Internalization of the societal standards of beauty is required for there to be resulting feelings of body dissatisfaction, or body discontent (Thompson and Stice, 2001). The second process by which body dissatisfaction arises based on the sociocultural theory is social comparison.

Social comparison theory. Social comparison is one of the primary ways through which individuals gather information about their personal level of attractiveness. It is believed that when the comparison yields unfavorable results, body dissatisfaction occurs (Tantleff-Dunn and Gokee, 2002). Festinger (1954) developed social comparison theory, which states that individuals wish to know where they stand in life, and therefore, seek out individuals or societal standards to which they are able to compare themselves. Even though the social comparison theory proposes that individuals are most likely to compare themselves to others similar to them, they also compare themselves to the unattainable, extremely thin, idealized media images of women (Engeln-Maddox, 2005; Strahan, Wilson, Cressman, and Buote, 2006). In other words, “unrealistic societal beauty ideals... provide widely accepted standards by which individuals can compare and evaluate their own appearance” (Hargreaves and Tiggerman, 2009, p. 109). This theory addresses engagement in both upward and downward comparisons, with upward comparisons being to someone or something that is perceived as better than oneself, and downward comparisons being to someone or something that is perceived as worse off than oneself (Festinger, 1954). Upward comparisons are thought to lead to negative consequences in individuals’ self-esteem because they encourage disparity between one’s current self, and one’s ideal self. Downward comparisons, however, are thought to lead to positive consequences in regards to self-esteem because they reinforce the idea that the individual is better than their target of comparison (Festinger, 1954).

Women often refer to the idealized images they see in the media or idealized women in their families or peer groups for comparison to see where they fall on the appearance scale. More often than not, due to its unattainable stature, women do not perceive themselves as physically good enough in comparison. Therefore, females engage in upward social comparisons (Dittmar, 2005). Additionally, women do not solely compare themselves to these ideal standards, but also extend this comparison process to other women in their life, evaluating their worth based on the extent to which they resemble their internalized image of beauty (Tylka and Sabik, 2010). However, while other means of comparison are incorporated within social comparison theory, this thesis will focus solely on the comparison to idealized media images.

More often than not, due to its unattainable stature, women do not perceive themselves as physically good enough in comparison

While the media is starting to influence men to a greater extent, males have not surpassed women in regards to the amount of social comparison they engage in, but it is believed they engage in more downward comparisons, increasing their self-esteem (Strahan et al., 2006), and thus do not experience as many negative consequences as females (Myers and Crowther, 2009). There-
fore, the “effect for social comparison and body dissatisfaction was stronger for women than men” (Myers and Crowther, 2009, p. 683). This is not to say that men cannot, or do not, engage in upward comparisons; instead, it demonstrates that women especially fall prone to engaging in upward social comparisons due to sociocultural influences and objectification.

While social comparison can negatively impact men, it is important to note when discussing this difference that the target of comparison for men may be the opposite of females (Karazsia and Crowther, 2008). The comparisons made by males are thought to be related to a drive for masculinity in that they seek out those with a muscular build to compare themselves to (Morrison, Morrison, and Hopkins, 2003). The differences between males and females in regards to social comparisons and correlating body dissatisfaction are investigated through this thesis by comparing male and female self-reports about media exposure and body dissatisfaction.

Myers and Crowther (2009) conducted a study which yielded an effect size of 0.77, supporting the theory that engaging in comparison on the basis of appearance is related to an increased amount of expressed body dissatisfaction. This study also supported gender being a moderating variable within social comparison theory; alternatively stated, “there was a stronger relationship between social comparison and body dissatisfaction for women than men” (Myers and Crowther, 2009, p. 691). These findings are also consistent with the tripartite model, as previously mentioned. This connection between social comparison theory and sociocultural theory opens the door for a third contributing theory—objectification theory.

Objectification theory. Integrating social comparison theory and sociocultural theory with the objectification theory opens the door for a broader understanding of the underlying mechanisms that make women more susceptible to upward comparisons as opposed to men. Objectification theory revolves around the idea that women experience sexual objectification. Sexual objectification is the idea that women are seen as a compilation of individual body parts; therefore, their inner qualities are not considered as meaningful as their physical qualities in determining their level of attractiveness (Bartky, 1990). There are two processes through which sexual objectification most commonly occurs: media outlets and social encounters with peers (Fredrickson and Roberts, 1997). When women experience sexual objectification in these ways, they are more likely to internalize "society's view that it is acceptable to focus on the appearance of all women, not just themselves" (Tylka and Sabik, 2010, p. 20). Therefore, women will compare themselves to the idealized standards of appearance set forth by society and other women in society. This component of objectification theory leads directly into social comparison theory in that individuals seek out targets of comparison to help them determine where they fall in specific areas of their life. Thus, objectification theory contributes to the idea of women engaging in more upward comparisons because women are socialized to believe that appearance is extremely important (Stice, Spangler, and Agras, 2001). It is important to note, however, that this thesis focuses on women’s upward comparisons to idealized media images, therefore, solely emphasizing the first process through which sexual objectification can occur.

"There are two processes through which sexual objectification most commonly occurs: media outlets and social encounters with peers"
(Fredrickson and Roberts, 1997)

It is useful to examine Tylka and Sabik's (2010) model to understand the integration of objectification and social comparison theory (refer to Appendix A). Within the model, the connection between sexual objectification and body surveillance primarily occurs. Body surveillance refers to the shift in women to “treat their bodies as object[s] to be looked at and evaluated” (Tylka and Sabik, 2010, p. 20). This shift occurs because of the internalization that women experience due to repeated exposure to objectification via the mass media and encounters with peers. Specifically, these encounters with peers offer “appearance feedback,” which can include weight commentary about a woman’s size and shape (Tylka and Sabik, 2010). Appearance feedback is found to be a main form of sexual objectification because it encourages women to see their bodies as determinants of their personal value and self-worth (Tylka and Hill, 2004). As women experience an increase in body surveillance, they will begin to engage in body comparisons, mirroring social comparison theory to determine where they fall on the appearance spectrum. The result of body comparison is body shame. This is because, as previously mentioned, women engage in more upward comparisons, and in doing so, “their bodies fail the beauty test” (Hesse-Biber et al, 2006, p. 212). This “failure” results in distress in regards to their physical appearance and encourages engagement in negative weight-management behaviors and disordered eating, the final stage in
Tylka and Sabik’s (2010) proposed model. Through the application of sociocultural, objectification, and social comparison theory, the analytical frame for this thesis is mediated actors, focusing on the gender differences in response to idealized media images.

**Hypotheses**

Based on current research findings, females should experience higher levels of body dissatisfaction resulting from the media than males. The shared assertions of sociocultural, objectification, and social comparison theory support this in saying that women feel more socialized and cultural pressure to resemble idealized media images. Therefore, women internalize the idealized images they are repeatedly exposed to and constantly comparing themselves with because of increased body surveillance.

Additionally, it is expected that level of body dissatisfaction will predict engagement in negative weight-management behaviors for females but not males because they engage in upward comparisons which produces feelings of inferiority and leads to a reaction of needing to change one’s appearance through the use of negative weight-management behaviors. However, engagement in downward comparisons creates feelings of superiority, leading to a sense of security and no need to change one’s appearance.

Finally, it is expected that females will engage in negative weight-management behaviors that focus on losing the most weight in the least amount of time, while males will engage in negative behaviors that focus on a drive for muscularity. Therefore, this thesis will examine both male and female engagement in negative behaviors by comparing them in order to expand the current knowledge base of differences and similarities between male and female body dissatisfaction and disordered eating patterns.

In summary, there were three main hypotheses established for this thesis. First, females will have statistically higher mean body dissatisfaction scores, pressure, internalization, and information subscale scores than males. The pressure aspect of the media refers to whether or not an individual experiences feelings of pressure from different forms of media. The internalization aspect refers to whether or not an individual utilizes the media as a means of comparison. The information aspect refers to whether or not an individual believes the media is a good source of information in regards to dieting, weight loss, and weight-management. Second, there will be a significant positive correlation between body dissatisfaction score and behavior score for females, but not for males. Third, it will be found that males engage in more negative weight-management behaviors characterized as a “drive for muscularity,” while women engage in more behaviors that will help them lose the most weight in a short amount of time. These hypotheses contribute to establishing this thesis’ frame of mediated actors, specifically gender variations in response to idealized media images.

**Method**

**Participants**

This study will employ a multivariate, deductive research approach. In order to obtain participants, two psychology professors were asked permission to have the thesis survey administered in their classes. Overall, two Introduction to Psychological Science classes were surveyed. Additionally, an e-mail was sent out to the Carthage College student body to aid in obtaining a representative sample of the Carthage College student population. Overall, there were 197 participants for this study. The sample was comprised of 45 males and 152 females of which 94 were freshmen, 37 sophomores, 36 juniors, and 30 seniors. While 197 participants completed the survey, only 191 were used in data analysis. This is because the population of interest is one of nonclinical individuals, and six participants indicated they had not successfully recovered from a current eating disorder. The sample, therefore, was comprised of 45 males, and 146 females of which 93 were freshmen, 35 sophomores, 35 juniors, and 28 seniors. Informed consent was obtained from the participants through a disclaimer placed on each survey indicating that completion of the survey implied informed consent and the allowance to use their responses solely for data collection purposes. The Carthage Institutional Review Board approved this study prior to survey administration.

The limitations of the methodological approach for this thesis include the representativeness of the sample. The gender disparity (45 males and 146 females) was difficult to control for because of the convenience/voluntary surveying process. The consequence of this is a lower level of confidence about generalizing the findings of this study to a larger population of males. The sample is also comprised of solely Carthage College students. Therefore, the researcher needs to be aware of the consequences involving the external validity of the findings.

**Materials**

For this project, no special equipment or room was used. The typical classroom setting was utilized for
paper administration of the survey, and the Internet (Google Forms) was used to administer the electronic copy of the survey via e-mail. The survey that was used included four components: the Sociocultural Attitudes Towards Appearance Scale (SATAQ-3), the Body Satisfaction Scale (BSS), behavior based questions from both the Eating Attitudes Test (EAT) and Drive For Muscularity Scale (DFM), and self-designed questions. All of these surveys were obtained publicly via the Internet. The self-designed questions were added to obtain demographical information, ascertain that the sample was undiagnosed, or fully recovered from an eating disorder, and to allow participants to openly comment on the study and their experiences with the mass media in regards to body image and body dissatisfaction. The SATAQ-3, BSS, EAT, DFM and self-designed questions were all combined into one survey for easier administration. A copy of the administered survey can be found in Appendix B with the specific SATAQ-3 subscale, BSS, EAT, DFM, and self-designed questions labeled.

Design

The survey used consisted of nominal and ordinal responses. The demographic and self-designed questions required nominal responses, while the SATAQ-3, BSS, EAT, and DFM required ordinal responses. The self-designed questions were all yes and no questions. When analyses were conducted, these responses were coded as a "Yes" response being a 1 and a "No" response being a 2.

The BSS used a Likert scale format ranging from 1-5, with 1 being "Extremely Satisfied," 2 being "Mostly Satisfied," 3 being "Neutral," 4 being "Mostly Unsatisfied," and 5 being "Extremely Dissatisfied." This coding corresponds with a high score on the BSS, indicating a high degree of body dissatisfaction. This portion of the survey was used to determine Body Dissatisfaction Score (BDS).

The SATAQ-3 also used a Likert scale format ranging from 1 to 5, with 1 being "Definitely Disagree," 2 being "Somewhat Disagree," 3 being "Neutral," 4 being "Somewhat Agree," and 5 being "Definitely Agree." It is subdivided into four subscales: pressure (questions 2, 6, 10, 14, 18, 22, 26), internalization-athlete (questions 19, 20, 23, 24, 30), internalization-general (questions 3, 4, 7, 8, 11, 12, 15, 16, 27), and information (questions 1, 5, 9, 13, 17, 21, 25, 28, 29). The internalization-athlete questions were removed from the survey due to their irrelevance to the research question. It is important to note that the SATAQ-3 also had seven questions that were reverse-keyed to enhance validity and reliability; on the created survey, these are questions 3, 6, 9, 12, 13, 23, and 24. The Likert scale coding indicates that a high score on each subscale represented feeling highly pressured by the media, internalizing the media's perception of beauty, and seeing the media as a good source of dieting and weight-management techniques respectively. This portion of the survey was used to determine Drive for Muscularity Score (DFMS) and Eating Attitudes Test Score (EATS).

The behavior-based questions selected from the EAT were also coded using a Likert scale format ranging from 0-5 with 0 being "Never," 1 being "Rarely," 2 being "Sometimes," 3 being "Often," 4 being "Very Often," and 5 being "Always." This coding corresponds with a high score on the behavior-based questions, indicating a more frequent engagement in negative weight-management behaviors. This portion of the survey was used to determine Drive for Muscularity Score (DFMS) and Eating Attitudes Test Score (EATS).

There were two versions of the survey—a paper copy and an electronic copy. The paper copy was used for classroom administration, and the electronic copy was used to obtain participants from outside of classes via the Internet. The electronic copy was created using Google Forms and was made accessible only to Carthage College students who had the link. When all of the data was coded, Pearson-r bivariate correlations and independent sample t-tests (sex being a quasi independent variable) were conducted in order to test the three main hypotheses.

Procedure

On September 12th and September 18th, two Introduction to Psychological Science classes were administered a paper copy of the survey. The participants were provided background information on the study, the purpose of the study, and instructions for completing the survey. They were also told to be sure to read the disclaimer at the top of the survey before beginning to answer any questions. The surveys were then distributed to each student. Every student voluntarily completed the survey after reading the disclaimer, indicating informed consent. After completing the survey, the participants returned them to the researcher. It is important to note that there were no identifiers that could link specific individuals to specific surveys. In other words, complete confidentiality was maintained throughout the in-person survey process. On September 16th, an e-mail containing the link to the electronic copy of the survey (Google Form) was sent out to all Carthage College students. The e-mail contained the same background infor-
mation, purpose of the study, and instructions for completing the survey that were used to brief the students in the classroom setting. The survey was active for one week. After one week, the link was deactivated and the coding process began.

First, the demographic questions were looked at to see whether any surveys had to be eliminated. Of the sample size (n = 197), six had to be eliminated due to a lack of recovery from an eating disorder. All of the “Yes” responses and “No” responses were coded as 1 and 2’s respectively, while the BSS, SATAQ-3, DFM, and EAT questions remained in their ordinal form for the coding process. In addition to coding these responses, by adding together the numerical response of each question in the Body Satisfaction Scale, each participant’s BDS score was calculated. Through adding together the numerical responses for each question in the corresponding subscale (pressure, internalization, and information), each participant’s PSS, INTSS, and INFSS were also calculated. Finally, by adding together the numerical responses for each question derived from the EAT and DFM scale, each participants’ DFMS and EATS were calculated. After the coding process was completed, the data were entered into the Statistical Package for Social Science (SPSS) program for data analysis.

Results

Analyses focused on participants’ BDS, DFMS, EATS, and SATAQ-3 subscale scores (PSS, INTSS, and INFSS) as coded and calculated after survey administration. Pearson-r bivariate correlations and independent sample t-tests were used for data analyses.

An independent samples t-test revealed that the mean BDS for females (M = 28.01; SD = 7.669) was significantly higher than the mean BDS for males (M = 22.18; SD = 6.024); t(189) = -4.671, p < .001, one-tailed. An independent samples t-test revealed that the mean PSS for females (M = 24.97; SD = 5.973) was significantly higher than the mean PSS for males (M = 17.18; SD = 6.843); t(66) = -6.876, p < .001, one-tailed. An independent samples t-test revealed that the mean INTSS for females (M = 23.00; SD = 5.001) was significantly higher than the mean INTSS for males (M = 18.80; SD = 5.194); t(189) = -4.881, p < .001, one-tailed. An independent sample t-test revealed that the mean INFSS score for males (M = 26.97; SD = 6.157) was significantly higher than the mean INFSS score for males (M = 24.64; SD = 5.236); t(189) = -2.293, p = .012, one-tailed [Table 1, Figure 1].

For females, there was a significant positive correlation found between BDS and BS, r(144) = .233, p = .005 [2]. However, for males, no significant correlation was found between BDS score and BS, r(43) = -.087, p = .568 [3].

An independent samples t-test revealed that the mean DFMS for males (M = 10.51; SD = 5.849) was significantly higher than the mean DFMS for females (M = 6.54; SD = 3.938); t(57) = 4.265, p < .001, one-tailed. An independent samples t-test also revealed that the mean EATS for females (M = 24.64; SD = 5.236); t(189) = -2.951; p = .002, one-tailed [Table 1, Figure 1].

Discussion

Overall, the collected data supported each of the hypotheses. First, females had statistically higher mean body dissatisfaction scores, and pressure, internalization, and information subscale scores than males. Second, there was a significant positive correlation between body dissatisfaction score and behavior score for females, but not males. Third, men engaged in negative weight-management behaviors resembling a “drive for muscularity,” while females engaged in more negative weight-management behaviors driven by the hope of
loosing the most amount of weight in the shortest amount of time. The results of this thesis fit the analytical frame of mediated actors and offer further support for the disparity between male and female reactions to idealized media images.

Females felt more dissatisfied with their bodies than males. They also reported feeling more pressure from the media; however, this does not mean that men are excluded from this category. The extreme pressures that females experienced are due to the differences in the way the media specifically targets each gender. The objectification of women within the media encourages body surveillance and social comparison to occur more frequently for females than males. Again, males also engage in social comparisons but not to the same degree as females. It is internalized within females from an early age that their worth is equivalent to their physical appearance.

Females also had higher internalization subscale scores than males, meaning they incorporated the media’s idealized images into their thought processes. When something is internalized, it becomes a lens through which one views the world. Therefore, through the internalization of the idealized images of the mass media, women now view their reality as needing to resemble those images. Males also reported that they internalize media images but not to the same extent that females do. Also, the images they internalize exhibit a different body shape than the images females internalize, again reinforcing the gender disparity in the media’s impact.

Females also reported that they sought out information from the media relating to dieting, weight-management techniques, and body image more than males. It is possible that this explanation is as simple as the fact that there are more tabloids and fashion magazines directed at females than males. The headline, “Lose 10 pounds in 5 days” may not attract a male because in reality, many men are trying to gain weight through building muscle. However, females, trying to resemble the idealized slender frame, generally jump at this type of headline and buy the magazine.

In terms of negative weight-management behaviors, males tend to engage in different types of behaviors than females. Females are drawn to the behaviors that will help them achieve their goal the fastest. With their goal being a slender, ultra-thin body type, they are more likely to engage in behaviors allowing them to lose the most amount of weight in the shortest amount of time. Women reported engaging in behaviors such as avoiding eating when hungry, avoiding sugary foods, and vomiting after meals. When males do engage in weight-management behaviors, their behavior choices reflect their end goal as well. In striving for a buff, strong, toned body type, they are more likely to engage in behaviors allowing them to bulk up the fastest and gain muscle. Males reported engaging in behaviors such as lifting weights to build muscle and drinking protein shakes. These findings provide continued support for the idea that the media targets both males and females, but each in a different way.

The statistically significant positive correlation between female body dissatisfaction score and female behavior score should be analyzed. Women are impacted by sexual objectification due to sociocultural factors and gender roles. Sexual objectification leads to body surveillance because idealized media images provide appearance feedback. Increased body surveillance leads to social comparison, contributing to feelings of body dissatisfaction because of a failure to meet the idealized standard of appearance. These feelings lead to engagement in negative weight-management behaviors in hopes of alleviating them and mirroring the ideal. This engagement can be so severe that an eating disorder
develops. While this does not happen for the majority of women, it does happen to many, and body dissatisfaction is a key to its development. Additionally, even if an eating disorder does not develop, helping women feel more satisfied with their bodies is still important to improve self-confidence and self-esteem. Men experience a pattern similar to this, yet it is nowhere near the severity and frequency at which females do.

Additionally, the idea that males engage in downward comparisons and females engage in upward comparisons makes the correlation between female body dissatisfaction and behavior score even more clear. Through downward comparisons, men are seeing themselves as superior to their target of comparison, and therefore, do not feel as much of a necessity to change their bodies. At the same time, through upward comparisons, females are seeing themselves as inferior to their target of comparison, further instilling in them the desire to change their bodies.

**Conclusion**

Overall, this study investigated the gender differences in response to idealized media images. In concordance with the sociocultural, social comparison, and objectification theories, females do experience higher levels of body dissatisfaction and a higher frequency of negative impacts from the media. Males do experience negativity from idealized media images; however, the media targets males and females differently in that the media provides each of them a unique body type to strive for. Therefore, the responses of males and females are differentiated based on social standards, the resulting direction of comparisons, and sexual objectification.

It is interesting that despite the large amount of research dedicated to this topic, body dissatisfaction and eating disorders still occur at a high rate. Therefore, pinpointing which aspects of the media seem to negatively impact men and women the most should be a focus of future research. This would narrow the search for what preventative measures need to entail and what treatment programs should focus on. Perhaps the aspects of pressure, information, and internalization of the media should be evaluated to see whether they individually, instead of collectively, have an effect on body dissatisfaction. Through the compilation of these aspects, the mass media established a significant influence as a socializing force, and will continue to have this influence unless more research is dedicated to this topic.

It is suggested that other researchers investigate additional avenues that stem from the main idea of this thesis. This phenomenon begs researchers to answer the question as to why this occurs. Moderating variables of interest are family support, academic achievement, and positive social relationships. Further research should be done in this area in the hope that numerous clinical implications will be found through learning about why individuals do not develop an eating disorder despite feeling dissatisfied with their body.

Another area of future research is that of age. Determining whether or not there is a peak age for when feelings of body dissatisfaction occur would provide numerous clinical implications and beneficial insight into prevention programs. For example, if there is a peak age of 18-24 years old, then implementing prevention programs during this time would be the most effective. Additionally, it would be interesting to see whether body dissatisfaction continues into adulthood and throughout one’s life, or if it is more of a centralized issue only during adolescence and young adulthood.

These research areas pose important implications in the ever-growing multidimensional field of body image, body satisfaction/dissatisfaction, and mass media.

**Author Reflection**

Throughout my undergraduate career at Carthage College, the majority of the research papers I have written have been based around the prevalence of eating disorders and dissatisfaction with one’s body. Therefore, for my Senior Thesis, I wanted to contribute to the existing literature on this topic. The significant disparity between the percentages of individuals that develop an eating disorder over their lifetime and those that experience body dissatisfaction established my foundational interest in further exploring this topic. Additionally, I am in the process of applying to graduate school to obtain a degree in Marriage and Family Therapy, through which I plan to help those suffering from eating disorders with family therapy techniques. While completing these applications, I realized how important undergraduate research is in creating a comprehensive academic program. Conducting a research project enhances students’ critical thinking and problem solving skills, while allowing them the opportunity to learn more about a specific area of interest. It is my belief that undergraduate research opportunities provide students with the knowledge base to continue their education at the graduate school level, making them an integral component of an undergraduate program.
References


Hesse-Biber, S., Leavy, P., Quinn, C. E., and Zonio, J.


Psychology of Women Quarterly, 34(4), 617-627.


Determinants of Emigration:

The Effect of Wealth on Push Factors

By Sebastian Jacinto

Considering that migration is a product of push and pull factors felt by individuals who face varying levels of cost to migrate, and that those costs to emigrate are relative to the wealth of the individual, it serves to ask the question “Are the effects of push factors on emigration rates dependent on wealth levels?”

Looking at various sociopolitical push factors such as religious fractionalization, government effectiveness, and corruption, this study uses Ordinary Least Square (OLS) regressions to investigate the relationships among country wealth level, sociopolitical push factors, and emigration rates. The study uses interaction terms within two sets of cross-sectional OLS regressions to look separately at 200 and 2010, and finds evidence to suggest that wealth does indeed determine how push factors influence emigration rates.

Globalization has been a topic of increasing interest in recent years: the world is becoming more connected, better integrated and more open. Ideas, capital, and people are moving faster and more freely than ever before, and trends suggest no end in sight to this rapid integration. Increasingly, nations find it in their best interest to open up and benefit from this new world. Globalization has become so prevalent that the idea of isolationism has garnered a more and more negative stigma among many. As trade restrictions become more and more unacceptable, capital restrictions are harder to justify. Nations that fail to comply with this new order find themselves at odds with international forces. This trend of integration pushes new questions to the political front where they are debated in a seemingly endless series of arguments, positions, and opinions. With all this discussion and movement of capital, immigration is nevertheless a topic which governments and their people show no qualms about restricting, particularly when it comes to low-skilled labor. Immigration reform looms around the corner for many nations--including the United States, which has a particularly important role as the largest immigrant-receiving nation.

Some attention has been given to the effects of immigration on the hosting country. This spotlight has expanded over the years to include the effects that the emigration population has on the source countries. While these effects are a rather important aspect of the debate, the causes or determinants of migration hold equal significance. Cause and effect are two sides of the same coin, which means that to truly understand the implications of migration on the globalizing world, the determinants of immigration must be given justice.

It is hard to overstate the importance of people flows. The mean world emigration rate (defined as the total amount of emigrants from a country divided by resident and emigrant population of the country) has increased from 4.3% in 1980 to 7.3% in 2010, a 69% increase (Brücker, Capuano, and Marfouk 2013). Nations like Dominica and Tonga
experienced total emigration rates just shy of 50 percent in 2010. This clearly reflects the trend of globalization, as more and more people choose to emigrate from their home countries despite the efforts by many receiving countries to restrict less skilled migration over the same time period. In fact, it should be noted that increase in migration numbers is quite possibly the reason for the implementation of the restrictions. Thus, the estimates of gains from reducing migration barriers should be accounted for. Clemens (2011) compares the estimates of the gains from reducing migration barriers to the gains found from reducing all remaining restrictions on international flows of good and capital. He finds that the elimination of migration barriers is as great as two orders of magnitude larger in economic gains than that found from the elimination of other types of barriers (Clemens 2011). Clemens points out that estimates of other studies show gains from the elimination of trade and capital to amount to less than a few percentage points of world GDP, while the estimated gains from the elimination of migration barriers typically range from 50% to 150%. This gives confirms that the globalization of people is at least as important as the globalization of markets and ideas.

**Historical Background**

The economic debate and theory of people flows has gained popularity only as of late, having never been a major concern for much of human history. No major economic thought on people flows would develop until the rise of the nation state.

Mercantilism didn't have much to say about people flows, for it was of great importance to neither the thinkers of the time, nor to the ruling classes or their people. People flows were largely limited to the exportation of labor to colonies where they would be subjected to work for the mother land. Labor was seen merely as a factor of production to be exported to colonies so that they could increase the riches of the sending country. Labor at home was to be kept working at maximum capacity to produce goods for the state’s benefit, preferably at low wages. For this reason, it could be inferred that there was no economic reason for dissuading immigrants since they would surely bring down the cost of labor. Perhaps sociopolitical tensions kept at bay any immigration that could have occurred. For a variety of reasons, no unifying or comprehensive thought arose.

It wasn't until the rise of classical economics that a theory addressing labor movement was born. Although Adam Smith said little on the matter himself, and what he did say was indirect, he did touch upon labor movements in “The Wealth of Nations” which would lead to the classical theory of migration. His main concern regarding people was the discrepancies in wages in Europe due to the uneven distribution of labor caused by the restrictions on labor mobility. In chapter ten in the wealth of nations Adam Smith writes:

"The policy of Europe, by obstructing the free circulation of labor and stock both from employment to employment, and from place to place, occasions in some cases a very inconvenient inequality in the whole of the advantages and disadvantages of their different employments. (pg116)"

Adam Smith clearly views restrictions on labor mobility as the cause of discrepancies in wages and standards in employment. He explains this reason-
ing by employing his economic thought on the matter earlier in the same book:

If in the same neighborhood, there was any employment evidently either more or less advantageous that the rest, so many people would crowd into it in the one case, and so many would desert it in the other, that its advantages would soon return to the level of other employments. This at least would be the case in a society where things were left to follow their natural course, where there was perfect liberty. (pg 51)

Both thoughts, gave rise to the classical and neoclassical theories of migration. Here, the view is that the main reason for labor movements (both internal and international) is wage differences between the geographic regions. That is to say, labor will migrate from an area of low relative wage to an area of high relative wage in order to take advantage of the increase in relative wage. The lack of uniformity in relative wages is explained in the same manner as Adam Smith first explained it, as being the result of restrictions of labor mobility. Markets for labor are therefore seeking equilibrium, with migration being a force always seeking to reach this state.

This theory on migration was the prominent view until the rise of the New Economics of Labor Migration (NELM) theory. The NELM theory arose during the 1980s as a response to the inability of the neoclassical migration theory to adequately explain migration patterns internationally and, to a lesser extent, internally. The theory has gained popularity and success due to its greater sophistication and adherence to reality. The New Economics of Labor Migration Theory is encapsulated in five ideas as summarized by two of NELM’s major proponents, Stark and Bloom: 1) the emphasis on relative deprivation as a determinant of migration; 2) the emphasis on the household as the relevant decision-making unit; 3) the emphasis on migration as a strategy to diversify risk and overcome market incompleteness; 4) the introduction of information-theoretical considerations in migration theory; and 5) the interpretation of migration as a process of innovation adoption and diffusion (1985, 173-6). It is under this NELM theory that determinants of migration are studied, taking such ideas into account for the construction of the theoretical and regression models.

**Literature Review**

Previous work on the study determinants of migration has been carried by several prominent papers of which “Brain Drain in Developing Countries” has played a major role in expanding the knowledge and understanding of such determinants. As a major study in the field of immigration, the paper has been used as the starting base for many subsequent papers by other prominent immigration economists. Determinants of migration are treated as a two-way process comprised of push and pull factors. Migrants then are induced to move by things that push them away from their home, and things that attract them to their new home. A variable that may be a push factor in the source country may be a pull factor in the hosting country. A good example of this is political stability. A group of migrants may find that the low level of political stability in their home country is dangerously low, and find this insecurity as a push factor. They then will seek a country in which political stability is high, which then makes the variable a pull factor to the hosting country.

**Migration becomes a reality when the combination of push and pull factors produce gains larger than the cost of migration**

The push/pull view is rather intuitive, being applicable to the individual and the aggregate. Even internal migrants operate according to this same model. Migration becomes a reality when the combination of the push and pull factors produce gains larger than the cost of migration. This of course is restricted to those who are not restricted by political forces and who can cover the costs of migration. These costs are relative to the individual, and are
at times impossibly high despite the possibility of higher gains. Furthermore, the stronger or more significant a push factor is, the larger the proportion of the population it affects (Figure 1). Information availability of gains and costs is not perfect, and can at times be an inhibiting factor in and of itself (Stark and Bloom 1985).

It is important to note the nature of the relative cost of migration. The cost of migration is not just monetary but also logistical, cultural and geographic. Costs of migration include the cost of moving away from family and friends as well as the sentimental value found in the geographic location. The cost also includes the cultural disparity one finds when migrating. The larger the culture gap, the larger the cost for the individual. A migrant moving within the western world finds a degree of culture gap; however, a migrant moving from an eastern culture to a western culture will find the culture gap to be much more formidable. This includes language barriers, religious frictions and the general culture shock one must endure from common practices and expectations of a society (Docquier et al. 2007).

Docquier et al. breaks down the determinants of migration into five categories. They are: 1) country size, 2) level of development, 3) sociopolitical environment, 4) geographic proximity, and 5) cultural proximity. Each is measured using several variables. While there is some variation in the categories and classifications among studies of the different factors, the general theme of the five categories listed holds. They break down as follows:

**Country size**

The link between country size and emigration rate is well documented. This link is known as a stylized fact of migration determinants: average emigration rates decrease with country size. This corresponds well with a gravity model: the larger a country is, the larger its pull factor. Thus smaller nations have higher emigration rates than larger ones. Inversely, immigrants are attracted to larger country sizes rather than smaller ones. The gravity model also corresponds well with geographic proximity, which will be elaborated on further on.

**Level of development**

It’s not hard to discern the relationship between
development and emigration rates. Nations with high level of development attract migrants, while nations with low levels push them away. In other words, the level of development is negatively correlated with emigration rates. Thus, the large immigration flows into the United States and other OECD nations can be explained by their high level of development. The reverse is also true: less-developed nations exhibit higher emigration rates.

Sociopolitical environment

The sociopolitical environment is most important at the source country. This category measures social friction. Measurements of the sociopolitical environment include religious and ethnic fractionalization, political corruption, government effectiveness and any other variable which may cause a nation to divide itself in a strong, hurtful or hostile manner.

Geographic proximity

The geographic distance between nations also determines the level of migration between them. Just as the size of a nation is part of the gravity model, so is the distance between them. The further a nation is from another, the less gravity is found between them. To elaborate, large countries possess large gravity, which then attracts migrants from further away. The power of the gravity diminishes the further away it is from the other nation. This is the key to geographic proximity.

Cultural proximity

Cultural proximity refers to the distance between the hosting and source country cultures. The larger the cultural proximity the larger the cultural gap, the larger the cultural gap the larger the cost of migration. Thus closer cultural proximities between source and hosting nations produce higher stocks of migrants. The reverse is also true. The cost to the migrant includes the cultural gap and thus serves as a barrier to would be migrants. Cultural proximity can also be influenced by past colonial ties, which creates a channel of economic and cultural exchanges between the colonizer and the colonized. Accordingly social networks are created and used for migration purposes. Former colonies thus face lower cultural costs to migration to their former colonizer.

The Dependent Variable

Emigration rate

The dependent variable is the emigration rate of the country (i.e. for the unit of observation). The emigration rate is defined and calculated as the total migrant population from a given source country divided by the sum of the migrant and resident population of said country. Data for emigration rates is calculated by aggregating and harmonizing immigration data collected in receiving countries. It is calculated this way since emigration statistics provided by origin countries do not offer a realistic picture of true emigration values (Wickramasekera 2002). Data on emigration rates are assembled from the census of all OECD countries thus deriving stocks and emigration rates for 189 sending country in the year 2000 and for 190 sending countries in the year 2010. The collected information of all migrants in all OECD countries captures the large majority of migration flows, with an estimated accountability of 90% of all high skill international emigrants (Docquier et al. 2007). The figures exclude individuals under the age of 25 in order to eliminate temporary school related migration and those traveling with parents. For the purpose of transforming the range of the emigration rate away from the restriction of being greater than zero but less than one, the emigration rate is used as a logistic transformation when used as the dependent variable, thus expanding the variable range and allowing for easier interpretation of the independent variables.

Regression Methodology

The empirical analysis of the research question is done through the use of Ordinary Least Square (OLS) regressions. The OLS regressions utilize interaction terms to show how wealth levels affect sociopolitical push factors influence on emigration rates. All regressions used for the empirical analysis follow some basic principles discussed earlier in the paper, but expanded upon in this section. The data is in country level macro data. The unit of observation is the country. The regressions are each
run using cross sectional data. All regressions, independent of what year or set the regression is run from, control for the same basic economic forces in accordance to the five explanatory categories of determinants of migration flows.

**Econometric Issues**

The natural restrictions imposed by the nature of the study are categorized into two sections. The first section of restrictions stems from the nature of the determinants of migration flows. The second section is the restrictions imposed by the availability of data.

The first section, restrictions from the nature of the determinants of migration flows, produces two potential problems. The first of these is the potential endogeneity in one of the explanatory variables. The variable in question is the educated proportion of the native population. Some previous studies have treated this variable as endogenous, and others have treated it as exogenous. For the purpose of this study it is treated as an exogenous variable. There are two strong motives for this. The first is that when treated as an endogenous variable, and the regression ran as a two-stage regression using instrumental variables, there are no noteworthy or significant changes in the results as when ran as an exogenous variable. The second motive for this is the complication of running two-stage regressions due to the use of the variable in interaction terms.

A regression seeking to explain labor flows should account for each category as best as possible; often, doing so requires more than one variable per category to capture the “full” picture of economic forces at work.

The second restriction due to nature of the determinants of people flows is the restriction of the usefulness of time series data. Economic literature on the determinants of emigration rates traditionally distinguishes among five categories that encompass the many potential determinants of labor flows. To reiterate, the five categories they are as follows: Country size, level of development, sociopolitical environment, geographic proximity, and cultural proximity. A regression seeking to explain labor flows should account for each category as best as possible; often, doing so requires more than one variable per category to capture the “full” picture of economic forces at work.

Of the five categories, sociopolitical environment and level of development comprise the majority of the push and pull factors that display variation over time. To a lesser extent, cultural proximity also poses variables that are subject to change over time. However, of all the variables subject to change over time, cultural proximity changes the most slowly, often moving so slowly that no significant change can be measured over reasonable time periods in regards to empirical analysis. Furthermore, cultural proximity creates an extra challenge in the quantitative measure of such variable. This makes such treatment of cultural proximity as a time variant variable impractical. On the other hand, the category for country size is considerably easier to measure, as population size is a convenient and readily available quantity. Still, the change in population size is not pronounced enough to produce significant results when treated as a time variant variable over short time periods. Lastly, at the very extreme of time invariant variables is geographic proximity, which poses no change to the value of the variable whatsoever. The large burden of change over time is then left to the sociopolitical environment and level of development categories. The large number of time invariant variables makes time series analysis impractical at the country level macro data. Instead, regression analysis is better suited for cross sectional or panel data.

Another set of restrictions on regression analysis stems from data availability. One specific set of data not available is the working stock of natives by skill for the year 2010 at the time of this study. This data is used to calculate native population and the proportion of post-secondary educated natives. Another key missing data piece is data for the Human Development Index. The data for the HDI is available to use for 2010 data, but is missing for a crip-
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Of the five categories, sociopolitical environment and level of development comprise the majority of the push and pull factors that display variation over time.

Data from both 2000 and 2010 is available for neither wealth variable. This prohibits the use of data from 2000 and 2010 to be used as panel data. Instead, the regression models are restricted to running as cross-sectional data in the two time periods. Of further hindrance is that this change in the wealth variable creates an inconsistency for comparison when comparing results from both sets of regressions across the year 2000 and 2010. Data discrepancy also forces the change of three other variables. The first, which was touched upon previously, is the change of the variable Native Population in the 2000 data to the variable Population in the 2010 data, since native population cannot be calculated without native population stock data, which was unavailable. The next variable forced to change is an indirect consequence of the same data availability problem. The use of HDI forced the change of the Government Effectiveness index to the Control of Corruption Index due to multicollinearity between the HDI and the Government Effectiveness index. Finally, the last variable to change was Religious Fractionalization to Language Fractionalization. This change was also an indirect consequence of data availability, but in an even more indirect form. The Religious Fractionalization variable was chosen as in unison with Government Effectiveness because their behavior together in the regression models helped exemplify each other. Without the inclusion of the Government Effectiveness, however, the variable Language Fractionalization was deemed a better choice to study. This is because religion has inconsistent dividing pressures due to large variations in the degree of difference between religious. For example, the average Buddhist-Hindu separation is closer than the average separation between the Christian-Muslim division. This variance in distance between given religions may thus cause a variance in the degree to which religious fraction-

Figure 2. Step Theory Figure: A graphic that helps facilitate the understanding of economic theory by creating a visual.
Table 1. Regression Models Year 2000 series: first set of OLS regressions.

<table>
<thead>
<tr>
<th></th>
<th>Base Total emigration rate (Logistic transformation)</th>
<th>Alteration 1 Total emigration rate (Logistic transformation)</th>
<th>Alteration 2 Total emigration rate (Logistic transformation)</th>
<th>Alteration 3 Total emigration rate (Logistic transformation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b/se</td>
<td>b/se</td>
<td>b/se</td>
<td>b/se</td>
</tr>
<tr>
<td>Native Population (logs)</td>
<td>-0.1446*** (0.0556)</td>
<td>-0.1281*** (0.0552)</td>
<td>-0.1475*** (0.0553)</td>
<td>-0.1309*** (0.0550)</td>
</tr>
<tr>
<td>Small Island Developing States (UN defined)</td>
<td>0.8914*** (0.2865)</td>
<td>0.8986*** (0.3041)</td>
<td>0.7955*** (0.3018)</td>
<td>0.667*** (0.3116)</td>
</tr>
<tr>
<td>Real Proportion of Post-Secondary educated natives (logs)</td>
<td>0.3286*** (0.1147)</td>
<td>0.6221*** (0.1233)</td>
<td>0.7895*** (0.1768)</td>
<td>0.8743*** (0.1800)</td>
</tr>
<tr>
<td>Oil exporting (UN defined)</td>
<td>-0.7363*** (0.2087)</td>
<td>-0.7053*** (0.2042)</td>
<td>-0.7683*** (0.2061)</td>
<td>-0.7147*** (0.2024)</td>
</tr>
<tr>
<td>Distance from selective immigration countries (logs)</td>
<td>-1.2436*** (0.2544)</td>
<td>-1.2933*** (0.2552)</td>
<td>-1.2931*** (0.2580)</td>
<td>-1.3453*** (0.2621)</td>
</tr>
<tr>
<td>Distance from EU15 countries (logs)</td>
<td>-0.3998*** (0.0960)</td>
<td>-0.3655*** (0.1002)</td>
<td>-0.3738*** (0.0949)</td>
<td>-0.3523*** (0.0985)</td>
</tr>
<tr>
<td>Landlocked Developing Countries (UN defined)</td>
<td>-0.8429*** (0.2683)</td>
<td>-0.7878*** (0.2743)</td>
<td>-0.8058*** (0.2676)</td>
<td>-0.7273*** (0.2749)</td>
</tr>
<tr>
<td>Previously Colonized by an OECD Country (Sending Countries)</td>
<td>1.0551*** (0.2656)</td>
<td>0.9690*** (0.2545)</td>
<td>1.0027*** (0.2682)</td>
<td>0.9126*** (0.2572)</td>
</tr>
<tr>
<td>Government Effectiveness</td>
<td>-0.2355* (0.1315)</td>
<td>-0.6260*** (0.2360)</td>
<td>-0.2435* (0.1290)</td>
<td>-0.6245*** (0.2341)</td>
</tr>
<tr>
<td>Religious Fractionalization</td>
<td>0.5577* (0.3268)</td>
<td>0.5531* (0.3281)</td>
<td>1.5010** (0.6098)</td>
<td>1.5314** (0.6192)</td>
</tr>
<tr>
<td>Interaction Term: Proportion of Post-Secondary Educated Natives &amp; Government Effectiveness</td>
<td>0.0355* (0.0182)</td>
<td></td>
<td>0.0368** (0.0181)</td>
<td></td>
</tr>
<tr>
<td>Interaction Term: Proportion of Post-Secondary Educated Natives &amp; Religious Fractionalization</td>
<td></td>
<td></td>
<td>-0.2319** (0.1018)</td>
<td>-0.2404** (0.1008)</td>
</tr>
<tr>
<td>Constant</td>
<td>10.4180*** (2.7158)</td>
<td>10.3535*** (2.7218)</td>
<td>9.9766*** (2.7503)</td>
<td>9.8335*** (2.7630)</td>
</tr>
<tr>
<td>Observations</td>
<td>142</td>
<td>142</td>
<td>142</td>
<td>142</td>
</tr>
<tr>
<td>R²</td>
<td>0.707</td>
<td>0.715</td>
<td>0.712</td>
<td>0.721</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.684</td>
<td>0.691</td>
<td>0.688</td>
<td>0.696</td>
</tr>
</tbody>
</table>

*p<.10, **p<.05, ***p<.01
alization creates is evaluated as a costly by different populations.

Language fractionalization, on the other hand, creates direct costs to citizens, as it creates barriers for trade, communication, and general transactions. Such costs can become even more deeply rooted as they over time become manifest in general friction between the populations, often also reflecting ethnic fractionalization and religious fractionalization. Therefore, the use of language fractionalization serves as a better measure of sociopolitical costs of the sociopolitical environment for source countries.

**Organization and purpose of the regression models**

The empirical analysis of the research question consists of two sets of Ordinary Least Square regressions categorized by the time period of the data. The first set is created using year 2000 data; the second uses 2010 data. For each time period, the set of regressions consists of a base regression plus three variations of the base regression. The base regression is the basic or “simple” regression, which is distinguished from the variations by the absence of any interaction terms. The first variation of both sets introduces an interaction term between the wealth variable and the government indicator variable. The second variation for both sets introduces a different interaction term to the base regression consisting of the wealth variable and fractionalization variable of the base regression. Notice that the interaction term of the first variation does not carry over to the second variation, but is instead replaced by the new interaction term. Lastly, the third variation is the introduction of both previous interaction terms from the first and second variation to the base regression simultaneously. The third variation is the most complex model, as it consists of two interaction terms. It is this third variation that is primarily used for the interpretation of results from each set sense it the most comprehensive regression and is therefore the regression of primary interest from each set. The base, first and second variation regressions serve two main functions. The first main function they serve is that they allow the ability to see how the introduction of each interaction terms affects the other variables in the regression. The second main function they serve is to show the robustness of the variables in the regression when the regression undergoes some changes (Figure 2 and Table 1).

**Interpretation of year 2000 regressions**

The base model for first set of regressions, the set which consists of year 2000 data, possesses all coefficients that have at least significance levels that are statistically significant at the 10% level. The model holds expected signs consistent with the previous migration literature as well as economic theory. The two sociopolitical measurement variables, Government Effectiveness and Religious Fractionalization, possess the lowest significance levels at only 10%, followed by Native Population with 5% and then the rest of the variables who possess significance levels at 1%. The base model holds an adjusted value of 68% which stays consistent throughout the three alterations, deviating by no more than 1.2%. Increases in sociopolitical costs as measured by government effectiveness and religious fractionalization produce an increase emigration rates, reflecting the push-pull theory of immigration. The introduction of the interaction terms on the three alterations does not dramatically or significantly change the coefficient, sign and significance level of the control variables (all variables that are not the variables of interest with regards to this study). This instance does not hold for the variables of interest, except in regards to sign values which do not change. Both interaction terms are statistically significant. The addition of both interaction terms increase the coefficient of the real proportion of post-secondary educated natives, with the effects compounded in the third alteration. Significant levels increase for government effectiveness and religious fractionation coefficients with the introduction of their respected interaction term.

In regards to the behavior of the effect of religious fractionalization, we find an increase in religious fractionalization to produces higher emigration rates in less wealthy countries than their
### Table 2. Regression Models Year 2010 series: second set of OLS regressions.

<table>
<thead>
<tr>
<th></th>
<th>Base Total Emigration Rate (Logistic transformation)</th>
<th>Alteration 1 Total Emigration Rate (Logistic transformation)</th>
<th>Alteration 2 Total Emigration Rate (Logistic transformation)</th>
<th>Alteration 3 Total Emigration Rate (Logistic transformation)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>b/se</td>
<td>b/se</td>
<td>b/se</td>
<td>b/se</td>
</tr>
<tr>
<td>Population (logs)</td>
<td>-0.2638*** (0.0602)</td>
<td>-0.2763*** (0.0594)</td>
<td>-0.2781*** (0.0603)</td>
<td>-0.2882*** (0.0600)</td>
</tr>
<tr>
<td>Human Development Index (HDI) (logs)</td>
<td>1.8198*** (0.4629)</td>
<td>2.7291*** (0.6980)</td>
<td>3.1211*** (0.8147)</td>
<td>3.7990*** (0.9085)</td>
</tr>
<tr>
<td>Oil Exporting Dummy Variable</td>
<td>-0.8666*** (0.2346)</td>
<td>-0.9128*** (0.2437)</td>
<td>-0.8393*** (0.2361)</td>
<td>-0.9114*** (0.2452)</td>
</tr>
<tr>
<td>Distance to Select Immigration Countries (logs)</td>
<td>-0.6662*** (0.2478)</td>
<td>-0.6073*** (0.2486)</td>
<td>-0.6473*** (0.2415)</td>
<td>-0.5957*** (0.2436)</td>
</tr>
<tr>
<td>Distance to EU15 (logs)</td>
<td>-0.2927*** (0.0698)</td>
<td>-0.2921*** (0.0697)</td>
<td>-0.2813*** (0.0690)</td>
<td>-0.2821*** (0.0690)</td>
</tr>
<tr>
<td>Land locked</td>
<td>-0.6363*** (0.2673)</td>
<td>-0.6254*** (0.2610)</td>
<td>-0.6281*** (0.2653)</td>
<td>-0.6195*** (0.2601)</td>
</tr>
<tr>
<td>Previously Colonized by an OECD Country</td>
<td>0.8904*** (0.2138)</td>
<td>0.7183*** (0.2064)</td>
<td>0.6831*** (0.2155)</td>
<td>0.7076*** (0.2069)</td>
</tr>
<tr>
<td>High Income OECD Country (World Bank Classification)</td>
<td>-0.5177 (0.3312)</td>
<td>-0.9420*** (0.3653)</td>
<td>-0.6334* (0.3537)</td>
<td>-1.0073*** (0.3763)</td>
</tr>
<tr>
<td>High Income (nonOECD) Country (World Bank Classification)</td>
<td>-0.1133 (0.3204)</td>
<td>-0.2866</td>
<td>-0.2015</td>
<td>-0.3503</td>
</tr>
<tr>
<td>Control of Corruption Indicator</td>
<td>-0.3242** (0.1576)</td>
<td>-0.0301 (0.1788)</td>
<td>-0.3561** (0.1572)</td>
<td>-0.0839 (0.1819)</td>
</tr>
<tr>
<td>Language Fractionalization</td>
<td>-0.6382* (0.3584)</td>
<td>-0.6878* (0.3549)</td>
<td>-1.6515*** (0.6057)</td>
<td>-1.599*** (0.6241)</td>
</tr>
<tr>
<td>Interaction Term: HDI(logs) &amp; Control of Corruption</td>
<td>1.0365** (0.5101)</td>
<td>1.0365** (0.5101)</td>
<td>1.0365** (0.5101)</td>
<td>1.0365** (0.5101)</td>
</tr>
<tr>
<td>Interaction Term: HDI(logs) &amp; Language fractionalization</td>
<td>-2.1416** (1.0528)</td>
<td>-2.1416** (1.0528)</td>
<td>-2.1416** (1.0528)</td>
<td>-2.1416** (1.0528)</td>
</tr>
<tr>
<td>Constant</td>
<td>5.6939*** (2.1824)</td>
<td>9.6225*** (2.1846)</td>
<td>10.1637*** (2.1691)</td>
<td>10.0435*** (2.1800)</td>
</tr>
<tr>
<td>Observations</td>
<td>172</td>
<td>172</td>
<td>172</td>
<td>172</td>
</tr>
<tr>
<td>R²</td>
<td>0.565</td>
<td>0.576</td>
<td>0.573</td>
<td>0.582</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.535</td>
<td>0.544</td>
<td>0.541</td>
<td>0.548</td>
</tr>
</tbody>
</table>

* p < 0.10, ** p < 0.05, *** p < 0.01
wealthier counterparts. This is counter intuitive to the expectations of the economic theory. A possible explanation could be the case that wealthier nations do not find religious fractionalization as costly as their less wealthy counterparts. It is conceivable that the increase in the educated population causes society at large to be more accepting of differences, and thus finds them to be less costly on the aggregate.

Increases in sociopolitical costs, as measured by government effectiveness and religious fractionalization, produce an increase emigration rates, reflecting the push-pull theory of immigration

We turn our attention now to the second variable in question, government effectiveness. The expected sign is not the sign produced, showing that an increase in government effectiveness is associated with an increase in emigration rates holding the other variables constant. It also shows that an increase in government effectiveness produces less emigration in less wealthy countries than their wealthier counterparts. The most plausible explanation for this behavior is that government effectiveness promotes emigration through lowering the cost of emigration. By being more efficient, governments make the process of emigration easier and thus less costly to the population.

Interpretation of year 2010 regressions

This second set of regression exhibits statistical significance to all variables except the dummy variables High Income OECD countries and High income non-OECD countries. The introduction of an interaction term in any of the variations make High Income OECD countries variable significant, but does not do so for its non-OECD counterpart. The signs, barring language fractionalization, are consistent with expectations set by theory, previous studies, and the regressions of the year 2000. The introduction of interaction terms increases the value of the Human development Index, also compounded for the third variation. This behavior is similar to the wealth variable of the year 2000 regressions. The introduction of the interaction terms in the three variations increase the value slightly, but by more than the year 2000 counterparts. The interaction term for language fractionalization increases the statistical significance of the language fractionalization coefficient. This behavior is reversed in the second interaction term containing the control of corruption indicator, making this variable statistically insignificant when introduced.

Poorer nations... should increase attempts at creating a stable and peaceful demographic population in order to retain skilled labor

Both variables exhibit the same behavior as their counterpart in the first set of regressions. In regards to language fractionalization, we find an increase in language fractionalization to produces higher emigration rates in less wealthy countries than their wealthier counterparts. This is again counterintuitive, but the same explanation for this behavior and the behavior of religious fractionalization can hold true.

Control of corruption is also counterintuitive in the outcome of values. The expected sign is not the sign produced; presenting that an increase in control of corruption is associated with an increase in emigration rates holding other variables constant. It also express that an increase in control of corruption produces less emigration in less wealthy countries than their wealthier counterparts. No plausible economic reason for this behavior comes to mind.

Limitations of Results

Although both sets of regressions display similar results, comparability is highly restricted due to limitations in data availability. Comparisons between both data sets should be taken lightly, as a series of factors could affect perceived cohesion. It should also be noted that the number of obser-
Observations for the first set of regressions for the year 2000 data is much more restricted, having only 142 countries as compared to the second set containing 172. This is again another limitation of data availability. Another major limitation is data validity, with special regards to emigration rates. The rates have are not perfect, and are at times estimated with assumptions that could skew the numbers incorrectly. Lastly, although statistically significant, the interaction terms and their measure of dependence of the variables of interest does not prove causation of dependence, only correlation.

Conclusion

The results of the empirical analysis support the thesis that the effects of push factors on emigration rates are dependent on wealth levels. The statistical and economic significance of the interaction terms are evidence of this. However, the results of the OLS regressions for both sets of years do not reflect the behavior expected of them from the theoretical analysis of emigration rate behavior. Possible reasons for this are given which if correct would be consistent with the economic theory. Data limitations from availability is a major limiting factor in testing further ideas with the current data set, but provide adequate resources for the empirical analysis of this study. If the effects of push factors on emigration rates are indeed dependent on wealth levels then this would suggest further challenges for poorer nations who are trying to keep high skilled migrants from emigrating. For such nations the importance of the sociopolitical environment could be more important than previously thought and therefore should increase attempts at creating a stable and peaceful demographic population in order to retain skilled labor.

Author Reflection

This being the first serious endeavor into research I have undertaken, I have found the encounter to be a most educational experience. The challenges, problems, and methods which presented themselves throughout have taught me as much as the research itself. I was surprised by just how much goes into the process as a whole, particularly the planning process. It has also given me a new outlook on research, and I found both pleasure and true reward in the work itself. Unlike previous work in the classroom, this research has allowed me to explore areas of education that cannot be replicated. The project challenged both my mental and creative capabilities in a new and exciting way. It is hard to overestimate the gratitude I feel for having had the opportunity and honor of being a part of it all.

References


Coulombe, Serge and Tremblay Jean-François. 2006 “Literacy and Growth” The B.E. Journal of Macroeconomics, De Gruyter, vol. 6(2),(August, 2006): 1-34


Freeman, Richard B. 2006 “People Flows in


Lowell, B. Lindsay, Allan Findlay and Emma Stewart “Brain strain: Optimizing highly skilled migration from developing countries” Institute for Public Policy Research Volume 3 (August, 2004)


The New Democracy:

Culture Industry as an Authoritative Power

By Carolyn Kick

The purpose of this work is to utilize modern political theory to identify shifts in the culture industry. These changes are then applied to the modern Democratic complex to emphasize emerging power structures. Additionally, the effects of the changing political structure are explored and modern democratic theory is used to present a possible solution to dangerous shifts in political power.

There are various theories about how political structures have changed in the modern democratic era. Some may argue politics has become a struggle of irreconcilable differences between individuals. Others believe these conflicts are not unsolvable—but can be resolved through instilling common beliefs in citizens. However, the views of contemporary political theorists Theodor Adorno and David Foster Wallace make substantially different claims about the current state of modern democracy.

Rather than focusing on differences between individuals and political opinions, Adorno and Wallace focus on the commonality that dominates the modern world—the culture industry. This industry does not drive people apart, but instead, creates a common authoritative structure that has replaced political organizations in many ways.

This authoritative structure outlined in “The Culture Industry: Enlightenment As Mass Deception” by Adorno and “Mister Squishy” by Wallace allows for multiple conclusions to be drawn. Primarily, the modern democratic system is dominated by the authority of culture industry. This industry does not drive people apart, but instead, creates a common authoritative structure that has replaced political organizations in many ways.

According to Adorno, the modern democratic system is dominated by the power of culture industry. This industry operates as a series of “authoritative pronouncements,” thus developing into “the irrefutable prophet of the prevailing order” (Adorno, 1972, p. 147). Through utilizing an authoritative position in society, culture developed as a system of order. In practice, this authority is exemplified in the industry’s attempts to transform products into “proliferating movements in group choice” resulting in the product’s function as “a piece of cultural information” (Wallace, 2004, p. 23-4). Through the power of industry, physical products transcend economic markets, becoming part of culture itself. Therefore, culture industry must be viewed not as a mass media and marketing mechanism, but as a politically authoritative machine with the fundamental human desires, and total domination by the power of industry. Tertiary, resolution from this domination by revealing industry flaws to the public, thus undermining the ultimate authority of the culture industry.

Deriving the Authority of the Culture Industry

The culture industry has not unintentionally transformed the essence of politics in modern democracy. Rather, the industry began to operate as a series of “authoritative pronouncements,” thus developing into “the irrefutable prophet of the prevailing order” (Adorno, 1972, p. 147). Through utilizing an authoritative position in society, culture developed as a system of order. In practice, this authority is exemplified in the industry’s attempts to transform products into “proliferating movements in group choice” resulting in the product’s function as “a piece of cultural information” (Wallace, 2004, p. 23-4). Through the power of industry, physical products transcend economic markets, becoming part of culture itself. Therefore, culture industry must be viewed not as a mass media and marketing mechanism, but as a politically authoritative machine with the
capacity to alter social movements. This machine not only shifts culture, but defines it. As a defining power, industry becomes an authoritative and omnipotent sociopolitical structure, thus transcending previously rigid political bounds. In the modern era, opposing political views are ultimately all submissive to the greater power of culture industry (Adorno, 1972, p. 120).

...culture industry must be viewed not as a mass media and marketing mechanism, but as a politically authoritative machine...

The authority of the industry arises not solely from its politically transcendent nature but also from restructuring of societal order. Adorno emphasizes that the culture industry "reduces mankind" into categories of "customers and employees" (Adorno, 1972, p. 147). This binary allows industry to reduce complex society into a simple system addressing consumer needs. The process of producing, controlling, and disciplining these needs becomes the greater aim of society, thus overshadowing previously established political order (p. 144). Prior political conflict subsides as buyer/seller culture creates an "ideological truce" among individuals, allowing for an omnipresent sameness among both citizens and productions of society (p. 134). This ultimate sameness counteracts previous conceptions of modern democratic pluralist systems (p. 131).

In fact, the creation of sameness is the new democracy. It is considered democratic because it "turns all participants into listeners and authoritatively subjects them to broadcast programs which are all exactly the same" (Adorno, 1972, p. 122). Thus, the culture industry functions as the democratic political machine in two ways. Primarily, through operating in an authoritative manner. And secondarily, by creating expectations for sameness which permeate all aspects of life, including the political democratic life (Adorno, 1972, p. 123). More importantly, "the result is the circle of manipulation and retroactive need in which the unity of the system grows ever stronger" (p. 121). The system of ultimate authority is perpetuated through facilitation and satisfaction of consumer needs.

Implications for Citizens Under the Culture Regime

The culture industry’s authoritative position creates additional problems, altering citizens’ roles as members of the working class. In "Mister Squishy," Wallace claims that many men and women view themselves as superior to the common man (Wallace, 2004, p. 30). However, individual differentiation is destroyed when one recognizes the creation of a working class in which each citizen is "nothing but a faceless cog [...] doing a job that untold thousands of other bright young men and women could do at least as well as [them]" (p. 32). Wallace demonstrates the irrefutable “smallness” of the individual. Essentially, within the culture machine, the ability to differentiate oneself from others becomes obsolete (p. 31-2). Adorno defines the individual under the culture industry regime as "completely and utterly insignificant" (Adorno, 1972, p. 145-6).

This insignificance is further embodied when Terry contemplates his potential raise at the company. Although he would be able to afford a nicer condominium, he would continue to spend his life lonely, "masturbating himself to sleep," and ultimately failing to make a "more substantive difference in the larger scheme of things" (Wallace, 2004, p. 47). Thus, under the
political culture of the industry, individual progress becomes an illusion. Terry's desire to achieve more is simply a "delusion that he differed from the great herd of the common rule of men" (p. 47). The authority of culture reduces men into a "herd," or, an indistinguishable group in which everyone "can replace everybody else" (Adorno, 1972, p. 145). The rule of the culture industry also forces submission from citizens, thus further destroying individuality. Adorno paints preliminary stages of submission as sacrifice of imagination, an important aspect of each individual's unique thought process. He uses the example of a film which is so incredibly realistic that it leaves "no room for imagination or reflection on the part of the audience," thus emphasizing "the stunting of the mass-media consumer's powers of imagination" (Adorno, 1972, p. 126). The realism of the film industry, as directed by the omnipotent culture industry, is able to penetrate and destroy the imagination of observers. However, the industry does not stop at film. As a politically-cultural movement, it affects all societal aspects, including the way citizens view themselves as distinct individuals.

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**Culture industry derives its authority from repression of people's individual desires**

A change from idealization of individuality to total submission to culture is apparent in Terry's thoughts and behaviors. First, Wallace expresses that Terry's "professional marketing skills [had] metastasized throughout his whole character" (Wallace, 2004, p. 26). Terry's participation in the industry ultimately leads to dissipation of his personal character in favor of an identity more suitable to the authoritative culture regime. This becomes incredibly apparent when Terry imagines his own face as the Mister Squishy logo when looking in the mirror (p. 33-34). Terry is not only part of the culture industry, but is transformed from an individual into a product of the industry he operates within. As a product, his personal affect is reduced to "inwardly attached and almost clinically observant" (p. 9). Terry's submission to the culture industry resulted in a total loss of individuality which causes him to question if "he even had what convention called a Free will at all, deep down" (p. 55). Thus, domination of society by the culture industry has dangerous implications of total loss of individuality. In addition to requiring total submission from citizens, the culture industry derives its authority from repression of people's individual desires. The first step in the industry's ability to repress individuals is establishing them not as subjects of the regime, but as objects. This objectification is premised off a false promise in which consumers believe that only submission to the industry can fulfill their needs (Adorno, 1972, p. 142). Resultantly, consumer needs created by the industry become the means of objectifying individuals within it. Due to the role of necessity within the system, it is absolutely crucial "not to leave the customer alone, not for a moment to allow him any suspicion that resistance is possible" (p. 141). As culture overwhelms consumers, potential resistance becomes obsolete. Ultimately, the obligation to submit becomes unavoidable.

The rigorous strains of submission to culture manifest themselves in unhealthy repression of individual desires. Terry's clearly unhealthy sexual obsession with his coworker Darlene Lilley embodies this. Terry is haunted by constant dreams of Darlene, and has even put his coworker's number on his home phone speed dial (Wallace, 2004, p. 46; 33). But the clearest indicator of his rampant obsession for Darlene is that "at night in his condominium sometimes without feeling as if he could himself masturbated to thoughts of having moist slapping intercourse with Darlene Lilley on one of the ponderous laminate conference tables of the firms they conducted statistical market research for" (p. 16). Terry's incessant masturbation to the thought of Darlene indicates unhealthy sexual repression. Most importantly, this obsession is to Darlene, one of his coworkers. The industry he operates within permeates every part of his life, even the most personal such as sexual desire. Due to cultural restraints put on him by the authoritative regime, Terry feels sexually repressed and thus attempts to alleviate some of this repression through masturbation. However, this repression will never be overcome. Terry recognizes his own sexual obsession with Darlene as unhealthy and unviable in real life. Because of culture's domination of his entire being, he submits to the repression and gives up hope of ever having a healthy sexual relationship (p. 26). Ultimately, the culture industry is not a redirector of desire, but a repressive entity which consumes citizens of the regime (Adorno, 1972, p. 140).

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**Defying the Authoritarian Power**

Finally, another fault of culture industry as a functioning political power is the prevention of any escape from the regime. Although Adorno does not deny people's capacity to reject the culture industry as a politi
behavior and seek a solution to the domination of modern democratic political structure by industry. In Wallace’s story, Terry explores the means of producing toxic chemicals in hopes of poisoning snack cakes. He claims that “Botulinus had also the advantage of directing attention to defects in manufacturing and/or packaging rather than product tampering, which would of course heighten the overall industry impact” (Wallace, 2004, p. 58). As a functioning member of the politico-cultural regime, Terry seeks escape through damaging the industry’s image. The culture industry retains power through keeping citizens in “opaqueness block[ing] any insight” (Adorno, 1972, p. 147). Thus, through bringing to light a structural defect within this authoritative regime, the chance of destroying or limiting its power is increased.

With faults exposed, the promises of the culture industry are decreased and “the less the culture industry has to promise, the less it can offer a meaningful explanation of life, and the emptier is the ideology it dissemnates” (p. 147). By instilling doubt in the original promise of the industry, it becomes possible to limit the destructive nature of culture, thus reducing its effects of conformity, repression, submission, and domination.

Author Reflection

Application of modern democratic theory is absolutely essential in an era of rapid political development. Examination of the culture industry as an authoritative power is especially important, as many political scientists tend to explain the current state of modern democracy by party polarization. However, through careful consideration of other sources of political power, it is easy to see culture plays a large part in modern political struggles. I hope my research allows other political scientists to explore alternate means of political authority. Ideally, my research will facilitate a discussion surrounding the imminent danger facing the American people: degradation of the culture industry.

Reference


Effect of Wealth on Health in the US from 1999 to 2011

By Ryan Lindsay

This study examines the effect of wealth on the health status of an individual using 7 waves of the Panel Study of Income Dynamics (PSID) from 1999 to 2011. Health status is self-measured, requiring individuals in the study to rate their own health status on a scale of one to five. Past research has established a relationship between health and wealth, but the direction of causality remains an open issue. Looking at changes in wealth and employing a two year lag, I will attempt to isolate a causal effect of an individual’s wealth on their self-rated health status. Although total measured wealth has a small effect on health, individual variables within wealth do have significant value. With the rising call for universal health care, these findings have important policy incentive implications.

Changes in an individual’s fiscal means impact a number of factors in their life: a negative shock to these means may impact significant factors that diminish an individual’s health status. Currie and Tekin (2011) use the Panel Study of Income Dynamics (PSID) database in order to identify a relationship between areas with a large number of foreclosures during the financial crisis of 2008 and a rise in emergency room visits. The effects of local unemployment, changes in house prices, migration, and people switching to outpatient providers cannot account for the estimated effects on emergency room visits between 2008 and 2009. Therefore they conclude that the stress associated with the financial distress of foreclosure harm an individual’s health. Financial distress of foreclosure is a shock to a household’s wealth and or income; Schwandt and Fabra (2011) isolate wealth shocks looking for a relationship with health and mortality. They discuss the “well-established fact that richer people are healthier, happier and live longer” and they capture the relationship between fluctuations of stock wealth and health among the elderly. Using a two-year lag, Schwandt and Fabra find that a +10% wealth shock over two years will decreases the probability of death within the following two years by 10%; this effect is greater the older the individual.

The primary determinant to wealth is a person’s income. Gardner and Oswald (2006) discuss influences of income by looking at 137 individuals who received medium-sized lottery wins and then measures their psychological health two years later to gauge whether or not their health has improved or diminished due to the change in wealth. Their study creates three groups: one with no lottery wins, another with small lottery wins, and the last with medium-sized wins between £1,000 and £120,000. They found that people with the medium-sized lottery wins had significantly better psychological health two years after receiving the winnings. With such a small sample the time delays effect is unclear.

Grossman (1999) in his paper to the NBER is instrumental in establishing that health has a demand as an asset that an individual may invest in. Grossman defines health as the amount of productive time someone possesses, a combination of longevity and illnesses free days. Everyone is born holding a base stock of health that can be invested in through habits or medical care and depreciates with age. By increasing an individual’s “holdings of health” they are able to increase their productivity and invest more. This theory is the foundation for much of past research in this area. This creates an imperfect relationship as health is subject to the law of diminishing returns, and with health decreasing as
age increases, a shadow price is formed. The shadow price is the cost of a good for which no market exists, and this price increases as the stock of health decreases over time. An individual’s shadow price is limited to his means to pay, Deaton (2002) suggests an individual’s income designates their social rank and that rank is what has a relationship with their health. While an individual’s rank is difficult to fully capture, Deaton uses rank as the variable for solving the issue of reverse causation between health and wealth. His results say that the top 5% of Americans live 25% longer than the bottom 5%, with his data being from 1980.

Idler & Benyamini (1997) use multiple studies across a range of countries, age groups, and other demographic groups to see if self-rated health could be an accurate predictor of an individual’s survivability. 23 of the 27 studies found that self-rated health was a reliable predictor of survival. Franks, Gold, & Fiscella (2003) also find evidence that self-measured health has the ability to predict outcomes; however, they add that self-rating is a more accurate measurement of health than health indicators. Self-rated health allows for a wider scope of application in regard to data analyses by assessing individuals across a range of illnesses. While both of these studies offer robust insight they do discuss some issues that arise from the use of self-rated health figures. The largest concern these studies share is sampling bias as individuals have differing views on what healthy is defined as. Franks, Gold, & Fiscella (2003) find that an individual’s age as well as gender and race may impact how they rate their current health. They find that older individuals rate themselves as having lower health than younger individuals do, women on average say that they are healthier than men, and Latinos are healthier than Caucasians who are healthier than African Americans. These trends are clear in their analysis and after controlling for these demographics, there is significant evidence to support using self-rated health as an accurate representation of an individual’s health.

The literature on the effect of wealth on health focuses on shocks to wealth. In contrast to other studies, my study looks to capture wealth as a family’s financial condition; using income, wealth, equity, and asset values. I argue that negative financial fluctuations cause stress on a family causing health to diminish after the shock.

**Research Methods**

**Analytical Framework**

This research looks to answer the question of what is the impact of a change in wealth on an individual’s health? Grossman (1999) introduces the theory behind a relationship between health and an individual’s financial situation. He explains health as an investable commodity that can be invested in order to appreciate the value of health, which is explained as longevity and sick free days or more broadly a person’s productive lifespan. Everyone starts off with an initial stock of health that depreciates over time as well as fluctuates with an individual’s actions and investments. Since a person cannot live forever no matter how great their investment(s) may be, Grossman explains this with the law of diminishing returns.

With health considered a good there must be a marketplace in which health can be traded or purchased. While there are markets for healthcare services Grossman discusses that they are only a part of the entire market that produces health. This marketplace is not tangible and health traded within it is governed by a shadow price, which is a price assigned by the utility of a good or service where no market exists. This shadow price is different for many individuals since health is within an individual’s shadow market, or their own personal definition of a good’s or service’s utility. This price is difficult to capture and impossible to fully capture since there is not a clear exchange between investment in health and return to health. My study looks to capture a portion of this shadow price in an attempt to shed more light on the shadow market.

Since health and wealth are intertwined in this shadow market, the direction of causality is not established. In order to isolate a causal relationship, the most commonly used method is to look at shocks. Schwandt and Fabra (2011) use fluctuations in stock holding value to predict the longevity of the elderly. Currie and Tekin (2011) measure foreclosure rates to determine the impact of the financial distress associated with undergoing foreclosure on an individual’s health. Gardner and Oswald (2006) select individuals to receive medium sized lottery wins and then measure their health two years after this shock.

The other key component to defining the relationship between wealth and health is through the measurement of health. The data set I used, the Panel Study of Income Dynamics (PSID), uses self-measured health on a scale of 1 to 5. The PSID is a reputable database used extensively in economics research.

**Data**

The PSID is conducted every two years and surveys a representative sample of the U.S. population. Seven waves of the PSID, from 1999 to 2011, were chosen to overlay the 2008 financial crisis for panel regression.
Individuals without recorded observations were omitted.

Variable Definitions

Health status is a self-reported variable by an individual in the survey. The PSID survey allows individuals to rate their health from 1 to 5 where 1 indicates excellent health, 2 indicates very good health, 3 indicates good health, 4 indicates fair health, and 5 indicates poor health. I convert overall health into a dichotomous variable where an individual either has good health or poor health, the cut off for good health are individuals with a rating of 3 or lower. I also account for health during a person's youth, before the age of 16, as this measure may indicate the initial health stock which will affect future health.

Wealth is measured as the sum of home equity, debt, present value of farmland and businesses owned, bank account balances, present value of real estate, stock holdings, present value of vehicles, and present value of other assets, annuities and IRA. Compiling these 11 variables captures a more complete representation of an individual's financial situation. However, since a significant portion of sampled individuals had no home equity and some Americans will only live on rented real estate and this difference can skew findings, I have extracted home equity into an independent variable. Both wealth and home equity are in terms of thousands of USD.

Health can also differ due to a person's education level, race, age, or gender so these four variables are included within my model within the X term or my controls. Age is both a stand-alone term as well as a squared term in order to gauge if age's impact appreciates, depreciates, or remains unchanged over time. Race is a dummy variable measuring the health impact of not being Caucasian. The 1999 race variable will be used as the race of an individual because race is unlikely to change over time. The variable for education is the number of years an individual has attained which will be between 1 and 17, a score of 17 represents college education or greater. Since education can be a factor in wealth I will test for collinearity, which I will discuss later.

Estimation Model

The reduced form model for health as a function of wealth and socioeconomic factors is represented by:

\[ H_2 = \beta_0 + \beta W + \beta_1 H_1 + \beta_2 X + c \]

H2 is the binary indicator of whether an individual has rated themselves with good health or poor health in the current year; and conversely H1 is the individual's health status at the start of the period, two years before, as well as their health status during their youth, before the age of 16. Wealth is accounted for in W where all 11 of the variables discuss earlier are measured. X accounts for my four demographic controls: age, race, education, and age¬2. And C is the unmitigated error in my equation.

My first model uses the equation listed above, and the data and results are discussed first in my discussion section and are shown in Tables 1 through Tables 4. Table 5 and Table 6 use a similar model as shown above however the model uses all of the years' data pooled into one dataset. This means that this model does not have a two-year lag as the previous model does, but accounts for fluctuations between years by having a variable for each year. My third model uses a structure similar to the first model; however both the wealth and health variables are the change between the years. For instance, the wealth for 2011 is actually the change in wealth between 2011 and 2009 calculated as the difference between those two years and the health variable is the change in health between two years. This model's data and results can be found in Table 7 through Table 9, and will be discussed last. My final model utilizes a Probit regression, found in Table 10, in lieu of the Ordinary Least Squares (OLS), which my prior models use. The Probit regression results use the same data pool as the lagged regression, therefore the summary statistics for my Probit regression will be in Table 1. The benefit of using a Probit model is that it will help identify marginal effects as well as the degree of responsiveness health is changes in wealth.

Summary Statistics

Summary statistics are shown in Table 1; the table breaks down the variables used into their appropriate years and separates race from all years, since race does not change between years. Every year is broken into the same five variables used within the regressions. Observations slightly vary between years; however, this does not create a large enough margin of error to dramatically impact my results.

There are a few notable observations. Average health has decrease from 1999 to 2011, though it is still leaning towards a healthy population. The average age of an individual is around 42 years of age. A minority of my sampled individuals are Caucasian, with 88.5% being non-Caucasian. However, race is kept outside of individual years, since a person’s race does not change over...
time. The observation that education has not changed over the course of the 10 year period is a stability I did not anticipate. This is most likely due to the fact that 1 standard deviation from the average age still puts an individual around 28 years of age and outside of the typical education age, 18 years old or younger.

Table 3 offers another set of summary statistics. These variables are the same as in Tables 1; however, they pertain to the model in Table 4 which uses a pooled dataset in lieu of individual years. This model is meant to capture the effect time has on an individual’s health, as health can appreciate of depreciated due to national or local situations. The regression omits the variable “Year 1999” in order to avoid the dummy variable trap; however, the variable is included to represent that 1999 data is accounted for and to offer continuity in explaining 100% of the observations. Race was omitted because of an error generated that corrupted the computed values of every individual’s race.

Table 5 looks at the summary statistics for my dataset that isolates changes in wealth and changes in health. The variables with the delta (Δ) in front of them represent the change between the two years specified by the variable. These variables may have a negative value as change can reduce the value of a variable. An interesting observation is that the mean sign of these rate-of-change variables is not consistently positive or negative, suggesting there is not constant mean growth or loss. Additionally, the largest equity loss was between 2007 and 2009, which contains the 2008 financial crisis which is seen as an average loss of $20,000 in equity; however, the deepest loss does not come until between 2009 and 2011 which has a recorded loss of $1.5 million in equity.

Results

Table 2 contains the regression output for 2001, 2003, and 2005. The coefficients of my variables are taken out to 8 places after the decimal in order to see what small effect some variables on health status that year. Initial models were run with education, and while I feel that education is a valuable indicator of an individual’s status, the variable did not have significance (even with a confidence level of 10%) in any year so I have omitted the variable from my regressions in order to more accurately represent the other variable values. Age and Age2 (Age2) clearly have a relationship because one is contingent on the other. There appears to be a slight relationship between high wealth and equity with age, this finding suggests accuracy of the lifecycle theory. While these variables appear to have a relationship, this can actually be assumed as random since there is inconsistency in the pattern. With a greater number of individuals in the sample there may or may not be a pattern that my data does not fully capture.

Since race is consistent between all six regressions I would like to start with understanding the coefficient associated with a person’s race. In all of the models the coefficient is significant at the 99% confidence level, very confident in the coefficient value, and is negative. A negative coefficient suggests that when a person’s race is equal to 1, or a person is not Caucasian, their health status is reduced by the value shown in the year’s regression. A minimum and maximum approach would say that a non-Caucasian individual have a health status between 3% and 8.4% worse that their Caucasian counterpart. This upholds the findings in Franks, Gold, & Fiscella (2003), that non-Caucasian persons have worse health than Caucasian persons.

The next two consistent variables within my models are Age and Age2. Age is consistently positive, so as an individual gets 1 year older their health status gets better by at most .42%. The negative value of Age2 mitigates this increase in health by a person’s increase in age. While the Age2 variable is much less than Age, having a maximum effect of .01% per year, this variable does create a negative total between Age and Age2 terms after 38 years, suggesting that those older than 38 years of age will start to have depreciating health with each passing year and those younger than 38 years of age will have appreciating health with each passing year. Also worth mentioning is that Age is not significant in some years whereas Age2 is very significant in every year implying that the coefficient for Age could be smaller than it currently is, or zero. This means that age may have a depreciating effect before the age of 38.

My last demographic is the health status of a person before the after of 16, or their health as a youth which past studies have found to be highly significant. And with highly significant results, my study also finds that having a healthy adolescent lifestyle translates to having a healthier adulthood, especially since this variable has the largest coefficients out of all of my variables in nearly every regression. However in 2005, Table 2, the coefficient is negative and since inherited health is a very important factor in predicting future health this seems to be an error in either the recording of the variable.

Lastly, the effect of wealth on health fluctuates between years in both sign and significance. The portion of wealth defined as equity remains positive and highly significant throughout all of my models. While this co-
efficient seems small, it represents a change in equity of 1,000 USD. Home-owning Americans with a home valued at $200,000 and a 20 year mortgage will contribute $10,000 per year to their home equity, which translates to an increase in health of approximately 20% each year. Wealth without equity contains the other 10 variables that classify a person’s financial status, and even with separating the variables out in the equation equity had the largest coefficient and most significance.

Table 4 shows the regression output for the pooled dataset, summarized in Table 3. The pooled dataset represents the effect wealth has on health without using a lag; without a lag this regression captures the effect an individual year has on health. Again in this model health as a youth has a large effect on a person’s health status. But the strongest effect on a person’s health is caused by the year, which can be due to a number of different variables outside of the scope of this study. Compared to Table 2, wealth without equity is highly statistically significant but not very economically significant because even if a person’s wealth were to increase by $1,000,000 over the 12 years this would only increase their health by .006 or less than 1%. Alternatively an increase of equity by $1,000,000 would cause a person’s health to increase by .34 or more than a third of the way to becoming very healthy. Additionally, the pooled regression supports the positive effect investing in equity has on a person’s health and suggests that wealth has a statistically significant but not economically significant effect on health.

Table 6 and Table 7 show the regression output for the dataset that is summarized in Table 5. These regressions are my “shock regressions” and display the how a change in wealth effect a change in wealth. A large indicator of health in prior regressions was the health of a person as a youth which in these regressions is very underwhelming outside of the 2001 to 2003 regression. Another point is that wealth, equity, and race are predominantly statistically insignificant in these regressions. The notable observation from these regressions is that as individuals get older their health declines. This may seem obvious, but in earlier models age has a diminishing positive return, whereas here age has a negative return. This negative return has a high point around age 35 where another year hurts your health the most, but the relationship between age and health remains the same across all observed years.

The significant findings from my Probit model can be found in Table 8. Probit model coefficients can be used to interpret the sign of a relationship as well as the significance but not the magnitude of the relationship. The marginal effects of the regressors indicate change of an independent variable affects the probability of change in health. The results in Table 8 portray the variables that are significant in three or more observed years, of the 6 years that were modeled, as well as a breakdown for each year modeled. The marginal effects shown are for the year to the left (in gray) and the results under the dependent year are the Probit results (in gray).

The first sub-table in Table 8 looks at how an individual’s health as an adolescent impacts their health as an adult. The Probit results in gray show that a person’s health in their youth is highly significant and has a positive relationship with their health as an adult, which is consistent with previous models. And the marginal effect to the right of the year shows that health during adolescent years increases the probability of a healthy adult life between 26% and 39%. The second sub-table looks at the home equity’s probability impact on health which is also has a significant and positive relationship, similar to previous models. The marginal effect of these years is also similar to previous models, but in here a change an increase of home equity by 10,000 USD increases the probability of a health life by .5%. The last sub-model observes the effect race has on a person’s health; similar to previous models, being a minority has a significant negative impact on a person’s health status. Observed minorities, non-Caucasians, had between a 1% and an 8% probability of having worse health than their Caucasian equivalents.

Discussion

The study recreates results similar to those in previous literature, that being low R2 values and wealth values that are typically insignificant. A limitation of this study is that wealth is defined as home equity and all other holdings outside of home equity, this creates a significant home equity variable and future studies should look to isolate other wealth factors. The mean age of the observations was middle age, which is not inherently poor; however, it creates a very wide sample population, whereas if the model isolated younger age groups the variables may have had a smaller impact, or if the model isolated older age groups the variables may have had a larger impact. Age variables attempts to account for fluctuations by age; however, an individual’s age is not significant within every model’s observed years. With a smaller standard deviation for age these variables might be more significant and may show age groups that these models do not represent.

Similarly, this models only separate race in
This study sought to identify a causal relationship between health and wealth. With wealth insignificant, (statistically or economically), in a majority of my study years the relationship would seem to be null, and past wealth does not affect health or wealth would cause a very small deviation in health; however the fact that my models can only explain 15% of the fluctuations in a person’s health at best should be noted. With equity spliced out of total wealth a completely different relationship appears in lagged and pooled regressions, being statistically significant as well as economically having a value that can affect a person’s health annually. Understandably this is why many studies focus on the U.S. housing crisis as there were large shocks to housing.

The more difficult policy would be to encourage investment in equity, and ultimately housing. The concept of encouraging citizens to be homeowners in not new, and the follow-through of encouraging homeowners arguably led to the recession in 2008 and the global recession of 2009. This recession led to an increase in unemployment and foreclosures, both of which eat away at equity whether slowly or suddenly. Policymakers should consider the potential for relapse when encouraging housing investment as well as other factors that may require legislation in order to promote stable housing markets for current and future investors. Future studies should isolate negative changes in equity.

Author Reflection

The research for my thesis began in January 2013 with interest in housing markets and how fluctuating housing prices impact a person’s health. This interest carried into the Summer Undergraduate Research Experience in 2013 where my research expanded to include the impact of an entire individual’s wealth. My modeling was restricted due to the unavailability of the 2011 data until the Fall semester so research over the summer was comprised of theory while the semester was primarily testing. This split allowed me to read deeper into the theory behind health and how a person’s life or worth is calculated. I thought my study would be fairly straight-forward and while my study does maintain a narrow scope there is a substantial amount of research that can be done to better understand shadow market forces on an individual.

References


Currie & Tekin. (2012) Is There a Link between Foreclosure and Health? NBER No. 7310

Deaton. Policy Implication Of The Gradient Of Health And Wealth Health Affairs, 21, no.2 (2002): 13-20


Panel Study of Income Dynamics, public use dataset. Produced and distributed by the Survey Research Center, Institute for Social Research, University of Michigan, Ann Arbor, MI (2013).
Liquid Fluoride Thorium Reactors in Public Policy

By Jason Olson

Given the current climate of sustainable energy development in the United States, an inspection of why the development, construction, and operation of liquid-fluoride thorium reactors (LFTR) has been hindered will give a valuable insight into the political process of agenda formation and policy-making. This thesis examines LFTR technology within the framework of the history of energy and energy policy; within public policy, specifically agenda formation, pluralist and power-elite theories, environmentalist theories, and how the history of energy has influenced policy. The shape of agenda formation and by proxy LFTR is evaluated within the context of pluralist and power-elite theories and their criticisms. The impact of the history of energy on current policies is weighed against an account of the political, social, and environmental history of fossil fuels as portrayed by a variety of historians and critics. Overall, this comprehensive picture leads to the conclusion that LFTR is trapped outside of the realm of political possibility in American policy due to the treatment of energy in politics: it is in the interest of power-elites to keep LFTR off the agenda and, when democratic, energy policy punishes front-heavy investments and demonstrates a poor understanding of the big picture.

The development, construction, and operation of liquid fluoride thorium reactor (LFTR) power plants in the United States have been hindered by political limitations, not technological ones. LFTR is a rational choice for sustainable energy development, but agenda formation is generally non-rational, as explained by a number of different models of policymaking including power-elite theory and pluralism. As a result, perverse incentives to continue using less efficient or more polluting energy sources combined with negative public attitudes towards nuclear energy have prevented Americans from taking advantage of liquid-fluoride thorium reactor technology.

In order to support the idea that liquid-fluoride thorium reactors are being kept off of the U.S. energy policy agenda for political reasons, this thesis will give technical and historical accounts of LFTR, to demonstrate the inexorable political influences since LFTR’s conception. Through a dissection and critique of competing theories of agenda formation, this thesis will determine what political forces are keeping liquid-fluoride reactors off the agenda. A thorough examination of the history of energy will show how the current sociopolitical and economic climates are a result of fossil fuel usage, and how this has resulted in a set of pro-fossil fuel, pro-energy biases in social, political, and economic spheres.

Technical Details and History

Liquid-fluoride thorium reactors are a type of molten-salt nuclear reactor. These reactors are more efficient, use a more abundant fuel supply, and have a smaller footprint both ecologically and geographically than
conventional nuclear and fossil fuel plants; additionally, LFTR plants and do not produce weapons-grade by-products. To say that the advancement of liquid-fluoride thorium reactor technology, or investigation of the lack thereof, is an important and interesting issue both environmentally and politically would be an understatement of impressive proportions.

David LeBlanc (2010) examines the technical logistics of molten-salt nuclear reactors, especially liquid-fluoride thorium reactors, claiming that molten-salt nuclear reactors “could actually deliver on nuclear power’s long-heralded promises of cheap and limitless energy” (p. 28). He claims that the abandonment of liquid-fluoride thorium reactor research and development in the 1960’s resulted from a policy decision rather than a scientific dead-end. Early nuclear physicist and Oak Ridge National Laboratory Director Alvin Weinberg agreed. The ORNL attempted to facilitate nuclear fission using a molten-salt reactor, similar to liquid-fluoride thorium, as early as 1944. In his memoir, The First Nuclear Era, Weinberg (1994) wrote:

In the early days we explored all sorts of power reactors, comparing the advantages and disadvantages of each type. The number of possibilities was enormous, since there are many possibilities for each component of a reactor--fuel, coolant, moderator... if one calculated all the combinations of fuel, coolant, and moderator, one could identify about a thousand distinct reactors. Thus, at the very beginning of nuclear power, we had to choose which possibilities to pursue, which to ignore (p. 38).

There was an element of chaos to early nuclear research. Many of Weinberg's combinations attempted at Oak Ridge National Laboratory had low criticality, meaning usable energy output, and high stability, or vice versa. Even in the early days of nuclear engineering it was clear that the water-moderated, water-cooled solid-fuel uranium reactor that persists today had relatively low stability and underwhelming criticality. Yet, Ralph Hawgraves and Robert Moir (2010) argued that early choices in nuclear implementation made by non-scientists strongly influenced the direction of nuclear power:

Among the many choices made, perhaps the most important choice for the future trajectory of nuclear power was decided by Admiral Hyman Rickover, the strong-willed Director of Naval Reactors. He decided that the first nuclear submarine, the USS Nautilus, would be powered by solid uranium oxide enriched in uranium-235, using water as coolant and moderator. The Nautilus took to sea successfully in 1955. Building on the momentum of research and spending for the Nautilus reactor, a reactor of similar design was installed at the Shippingport Atomic Power Station in Pennsylvania to become the first commercial nuclear power plant when it went online in 1957 (p. 304).

The choices in military hardware and civil engineering resulted in an overwhelming focus toward the now-typical solid-uranium, water-cooled, water-moderated reactor and away from other reactor types with as much promise, like liquid-fluoride thorium reactors. Weinberg was ordered to shut down the working liquid-fluoride thorium reactor at ORNL in 1967. Plans to develop a more advanced version of the reactor were promised to Weinberg, then canceled (Fishlock, 2007, p. 23). In more general terms, support for nuclear power has significantly decreased over time, highlighted by Frank Baumgartner and Bryan Jones as a series of reactionary economic and political maneuvers by alternating public and private interests: government boosterism decreased as government regulation increased, making it less economically viable for nuclear research and planning. In turn, investors pulled out of the nuclear industry starting in the 1960’s, creating a power vacuum that allowed “new actors to intervene, thereby changing the nature of the regulatory and the governmental environment for the industry, making it considerably less favorable. This led to serious changes in the financial outlook for the industry.” So it went, rotating between economic downturn spurring on more damaging government intervention in the nuclear industry, which in turn would worsen the economics of nuclear power, until arriving at nuclear power’s current status today (Baumgartner and Jones, 2009, p. 79). Such a steady decline in investor interest and economic feasibility for typical nuclear power has undoubtedly hindered the possibility of adoption of alternative nuclear reactors like LFTR.

**Agenda Formation**

Liquid-fluoride thorium reactors are a useful way to examine agenda formation in American energy policy because they are a rational choice for sustainable energy development and are not even a footnote on the energy policy agenda. Like an increasing number of nuclear researchers around the world, Nicholas Coo-
per, Daisuke Minakata, Miroslav Begovic, and John Crittenden (2011) support the idea that "LFTR can mean a 1000+ year solution or a quality low-carbon bridge to truly sustainable energy sources solving a huge portion of mankind’s negative environmental impact" (p. 6238).

Liquid-fluoride reactors are a rational choice for many reasons, most importantly "advantages in design, operation, safety, waste management, cost and proliferation resistance over the traditional configuration of nuclear plants. Individually, the advantages are intriguing. Collectively they are compelling" (Hawgraves and Moir, 2010, p. 304). Liquid-fluoride thorium salts are immune to radiation damage and can continue to hold fissile byproducts indefinitely, unlike solid-fuel reactors. Liquid-fluoride thorium reactors have a massively reduced waste output compared to other nuclear plants: they produce byproducts hundreds of times less radiotoxic than those from solid-fuel reactors, for a net toxicity over a 300-year timespan, the total waste output during that time being approximately “10,000 times less toxic” (Hawgraves and Moir, 2010, p. 304) than that of solid-fuel reactors. LFTR is inherently safer than any other form of existing nuclear chain-reaction, because its coolant is not pressurized and does not boil below 1,400 degrees Celsius, and naturally suppresses the potential to escalate uncontrollably in the event of a runaway reactor. Additionally, many liquid-fluoride thorium reactor designs include a frozen plug at the bottom of the reactor that would melt and drain all fuel into a special emergency reserve tank to prevent meltdown in the event of rising core temperatures – a technique unavailable to solid fuels. In terms of cost, liquid-fluoride thorium reactor plants could not only produce cheaper electricity than other alternative energy sources, but also have potential “to compete successfully against coal without subsidies or market-modifying legislation” because “large cooling towers and containment structures that handle high pressures are unneeded” and fuel, coolant, and moderator materials are significantly cheaper than their solid-fuel reactor counterparts (Hawgraves and Moir, 2010, p. 304). Another important issue in any discussion of nuclear power is the possibility of its abuse; proliferation, or the capacity of a nuclear reactor to produce weapons-grade byproducts, is something that is taken into account when evaluating the pros and cons of a reactor design. Interestingly, liquid-fluoride thorium reactors are proliferation-proof because they do not produce weapons-grade plutonium or uranium-238 byproducts (Cooper et al, 2011, p. 6238). Overall, it can be said that liquid-fluoride thorium reactors are a rational choice for sustainable energy development simply because their benefits significantly outweigh their costs.

...liquid-fluoride thorium reactors are proliferation-proof...

**Technical Feasibility**

In their book, Public Policy Praxis: A Case for Understanding Policy and Analysis, R. S. Clemons and M. K. McBeth stress the pragmatism of rational policy analysis via technical feasibility and cost-benefit analysis. In the context of how feasibility affects policy formation, Clemons and McBeth (2009) explain “both how this criterion of technical feasibility is flawed and how it can be met but will conflict with other criteria and objectives” (p. 127). In fact, one of the examples given for when a project meets the criterion of technical feasibility but conflicts with other objectives is the Cold War-era goal of an atomic airplane that was the precursor to modern LFTR technology, and corroborates LeBlanc’s own assertions about the mothballed atomic plane project. How technical feasibility informs, or does not inform, policy-making decisions is of great relevance in determining why liquid-fluoride thorium reactor technology is not already in use.

**Power-Elite Theory**

An examination of models of agenda and policy formation, including pluralist theory and power-elite theory, requires a closer look at the mechanics and truth value both theories. Power-elite theory, at its core, is the idea “that at the top of every society lies, inevitably, a small minority which holds power; controls the key resources and makes the major decisions” (Daloz, 2010, p. 1). Peter Bachrach and Morotz.

Against the elitist approach to power several criticisms may be, and have been leveled. One has to do with its basic premise that in every human institution there is an ordered system of power, a “power structure” which is an integral part and the mirror image of the organization’s stratification. This postulate the pluralists emphatically – and, to our mind, correctly – reject, on the ground that nothing categorical can be assumed about power in any community... equally objectionable to the pluralists – and to us – is the sociologists’ hypothesis that
the power structure tends to be stable over time. Pluralists hold that power may be tied to issues, and issues can be fleeting or persistent, provoking, coalitions among interested groups and citizens, ranging in their duration from momentary to semi-permanent. To presume that the set of coalitions which exists in the community at any given time is a timelessly stable aspect of social structure is to introduce systemic inaccuracies into one's description of social reality (p. 947).

Bachrach and Baratz argued that the reason both political scientists supporting power-elite theory or sociologists supporting pluralist theory were deeply methodologically flawed was a systemic failure to see the big picture. The titular two faces of power in agenda formation go partially or entirely unnoticed by both camps. The more relevant of these faces of power is the ability of a political actor to limit, or institutionalize a bias against, other actors from introducing new or outside choices:

To the extent that a person or group -- consciously or unconsciously -- creates or reinforces barriers to the public airing of policy conflicts, that person or group has power... Of course power is exercised when A participates in the making of decisions that affect B. But power is also exercised when A devotes his energies to creating or reinforcing social and political values and institutional practices that limit the scope of the political process to public consideration of only those issues which are comparatively innocuous to A. To the extent that A succeeds in doing this, B is prevented, for all practical purposes, from bringing to the fore any issues that might in their resolution be seriously detrimental to A's set of preferences? (Bachrach and Baratz, 1962, p. 947).

Indeed, one of the most powerful and most overlooked ways in which power-elites exercise their political influence is by making options that they are opposed to invisible, infeasible, or otherwise off the agenda. Baratz and Bachrach's view on agenda formation has been adopted by other political scientists. Floyd Hunter (1953) wrote:

Policy-makers have a fairly definite set of settled policies at their command... Often the demands for change in the older alignments are not strong or persistent, and the policy-makers do not deem it necessary to go to the people with each minor change. The pattern of manipulation becomes fixed... the ordinary individual in the community is 'willing' that the process continues... [while] the top leaders are in substantial agreement most of the time on the big issues related to the basic ideologies of the culture (p. 246).

In other words, Bachrach and Baratz's model of agenda formation relies on the unknowing consent of the people and the implicit approval of the power-elites. Hunter claims that the former and latter are achieved through back-room dealings "lumped under the phrase 'being practical', to keep down public discussion on all issues except those that have the stamp of approval of the power group" (Hunter, 1953). Most power-elite theorists, including Hunter, McNeill, and Hudson, identify the most powerful as being elected, wealthy, well-connected, or a combination. This shows how the power-elite model can be expressed under Bachrach and Baratz's methodology, because the top leaders of a democracy are clearly exercising power, not only to the exclusion of the majority, but to actively stifle and manipulate the greater population.

LFTR is a rational choice for sustainable energy development and absent from the agenda; but it is clearly not an unknown quality, as there are successful liquid-fluoride thorium reactor research and development programs worldwide. The Russian Kurchatov Institute is currently researching molten-salt reactors (AIP Conference Proceedings, 1995), the Korean Atomic Energy Institute has made several innovations in molten-salt reactor waste disposal (HS Park et al, 2007), and the South African Journal of Science recently published an article urging a re-examination of the ORNL experiments with liquid-fluoride thorium reactors (Rice, 2002). In

Japanese captains of the nuclear industry remain optimistic... Furukawa intends to build another molten-salt reactor by 2018

Japan, where the Nuclear and Industrial Safety Agency is organized within the Ministry for Economy, Trade, and Industry, regulations have historically been much more favorable to the nuclear industry, to the point that Japanese company International Thorium Energy & Molten Salt Technology, Inc., successfully built and operated a working, stable, commercial liquid-fluoride thorium reactor named FUJI in the 1980's and 1990's. The director of the project presented his findings, along with
Liquid-fluoride thorium reactors may not be at the forefront of energy research, but they are well-known enough that the LFTR option is actively being selected against in U.S. agenda formation. This thesis attributes LFTR’s absence from the U.S. energy agenda to three different causes for this: pro-fossil fuel power-elites “silencing” LFTR, problem definition, and how the energy shaped the environmental, political, and social discourses of Western society.

If Bachrach and Baratz are correct, then some political actor is exercising power in order to keep the choice of LFTR off the agenda. While precisely which political actors are exercising power to keep LFTR off the agenda is irrelevant to the thesis that political limitations are preventing the development, construction, and operation of liquid-fluoride thorium reactors in the United States, it may still be elucidatory to explore what groups are resisting LFTR. However, trying to identify political actors who are exercising power by making policy choices invisible is analogous to cryptid hunting: Bachrach and Baratz suggest identifying unknown policy actors confining the scope of decision-making by identifying every other political actor with the example:

If we can get our social life stated in terms of activity, and of nothing else, we have not indeed succeeded in measuring it, but we have at least reached a foundation upon which a coherent system of measurements can be built up... We shall cease to be blocked by the intervention of unmeasurable elements, which claim to be themselves the real causes of all that is happening, and which by their spook-like arbitrariness make impossible any progress toward dependable knowledge (Bachrach and Baratz, 1962).

What the duo are proposing is a kind of eliminative materialism, in that identifying all political actors visibly exercising power will also point to the political actors intervening “unmeasurably.” This methodology, while logical and philosophically sound, is exhaustively comprehensive to the point of being unfeasible for practical use. Sound though Bachrach and Baratz’s assessments of pluralism and power-elite theory may be, their proposed alternative methodology merely replaces fallaciousness with inaccessibility. Steven Lukes (2005) agrees, asking, “How was the researcher to investigate such ‘influencing’ (which they called ‘nondecisionmaking’) – especially if it went beyond behind-the-scenes agenda-setting, incorporation or co-optation of potential adversaries and the like and could be ‘unconscious’ and include the influencing of ‘values’ and the effects of ‘rituals?’” (p. 7) Consequently, this thesis will also examine the more orthodox theories of agenda formation.

How, then, can it be determined if energy policy is made by a political elite? Robert Dahl presented a testable hypothesis: if “the hypothetical ruling elite is a well-defined group; there is a fair sample of cases involving key political decisions in which the preferences of the hypothetical ruling elite run counter to those of any other likely group that might be suggested; in such cases, the preferences of the elite regularly prevail” (Dahl,
1958). If all of these conditions are met, Dahl argues, then the hypothesized political elite necessarily exists. It is clear that there exists a fair sample of cases involving decisions in energy policy in which the preferences of a hypothetical ruling elite run counter to those of environmentalists, nuclear advocates, alternative energy lobbyists, and so on. Defining the hypothetical power-elite, however, could be more difficult. Is there only one group suppressing LFTR? The existence of several groups that could otherwise qualify by Dahl’s standards may be mutually exclusive with the logic of the hypothesis. It may be difficult to prove some relationships within the realm of social science, but inferences can be drawn from the available data (see Table 1.)

A cursory glance at the most readily-available and transparent statistics on campaign donations and lobbying shows the power that fossil fuel industries wield. In 2012, coal mining PACs and individuals made campaign contributions more than six times as much as all alternative energy PACs and individuals, including stakeholders from the wind, solar, and nuclear sectors, did. Meanwhile, oil and gas PACs and individuals donated thirty-six times as much to campaigns (OpenSecrets.Org 2013). If campaign contributions correlate with political influence, then it is quite clear which industries have a stranglehold on the energy agenda (see graphic 1)

**Graphic 1: Histogram of 2012 Campaign Contributions by Energy Industry Sectors.** Oil and gas industry PACs and individuals out-contribute their alternative energy industry competitors more than thirty-fold. Graphic courtesy of Jason Olson.

American elections are increasingly unrepresentative because special interests, PACs, large corporations, and wealthy individuals have come to dominate electoral competition... Deliberation about public policy issues facing the country has become impossible as the sound bite, entertainment-oriented media coverage and candidate manipulation of symbols have come to dominate campaigns. And, finally, election outcomes have become less and less important for determining policy, which is now increasingly in the bureaucracy, the courts, and congressional committee rooms (p. 171).

Additionally, Hudson critiques the pluralist theory of policy making when claiming that one of the eight challenges of his book is the “privileged position” of business in American democracy by arguing that Big Business is a special interest group of unprecedented scale, rather than an array of discrete interest groups, and that this massive interest group receives special treatment in U.S. politics. This treatment has two faces, according to Hudson (2004):

It involves business and groups representing business actively manipulating the political system through lobbying, elections, and media propagandizing to attain their political objectives... The second face of business power... involves the power business wields over soci-
Hudson's treatment of a two-faced policy system originates in Bachrach and Baratz's "Two Faces of Power," in which the two authors systematically reject both pluralist and power-elite assertions, insisting that both ideologies are flawed at ideological and sociologically methodological levels (Bachrach and Baratz, 1962, p. 948).

Likewise, Dye describes a step-by-step policy-making process through a variety of models including institutionalism, rationalism, incrementalism that serve to evaluate the effect of pluralist theory and power-elite theory on policymaking. Baumgartner and Jones (1993) share Dye's assessment of incrementalism that "the American political system, built as it is on a conservative constitutional base designed to limit radical action, is nevertheless continually swept by policy change, change that alternates between incremental drift and rapid alterations of existing arrangements" (p. 236). On the surface, this appears to be congruous with the history of energy policy making: nuclear power in the United States is characterized by decades of stagnation punctuated by radical pushes away from the advancement of nuclear power in response to nuclear disasters like Chernobyl, Three Mile Island, and Fukushima, regardless of the circumstances or severity of these disasters. The impact of these disasters, such as the effect on the public opinion on nuclear power in the wake of these nuclear mishaps, as framed by the writings of Christopher Plein, D. A. Rochefort, Dye, and others, presents a convincing and comprehensive depiction of how the public fear of nuclear power is negatively influencing policy-making.

In addition to his work on policy formation in a broad sense, Dye (2008) also specifically addresses how various policy-making discourses shape nuclear energy policy:

Nuclear power is the cleanest and safest form of energy available. But the political struggle over nuclear power has all but destroyed early hopes that nuclear power could reduce U.S. dependence on fossil fuels. Nuclear power once provided about 20 percent of the nation's total energy... but under current policies it is unlikely that nuclear power will ever be able to supply any more energy than it does today... The nuclear industry itself is in a state of "meltdown," and the cause of the meltdown is political, not technological (p. 231).

Dye's assessment of the "meltdown" of nuclear energy is congruous with the claim that the limits on liquid-fluoride thorium reactor implementation are political rather than technical, as he puts the push back against post-WWII nuclear enthusiasm squarely in the hands of "a wide assortment of 'no-nuke' groups," including environmentalists, sensationalist media groups capitalizing on public misconceptions about nuclear power, and fossil fuel advocates (Dye, 2008, p. 232). While the rising costs of reducing the already minimal risks involved with nuclear power can make the rates offered by nuclear plants uncompetitive, many opponents of nuclear power argue that the cost of even a single nuclear accident is too great for any non-zero-risk system.

If Dye's models of policy formation are accurate, then Plein's analysis in "Agenda Setting, Problem Definition, and Policy Studies" becomes invaluable. Given a policy system like Dye's characterization of incrementalism, policy formation is relatively stable. Thus, Plein (1994) argues, "issue or problem definition, then, is at the center of policy change" (p. 702). In that vein, Rochefort and Cobb's The Politics of Problem Definition aims to "convey further, and in very concrete terms just how often and how profoundly the governmental process revolves around definitional concerns, irrespective of the nature of the issue, level of government, or institutional arena" (Rochefort and Cobb, 1994, p. 27). Perhaps part of what is holding back the research and development of molten-salt nuclear reactors in the United States is poor problem definition. That is to say, the problem of sustainable development in terms of generating electricity is defined, but the problem is being framed in terms of how policy can change to meet America's increasing demand for oil instead of how a policy change introducing a proven but forgotten technology can reduce or obviate our need for non-renewable fuel sources. Given that "cultural values, interest group advocacy, scientific information, and professional advice all help to shape the content of problem definition" (Rochefort and Cobb, 1994, p. 4), it may be possible to explore the nature and process of problem definition in nuclear energy policy by examining the influences exerted by the aforementioned forces. In this area, Plein (1994) argues, "problem definitions emanate increasingly from the institutional arena to the broader public arena. Public acceptance of an issue image, frequently through the proxy of the mass
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media, often is a prerequisite to successful agenda setting in the policy arena” (p. 702). If such is the case, the specter of long-gone and overblown nuclear disasters that haunt the public psyche is undoubtedly dampening any efforts to make widespread liquid-fluoride thorium reactor power a reality.

The Staying Power of Fossil Fuels

The way in which energy has shaped environmental and political discourses in the West contributes greatly to the immense policy inertia that fossil fuels enjoy.

The great modern expansion... brought disruption with it... Intellectually, politically, and in every other way, adjusting to a world of rapid growth and shifting status was hard to do. Turmoil of every sort was abandoned. The preferred policy solution after 1950 was yet faster economic growth and rising living standards: if we can all consume more than we used to, and expect to consume still more in the years to come, it is far easier to accept the anxieties of constant change and the inequalities of the moment. Indeed, we erected new politics, new ideologies, and new institutions predicated on continuous growth (McNeill, 2000, p. 17).

In addition to economic growth, the rapid gain in available energy resulted in an unprecedented population boom. Increasing levels of agricultural mechanization, combined with the invention of industry and commodity, resulted in expansion and growth on a massive scale. "In the period since 1950, population has increased at roughly 10,000 times the pace that prevailed before the first invention of agriculture, and 50 to 100 times the pace that followed" (McNeill, 2000, p. 9). Not only did fossil fuels bring into existence technologies and ways of life that would not have existed otherwise, they also brought humans. The rapid change that coal brought to society directly and indirectly shaped the future of global politics, and every change made by fossil fuels had unstoppable staying power, because "when an idea becomes successful, it easily becomes even more successful: it gets entrenched in social and political systems, which assists its further spread" (McNeill, 2000, p. 326). That same societal pressure towards endless growth became synonymous with market forces that conquered all else. People were fully aware of how harmful coal mining and oil drilling were in the 1800's, (McNeill, 2000, p. 300) but progress had to march ever-forward, even if that meant that indigenous populations were eradicated, rainforests trampled, lakes poisoned, and skies saturated with smog. The twentieth century focus on economic growth reorganized society and politics to meet its needs and mollify its victims. These are the market forces that discourage investment in nuclear power; thanks to heavy regulation, including mandated multi-billion dollar insurance policies, redundant licenses, “ratcheted” Nuclear Regulatory Commission policies which constantly require expensive changes made to plants already under construction, and sizeable front-end costs all heavily disincetivized nuclear development in the United States (McNeill, 2000, p. 312). To summarize the effects of coal on society: economic growth is just more efficient, more intense, more ubiquitous, or more innovative applications of the universal capital, energy.

Environmentalism

Every environmental discourse but the most radical have internalized the same immense societal pressure to continue acquiring and consuming more fossil fuels. "The most ecologically influential [ideas] probably were the growth imperative and the (not unrelated) security anxiety that together dominated policy around the world... both, but particularly the growth imperative, meshed well with the simultaneous trends and trajectories in population, technology, energy, and economic integration. Indeed, successful (that is, widely adopted) ideas had to mesh with these trends" (McNeill, 2000, p. 355). So, not only did the twentieth century growth emphasis directly shape much of Industrial Age politics and society, but a vast majority of competing ideas were tempered by the growth imperative in order to survive and succeed. What resulted were a series of environmental discourses that developed under the duress of the single most environmentally destructive acts in human history: “Both before and after 1970, for good and for ill, real environmental policy, both on the international and national levels, was made inadvertently, as side effects of conventional politics and policies,” the latter of course being shaped by the 20th century growth focus described by McNeill (McNeill, 2000, p. 354).

Examining energy policymaking through the lens of environmentalist discourse offers insight into the nature of agenda formation. Dryzek's The Politics of the Earth: Environmental Discourses concerns itself with the political and environmental pressures on policy-making with regards to energy, industry, and commerce. The environmental discourses described by Dryzek help the
reader to understand the socio-economic forces and political actions behind public policy through the lenses of different environmental theories. According to Dryzek, Survivalism is simply the idea that the world is incapable of infinitely absorbing pollution and endlessly supplying resources, and therefore needs to be protected as a natural resource and a “sink” for pollutants. Survivalism holds little explanatory power in American policymaking, as Dryzek describes Prometheanism -- the set of political and ecological beliefs stemming from the idea that natural resources cannot effectively or meaningfully run out, that the planet can absorb more pollutants than human industry can produce, or both -- as both more tempting and more ubiquitous in American politics. Dryzek defines Administrative Rationalism as an environmental discourse characterized by the delegation of problems to relevant experts for solutions; a bureaucratic approach to environmental policy issues. Finally, Dryzek frames Democratic Pragmatism as the most democratic environmental discourse, in that it enables the public to decide on environmental policy issues. While the dominant environmental discourses in American policy making are Prometheanism and Administrative Rationalism, more pro-environmentalism discourses have historically been applied when making policies regarding nuclear power. (Dryzek, 2005). Additionally, the discourse of Democratic Pragmatism may prove to be the best candidate for describing the public attitude – and by proxy the democratic involvement in selection of energy policy toward nuclear power – following Three Mile Island, Chernobyl, and Fukushima.

The effects of these nuclear disasters on energy policy are tremendously far-reaching, if the pluralist model is correct. In polls after the Three Mile Island Incident, approval ratings of continued nuclear development had dropped sharply: “There existed a minority opposition [to nuclear power] of just under 20 percent as early as 1970... After TMI, opponents outnumbered supporters by 60 to 30” (Baumgartner and Jones, 2009, p. 80). Nearly overnight, majority support for a policy was replaced with majority opposition to the same policy. Whether this was a direct result of the near-meltdown or a precipitate of media manipulation, as Baumgartner and Jones imply, is less clear.

Policy-making intersects with technical feasibility at the proposed Yucca Mountain nuclear waste storage facility. From the very beginning of the Yucca Mountain facility in 1982, energy policy has been in the hands of the people who do not necessarily understand energy. First, the Department of Energy was arbitrarily mandated by Congress to select Yucca Mountain as the site for a permanent storage facility after five years of circular congressional debate characterized by protesting Nevada state officials, environmentalists, and scientists who considered the site to be unsafe. In fact, the political battle over Yucca Mountain is arguably the incident in energy policy formation in which power is diffused among so many different groups, per pluralism. Federal and state-level Congressmen, the EPA, the NRC, concerned citizens, Nevadan captains of industry, and scientists all influenced the outcome of a policy decision no one could be proud of:

The Yucca Mountain site has become exemplary of what happens when there are dueling scientists and inconsistency among studies that have discovered various flaws in design and siting... [later findings] led Nevada officials to claim that the site should be disqualified. Hydrologists and officials of the Nuclear Energy Institute (a trade association for nuclear utilities) disagreed, however (Switzer, 2004, p. 155).

Carter, Barrett, and Rogers attribute President Obama’s withdrawal of the application for a nuclear waste disposal facility in Yucca Mountain, Nevada, to a combination of prerogative reactions to party lines and political pressure from anti-nuclear interest groups. Accusing President Obama of killing the Yucca Mountain storage application in order to match Hilary Clinton’s own condemnation of the proposed program, the authors accuse the Obama Administration and the Nuclear Regulatory Commission of endangering future generations by perpetuating a status quo which is “comfortable not having a repository until sometime well beyond the year 2100, when our great-grandchildren may be left to worry about the disposal of nuclear waste arising from the generation of nuclear electricity from which we benefit today” (Carter et al, 2010, p. 82). The fact that the NRC and Blue Ribbon Commission on America’s Nuclear Future have been coerced into the inherently less-safe storage paradigm of one-hundred and twenty above-ground temporary facilities rather than a permanent, deep underground solution is a testament to the dismal state of nuclear policy, Carter et al (2010) argue (p. 82). While not explicitly concerning the adoption of liquid-fluoride thorium reactor technology, the article does highlight how non-rational policy formation is due to influences by “Not in My Backyard” (NIMBY), partisan politics, and power “bought” by fossil fuel titans interested in maintaining the status quo. Such a combination
as seen in “Nuclear Waste Disposal: Showdown at Yucca Mountain” showcase a precedent for the categorical denial of the advancement of nuclear power for non-rational reasons.

Conclusion

This thesis has adequately demonstrated that liquid-fluoride thorium reactors are visibly absent from the energy agenda in the United States. Based on the literature review, it can be said that if this thesis contributed anything to the overlap between the studies of liquid-fluoride thorium reactors and public policy, it is something that LFTR advocates and innovators knew but perhaps did not articulate in such words: From the beginning, nuclear development has been characterized by seemingly random and unscientific decisions by politicians and generals. The inability of LFTR innovators and advocates to breach the invisible barrier posited by Bachrach and Baratz is a direct result of flawed agenda formation due to a combination of power-elite interests in keeping fossil fuels on top and pluralist fears of nuclear power. All of this arguably stems from the immense environmental and sociopolitical impact on an entire way of life that the rapid growth caused by coal in the Industrial Revolution left on the Western world.

The inability of LFTR innovators and advocates to breach the invisible barrier...is a direct result of flawed agenda

This thesis is not without its caveats. As stated when exploring the two faces of power described by Bachrach and Baratz, this thesis did not apply the eliminative methodology of identifying all political actors who influence energy policy. Again, this is more of a restriction of the scope of this thesis than an issue with Bachrach and Baratz’s methodology. Theirs was examined in order to highlight a flaw in the existing pluralist theory and power-elite theory, before either theory could be used to examine the influence of political actors on energy policy and agenda formation.

Another possible weakness of this thesis is that McNeill’s account of the history of energy, while convincing, is mostly unfalsifiable. While it is true that fossil fuels do appear to enjoy an immense kind of political inertia, some of the details of McNeill’s history, especially his argument that prehistoric wars were fought for greater control of somatic energy, stay standing because it is im-

possible for any opposing argument to produce count-evidence. Regardless of the philosophical underpinnings of McNeill’s more overarching arguments, he was able to clearly attribute the political inertia enjoyed by fossil fuels today to the rapid social inertia brought about by coal.

Author Reflection

Don’t do nuclear policy, kids. You say “just a little LFTR, just to see how it feels,” and then it’s five o’clock in the morning and you’re compiling tables of neutron energy and megawatt-hour levels by reactor fuel, coolant, and moderator when you just know it won’t even make it into your final draft. That’s how you know you’ve stumbled onto a topic you should be researching for more than a grade, though: it wasn’t simply about graduation, or getting my thesis done, or surviving senior year, or any of the other tiresome clichés and tropes of undergraduate pursuits; it was just about learning what I wanted to learn.

I don’t remember when I first started reading about LFTR’s, but I recall first asking the question of how scientific or rational the historical choices made in early nuclear submarine development were, in response to an example of a kind of mathematical problem solving that Professor Wheeler modeled in his Discrete Structures class. My thesis topic was definitely a natural progression of my scientific and political interests, so it was just a matter of taking the theory I’d been asked to absorb for four years and applying it to something I was interested in.

That’s hopefully what I’ll continue to do from now on. In the fall, I’ll be attending the University of Delaware to earn my Master’s of Public Policy while working at the Center for Community Research and Service. No one ever ends up doing with their degree what they set out to do, but I would be very interested in doing policy analysis at some point in my career.

References


A Thank You from the Editor

By Jacelyn Peabody

One of the most important steps in research is inviting one's peers to partake in the discoveries, so thank you for aiding in the diffusion of knowledge with your readership. The co-founders of this journal were inspired to take on this endeavor in order to fill a discernible void in publishing venues for undergraduates. The Carthage Vanguard is unique because it is the only completely student-run interdisciplinary undergraduate research journal in the nation. We started this journal to help provide a venue for our driven peers to share their research with the broader undergraduate community, to realize academic growth beyond the classroom, and to make them more competitive applicants in the graduate school market.

Looking forward to the next issue of The Carthage Vanguard, I would like to share one of my favorite quotations by the inspirational physicist Cecilia Payne-Gapschkin.

“The reward of the young scientist is the emotional thrill of being the first person in the history of the world to see something or to understand something. Nothing can compare with that experience... The reward of the old scientist is the sense of having seen a vague sketch grow into a masterly landscape.”

This quotation applies not only to scientific study, but also to all fields in which research is conducted; one must simply replace “scientist” with “researcher.” The Carthage Vanguard strives to facilitate research early at the undergraduate level by providing a venue for young researchers to publish and to share their work. We received many phenomenal articles and I would like to thank and congratulate the authors on their publication in The Carthage Vanguard. It is contributions like yours that will make this into the journal we envisioned. I am elated to see how The Carthage Vanguard will grow in the coming years.

With that, I welcome all entries for the next issue of The Carthage Vanguard! We will be going national, therefore all articles of exemplary research are encouraged. Submissions can be sent to research@carthage.edu

Warmest regards,

Jacelyn Peabody

Editor in Chief
Natural and Computational Sciences
The *Vanguard* is going national!

Submissions can be sent to the Vanguard staff at research@carthage.edu