The Undergraduate Review
A JOURNAL OF UNDERGRADUATE RESEARCH AND CREATIVE WORK

Urchin #3, copper fused with crystals, by Sarah Davis

Ackley, Amaral, Baker, Binns, Boucher, Bournazian, Buckley, Christenson, Concannon, Connery, Covert, Flint, Foote, Forina, Klapatch, Lydon, MacMurdo, Martin, Murphy, Oquendo, Riedlen, Ris, Rousseau, Spagna, Spicer, Sprague, Sun, Tully, Werhessen
Letter from the editor

Wow. Ten volumes.

Double-digits. The big one-ooh. Honestly, I hadn’t really thought too much about it this past year, until I recently created a new library area in my home. While carving out the space, I lifted my stack of URs and realized, Man...I’m going to need an entire shelf...Holy moly these are heavy...This is a lot of research...Just how much research IS in these? (Does that count as deductive reasoning?) In similar fashion to inquiry-based research, I set out to answer a question. I spent the next few days thumbing through the old volumes, taking note of the diversity of disciplines, the beautiful art and puzzling equations—Oh, physics, how you still aim to shame me!—and determined that my letter to you in this tenth issue of the journal would share my research on The Review.

In just ten years’ time this journal has published 1764 pages of research conducted by 257 BSU undergraduates who were mentored by 110 BSU faculty members. Of these 257 students, the journal has showcased the results of 100 Adrian Tinsley Summer Grants, 59 National Conference on Undergraduate Research (NCUR) presentations, 42 disciplinary conference talks, 5 Shea Scholar recipients, 25 honors thesis excerpts, 3 Posters on the Hill presentations, 82 projects written for courses, as well as the work of 10 students who, among them, traveled abroad to China, Israel, Jordan and India. The 1764 pages represent 27 majors, offering insights and findings on literary analyses; the importance of language and art and cultural identity; social injustices; education reform; economics; computer programming and coding applications and logistics; mathematical, biological, chemical and physical probabilities; tectonics; environmental concerns and sustainable solutions; and biomechanics.

Pretty impressive for a ten year old. It is clear that The Undergraduate Review reflects the climate of the Bridgewater State University campus: encouraged, enlightened, and engaged—a direct result of the dedication of faculty and the support of our university leaders.

The staff of The Undergraduate Review would like to thank the Adrian Tinsley Program (ATP) for its continued support and funding of the journal, the Office of the President, The Office of Undergraduate Research, and the faculty reviewers. Mostly, thank you to all of the dedicated students and mentors for their time, effort, and hard work on display not only here, but for the last ten years. We celebrate together.

It is my pleasure to present to you Volume X of The Undergraduate Review.

STACY MOSKOS
Managing Editor
Letter from the Director of Undergraduate Research

A Decade of Sharing Student Success in The Undergraduate Review

One of the aspects of high-impact undergraduate research that distinguishes it from “ordinary” academic work is its dissemination. Part of the thrill of discovery and creation of new knowledge includes sharing the results with peers, experts, and the broader community. Students gain immeasurable benefits from sharing what they have learned; they take greater pride in and responsibility for their work when they have an authentic audience; and in listening to others’ questions and responses, they refine their thinking and deepen their understanding of the topic. That iterative process of putting forth one’s findings, receiving feedback from others, devising new questions, and revising one’s initial ideas defines scholarly work.

This journal has been providing to Bridgewater students that exceptional opportunity of engaging in scholarly dialogue for the past ten years. In print and electronic forms, The Undergraduate Review shares outstanding student research and creative work with other BSU students (especially as faculty across the curriculum use its published pieces as models in their research-methods courses) as well as faculty, staff, alumni, friends of the university, and audiences well beyond the campus community. Students share the URL with graduate-admissions officers and potential employers, and they pass along hard copies of the journal to their extended family and friends. Due to the journal’s inclusion in Maxwell Library’s Digital Commons, scholars around the world are finding our students’ articles in Google searches of their various topics, several hundred times per volume.

Bridgewater State University invests in this journal because we recognize the value to students of participating meaningfully in an intellectual community and contributing to the ongoing dialogue in a field of study. We know that seeing one’s name and work in print, feeling the heft of the bound volume, even smelling the paper and ink, bring unparalleled satisfaction of a job well done. And receiving updates from the Digital Commons about how many times one’s essay has been recently downloaded is wonderfully rewarding. Beyond those immediate rewards of publication, students have in this journal a distinct and powerful medium for scholarly discourse—one that extends the exciting immediacy of a conference presentation to the further reach and permanence of publication.

My hope is that months and even decades after the initial pride and joy of holding their first publication in their hands, the student-authors featured in The Undergraduate Review will return to their pieces with deep satisfaction—reflecting on what they knew so well about a particular subject at a particular point in their life of learning; perhaps poignantly realizing how their subsequent experiences and emerging knowledge in the field have taken their thoughts in new directions. And, in the rewarding give-and-take of scholarship, they may muse about how their own published essay in turn helped shift the thinking of other inquisitive scholars who have had the privilege of learning from them.

JENNY OLIN SHANAHAN, PH.D.
Director of Undergraduate Research
Bridgewater State University
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The staff of *The Undergraduate Review* thanks these faculty reviewers for their time and effort in evaluating the manuscript submissions we received for this issue. Thank you to the Adrian Tinsley Program (ATP) for funding the journal and the Office of the President and Division of Academic Affairs for outstanding support of undergraduate research at Bridgewater State University. And many thanks to the dedicated students and faculty mentors whose excellent work is on display here.
On the cover: “Urchin #3” by Sarah Davis (’14). With the support of a 2013 ATP Summer Grant, Art major Sarah Davis researched and practiced the metalsmithing techniques of repoussé and chasing to create a grouping of small-scale, bowl-like sculptures that explore the visual and textural surface relationship between exterior and interior spaces. The forms and textures are inspired by sea urchins, especially the juxtaposition between their knobby, patterned exteriors and their smooth interiors as well as their rounded, orb-like forms. Sarah works with nonferrous metals such as copper and brass and incorporates accents, such as cast glass elements, crystals and freshwater pearls. Her sculptures include a variety of surface treatments, including patinas, polishing, sandblasting, and enamel painting.
Brandon Ackley is a junior Chemistry major with a concentration in professional chemistry. Brandon began doing research in the summer of 2011 as part of the STREAMS (STudent REtention Across Mathematics and Science) Summer Bridge program. STREAMS invites 16 incoming freshman in the STEM field to participate in 3 weeks of intensive class and research work. Brandon conducted this research under the mentorship of Dr. Edward Brush (Chemistry) with funding from a 2013 Adrian Tinsley Program summer research grant. Brandon presented this research at the 247th American Chemical Society National Convention in Dallas, TX.

Brandon Ackley

In 2011, the U.S. consumed over 18 million barrels per day of refined petroleum products and biofuels; almost 22% of global petroleum consumption. This includes oil used for transportation, electricity, and production of consumer products. More than half of this oil was imported from foreign countries, and in his 2006 State of the Union Address President Bush warned that, “We have a serious problem, America is addicted to oil, which is often imported from unstable parts of the world”. With the need for new energy sources more apparent than ever, serious research is needed to further the advancement of alternative fuels, so that they may become a more practical source of energy. Biodiesel is an alternative fuel to petroleum diesel, and is produced from renewable and/or recycled resources. Biodiesel’s benefits include reduced emissions of unburned hydrocarbons, carbon monoxide, particulate matter and nitrogen oxides, plus reduction of greenhouse gas emissions. The process of making biodiesel involves transesterification of triacyl-glycerides in Waste Vegetable Oil (WVO) with methanol, using potassium hydroxide (KOH) as a catalyst, Figure 1.

Figure 1. Traditional Transesterification Reaction of Vegetable Oil into Biodiesel.

Research in Dr. Brush’s group has focused on developing an efficient and cost-effective process for converting 50 liter (13 gallon) batches of Waste Vegetable Oil (WVO) from BSU cafeterias into biodiesel fuel for campus use. However, in a detailed analysis of our efficiency in producing biodiesel by this traditional process, we found that this “simple” transesterification reaction is only one small part of a complex, interrelated, and inefficient overall production process.
Trans-esterification is an equilibrium chemical reaction, and at some point a “balance” is reached and reactants are no longer converted into products. In order to “force” this balance in favor of biodiesel formation we use an excess of methanol to ensure that all of the WVO reacts to form biodiesel. The excess methanol must be removed as it is flammable and can cause pre-ignition problems in a diesel engine. Furthermore, the KOH catalyst is strongly basic, corrosive and an irritant, and is essentially hazardous waste. The most significant obstacle involves washing the crude biodiesel with water to remove excess methanol, KOH catalyst, and glycerol byproduct. Failure to remove these chemicals results in engine corrosion, making the biodiesel useless. The washing process is time-consuming and water-intensive, requiring two volumes of water for each volume of biodiesel produced.

Green chemistry is the science of making smart, sustainable decisions in how we design, make, use and dispose of chemicals. Green chemistry is incredibly important today: the production of chemical products generates hazardous waste that damages the environment, resulting in unintended exposure to humans. Table I summarizes the 12 Principles of Green Chemistry, which provide a general framework for a sustainable future in the design of more efficient technologies to produce consumer products that are better, safer and cheaper. Our research was focused on applying appropriate Principles to develop an efficient and cost-effective process for converting WVO into biodiesel. For this research project we determined that Principles 1, 2, 3, 6, 9 and 12 were most relevant towards improving the efficiency of the biodiesel process.

Table 1. The 12 Principles of Green Chemistry.
(Principles in bold were applied to this research)

| #1. Preventing hazardous waste. |
| #2. Maximizing the Atom Economy. |
| #3. Decreasing or eliminating all hazards in the chemical synthesis. |
| #4. Design functional chemical products with minimal toxicity. |
| #5. Minimize the use of solvents and auxiliary substances, and employ safe |
| #6. More efficient use of water and electricity. |
| #7. Use renewable raw materials for feedstock. |
| #8. Minimize or avoid derivatization and additional reagents. |
| #9. The use of safer, more benign catalysts. |
| #10. Design chemical products that break down in the environment. |
| #11. Develop analytical methods for real-time monitoring of hazardous substances. |
| #12. Preventing accidents through inherently safer chemistry. |

In this preliminary study, our initial focus was on Principles #6 and #9, and we selected and evaluated boric acid and sodium borate as catalysts for transesterification. These compounds are less hazardous than KOH, and if found to be effective catalysts they would reduce the energy required for heating our reactions. Furthermore, we believed that Principle #2 was relevant as boric acid and sodium borate may react with and remove the glycerol byproduct, essentially forcing the equilibrium to completion, and avoiding the need for excess methanol (Figure 2). Finally, by removing the glycerol byproduct during the reaction we would use less water during the washing and extraction step (Principle #6).

Preliminary Results and Discussion:
We carried out a number of small-scale room temperature reactions to evaluate the effect of boric acid and so-

Figure 2. Proposed Reaction of Boric Acid with Glycerol to Form Glycerol-Borate.

Figure 3. NMR spectrum of biodiesel product obtained from the standard transesterification reaction. General reaction conditions: 50g WVO, 4.96g methanol, and 0.175 g of KOH catalyst were mixed together and stirred for 60 minutes at room temperature (about 25°C). Reactions were extracted with 3 x 20 mL of water, and 0.002 g (1 drop) of the product mixture was dissolved in 1.0 mL of deuterated acetone, and the NMR spectrum was recorded. For test catalysts we used 1%, 5%, and 10% by mole amount (catalyst/theoretical glycerol amount).
dium borate as transesterification catalysts, and analyzed these reactions using Nuclear Magnetic Resonance spectrometry (NMR). Figure 3 illustrates the NMR from our traditional synthesis and purification of biodiesel (Figure 1), and our general reaction conditions are given in the legend.

Although NMR analysis of our small scale reactions using either boric acid or sodium borate did show the biodiesel signals seen in Figure 3, we also observed a substantial amount of unreacted WVO, suggesting that neither of these compounds were effective catalysts for transesterification with methanol, either on their own or when added in combination with KOH catalyst. Sodium borate gave the most encouraging results as NMR analysis suggested a very slow, continuous formation of biodiesel product; however, the reaction did not go to completion. Our conclusion from this preliminary work is that neither boric acid or sodium borate would be suitable catalysts for WVO transesterification.

We did notice that the NMR spectra from these experiments indicated very little contaminating glycerol, implying that boric acid and sodium borate might have potential for purifying biodiesel. Boric acid in particular may improve the efficiency of the water wash by: (1) KOH neutralization, and (2) glycerol extraction. We are following up on this idea by evaluating the effect of KOH-borate additives on the reaction equilibrium, and the effectiveness of acidic washing using aqueous boric acid.

**Future Work:**
In order to complete our evaluation of the effects of boron compounds on biodiesel production efficiency, we are conducting a more detailed assessment of sodium borate as a chemical additive (with KOH) to help push the equilibrium reaction to completion by removing the glycerol byproduct. We will also follow up on our preliminary results suggesting that boric acid increases the efficiency of the water wash of crude biodiesel by both neutralizing the KOH catalyst and binding the glycerol byproduct.

**Acknowledgements:**
I would like to thank Dr. Edward Brush for helping me through every step of this project, and the Adrian Tinsley Program and Center for Sustainability for funding this research.

**Literature Cited:**
**Circadian Rhythms Using a Non-Insulin-Dependent Type-2 Diabetes Mellitus Mouse Model**

**Danielle Amaral**

Type 2 diabetes mellitus is a chronic disease that affects the lives of millions. A type 2 diabetic is unable to properly produce insulin, a hormone that helps glucose enter the cells. As a result, there are high levels of glucose in the bloodstream, which can lead to heart disease, kidney and nerve damage and loss of eyesight. It is well known that some individuals are genetically prone to the disease, and studies have shown that a disrupted sleep/wake cycle can increase an individual’s chance of developing diabetes. Insulin is secreted in a predictable daily (i.e., circadian) pattern from the pancreas, and a functional biological clock is necessary for proper insulin release. In addition, studies have shown that diabetes affects some of the genes which regulate the circadian rhythm, such as period, clock, and bmal1. Given that there is a relationship between circadian rhythms and diabetes, this study investigates the selectively bred TALLYHO/Jng (TH) mice which develop type 2 diabetes at ten weeks of age, mimicking human diabetes symptoms such as hyperglycemia, hyperinsulinemia, obesity, and enlargement of the islets of Langerhans in the pancreas. Eight male TH mice running-wheel turn activity was observed under constant darkness for the course of several weeks. Their free running rhythms were observed pre-and-post onset of diabetes. TH displayed less activity but more frequent bouts per day than the wild type mouse C57BL/6J. TH mice with access to a running-wheel were significantly lighter when compared to studies done by Kim et al, 2006 and Steward et al, 2010, in which TH mice did not have access to running-wheels. Since there is such a weight difference among the mice from different studies, the blood glucose levels were measured for running and non-running mice. Access to running-wheel cage shows to cause long term reduction of diabetes symptoms.

**Introduction**

Type 2 diabetes mellitus (T2DM) is the most common form of human diabetes affecting 23.2 million Americans. As of 2012, the total cost of treating people diagnosed with diabetes in the United States is approximately 245 billion dollars according to the American Diabetes Association. Type 2 diabetes occurs when the body is unable to produce enough insulin or else the insulin does not work properly. Therefore, insulin is unable to assist glucose in entering cells and it cannot be used as an energy source. Long-term complications from high blood sugar include heart disease, diabetic retinopathy, kidney failure and poor blood circulation which may lead to amputations. External factors such as obesity, diet and lifestyle contribute to the occurrence and maintenance of the disease. The importance of a proper sleep cycle is...
fundamental for glucose homeostasis, because sleep allows the body to restore proper metabolic and hormonal (i.e., insulin) processes (Tsumura et al., 1999). A normal glucose tolerance depends on the pancreatic beta cells to efficiently produce insulin, and a type 2 diabetic also develops insulin resistance which can lead to higher blood sugar levels. As a result, patients suffer from insulin resistance, improper insulin secretion or a combination of both.

The pancreas releases insulin in a daily rhythm, i.e., in a circadian pattern (Peschke et al., 1998). A circadian rhythm is an approximate 24 hour long daily rhythm that controls our physiological and behavioral processes that synchronizes to environmental cues, such as light. Once an organism is isolated from an environmental factor (i.e., light) a free-running rhythm emerges, which is usually 30 minutes longer or shorter than the average 24 hour daily cycle. A stimulus that directly affects the free-running period affects the biological clock. In mammals, the suprachiasmatic nuclei (SCN), is responsible for synchronizing all the biological processes in response to daily events. The SCN maintains the circadian rhythms as hierarchically organized oscillators, including the pancreas. One of the most well known ways to investigate a circadian rhythm is through analyzing the sleep-wake cycle. Physiological and behavioral alterations have been recorded in mice and humans who experience a disrupted sleep cycle. Perturbations to this cycle lead to an increase in appetite, weight gain and increased chances of developing type 2 diabetes (Kawakami et al., 2004, Morikawa et al., 2005). Therefore an organism that suffers from type 2 diabetes has an impaired daily insulin secreting cycle, which can result in glucose intolerance (Pesche et al., 1998). The lack of a functioning pancreatic circadian rhythm leads to altered insulin production by the beta cells of the islets of Langerhans, which are critical for glucose homeostasis (Sadacca et al., 2010). In addition, glucose tolerance has been found to be lower in patients who are sleep deprived (Spiegel et al., 1999). Studies have also shown that diabetes affects critical genes, which regulate the circadian rhythm, such as “clock”, “bmal1” and “period” (Marcheva et al., 2010). Since there is a connection between diabetes and the biological clock, our study aims to uncover the physiological and behavioral aspects of the circadian rhythm in a selectively-bred, non-insulin dependent type 2 diabetes mellitus mouse model, TALLYHO/JngJ (TH).

TH mice show a comparable genetic basis to diabetic humans, as they develop hyperglycemia, hyperinsulinemia, obesity, and enlargement of the islets of Langerhans in the pancreas, at ten weeks of age (Kim et al., 2001, Kim et al., 2006, Stewart et al., 2010). While there are many studies showing the connection between the circadian rhythm and diabetes, few studies have investigated the free-running rhythm of diabetic organisms. Since diabetic humans may show altered sleep cycles, the study explored whether type 2 diabetes affects the sleep and wake cycles (Spiegel et al., 1999). It investigated the free-running rhythm, daily activity levels pre-and post-onset of diabetes in TH mice and other circadian parameters compared to wild type mouse C57BL/6J. It further explores whether access to a running-wheel cage alleviates diabetes symptoms such as body mass and glucose levels.

Methods

Eight, five-week old, male TallyHo/JngJ (TH) mice and fifteen male C57BL/6J (B6) mice were purchased from Jackson Laboratories (Bar Harbor, ME) and housed individually in running wheel cages (Minimitter, Bend, OR, diameter 16.5 cm). Running-wheel activity was monitored using the Vital View Interface System (Minimitter) and analyzed using ClockLab analysis software (Acitmetrics, Wilmette, IL). All mice were given water and standard mouse chow (Lab Diet 5001) ad libitum. Food and water consumption, and changes in body mass were recorded weekly.

The mice were initially maintained on a 12:12 Light:Dark (LD) cycle from 0600 to 1800 hours for 3-weeks to determine the entrainment and activity profiles of the TH mice. After those 3-weeks, the animals were placed into constant darkness (DD). As TH mice develop the symptoms of Type-2 Diabetes at 10-weeks of age, the first 2-weeks of DD were used to calculate the free-running period (i.e., the behavioral circadian rhythm) before the onset of the disease. The second 2-week epoch (10-12 weeks of age) was used to determine if any changes in the behavioral free-running period emerges after the onset of diabetes. Circadian rhythm parameters (free-running period, circadian activity profiles) were determined for each of the experimental epochs. Free-running circadian period was determined using the x² periodogram analysis, a well-established method in the ClockLab analysis routines. The total number of daily wheel turns was also determined for each animal and for each epoch of the experiment. A bout analysis for both LD and DD was conducted for all genotypes. An activity bout was defined as being greater than or equal to the average size of activity counts across the day, separated by at least ten minutes of inactivity. The mean length of time (minutes), beam crosses per bout, and number of bouts per day were analyzed. At 26 weeks of age, four mice were moved to a non running-wheel cage while four mice remained in running-wheel cages. Blood was obtained by snipping the tail with a 25 gauge needle and collecting 50 µl with a test strip. Glucose levels of weeks 28 and 30 were obtained using One-Touch Ultra Glucose Meters.

Statistical analyses were performed to calculate differences in
the circadian (period, wheel turns) and physiological (food, water, body mass, blood glucose) parameters between the two genotypes as well as throughout the course of the study. The experimental procedures described in this report were reviewed and approved by the Bridgewater State University’s Institutional Animal Care and Use Committee (IACUC 2013-08).

Results

Free Running Period and Activity Profile
TallyHo (TH) mice are able to successfully entrain to an LD cycle and show a robust circadian activity rhythm in DD (Figure 1). A paired t-test revealed that there is no significant change in the average free running period lengths pre- (23.72 h) and post- (23.75 h) the onset of diabetes (p=0.50 – Figure 2). In addition, there are no significant differences (all p>0.10) between pre- and post-diabetic TH mice, respectively, regarding average wheel turns per day (28.62, 24.16), average counts per bout (586.63, 442.93), average time per bout (46.49, 40.36), and number of bouts per day (8.30, 8.67).

Comparison of TallyHo/Jng and C57BL/6J
When compared to C57BL/6J mice (49.36), TallyHo mice (28.62) exhibit significantly lower locomotor activity in terms of average of number of wheel turns per day (p=0.016). Additionally, TH mice, when compared to B6 mice respectively, display more bouts per day (8.30, 5.11; p=0.015), but significantly shorter average bout length (46.49, 96.58; p<0.001) and reduced wheel turns per bout (586.63, 1402.72; p=0.004 – Figure 3). Thus, it appears that B6 mice have higher and more concentrated levels of activity compared to TH mice. There were no differences found between TH mice and B6 mice, respectively, regarding average free running circadian activity period in DD from weeks 8 through 10 (23.72, 23.72; p=0.97).

Food Intake and Body Mass
TallyHo mice food intake significantly increased from week 6 to 7 (p=0.025); however, paired t-tests with Bonferroni Correction for multiple comparisons revealed that food intake leveled off as they aged (all p>0.10 – Figure 4). As expected the body mass increased; however, there is no correlation (Pearson's Correlation – all p>0.10) between food intake and weight gain during the course of the experiment. A paired t-test showed
that weeks 5, 6 and 7 are significantly different from each other (all p<0.05); however, no differences were found from week 8 onward (p>0.10). An independent t-test revealed that our TallyHo is significantly heavier than our age matched C57BL/6J (p=0.003), which confirms results from previous experiments showing that TallyHo mice are consistently heavier than C57BL/6J mice. Additionally, TallyHo mice from the current experiment were noticeably lighter than TallyHo from previous studies (Kim et al., 2006, Stewart et al., 2010) at 8-weeks of age (Figure 5). Further investigation showed that the body mass reduction in the current study persisted over the next eight weeks (Figure 6). This result is different than what Rhee et al., 2010 found, where obesity in TH mice was directly correlated with increased food intake.

Double plotted free running activity profiles of diabetic TallyHo/Jng (TH) (left) and C57BL/6J (B6) (right). B6 mice show increased wheel turns per day and increased bout length, but reduced bouts per day than TH mice.

Graph on the left displays the food intake from week 6 through week 18. Graph on the right illustrates the body mass increase as the mice aged. There is no correlation between food intake and increased body weight for any of the weeks tested.
Blood Glucose Levels

The blood glucose levels are significantly lower than TH mice from previous studies (Figure 7). For the current experiment blood glucose levels for TH mice, weeks 28 and 30 were not significantly different between running and non-running mice. Upon removal from running-wheel the body mass increased; TH mice without access to running-wheel showed a higher body mass compared to mice kept in running-wheel cages (P=0.039) (Figure 8). These results suggest that exercise in the form of wheel-running leads to long term alleviation of diabetes symptoms, including obesity and glucose levels, but upon cessation of exercise, only blood glucose levels maintained stable while body mass significantly increased.

Figure 5.

The bar graph represents the body mass difference between C57BL/6J and TallyHO along three different studies at 8 weeks of age. TH mice are significantly heavier in all three studies compared to B6 mice. Additionally, access to wheel running from current study caused the TH mice to show reduced body mass compared to previous studies where TH mice had no access to wheel running. B6 mice from current study were purchased at 8 weeks of age and had no access to running-wheels.

Figure 6.

Bar graph displays TallyHO body mass from three different studies along the course of eight weeks. Wheel running access produced a reduction in body mass compared to two previous studies. While the TH mice from current study continued to gain weight over the course of the study, this reduction in body mass compared to previous studies persisted for eight weeks with continuous access to running-wheels.

Figure 7A.

Bar graph on above represents a 4-hour fasting glucose levels in male TH mice compared among two other studies and current study, which shows a large difference in blood glucose levels. Bottom graph shows TH mice blood glucose for running and non running mice. No differences were found; however, a small sample was used.

Figure 7B.
Discussion

The present study in TallyHo mice found that there are no significant differences pre- and post-onset of diabetes in terms of the behavioral circadian activity rhythm or activity profile, as TallyHo mice did not display significant alterations in activity levels and free running circadian period after the development of Type 2 diabetes. These findings suggest that diabetes does not directly affect the behavioral clock. It also suggests that the behavioral free-running period should be considered independent of the diabetic phenotype, whenever studies investigate this particular mouse model.

A detailed investigation of wheel-running behavior during DD revealed that TallyHo, when compared to sex and age match C57BL/6J mice, displayed significantly less locomotor activity. As TallyHo mice are consistently heavier than B6 mice throughout the courses of this and previous experiments (Kim et al., 2006, Stewart et al., 2010), the increased body mass may be having an impact on the ability of TH mice to run on the running-wheel, causing their activity to be reduced overall, but also more “choppy” with increased number of bouts per day, but each bout having reduced number of wheel turns and time. Still, the TH mouse was developed on a different background strain (Swiss) than the B6 mouse. As the B6 mouse is considered a “high-locomotor activity” mouse strain (Jackson Labs), differences in background strain cannot be ruled out as a possibility for the source of the activity level differences found between the two strains.

Our TallyHo are significantly lighter than mice from previous experiments (e.g., Kim 2006 and Stewart 2010); these results suggest that an accessibility to a running-wheel affects body mass. In addition, mice see wheel running as a rewarding activity, as voluntary wheel running increases the dopaminergic system pathway (O’Dell et al., 2007). Previous studies have shown that increased body weight due to fat deposits can decrease dopamine signaling within the brain in humans (Wang et al., 2001). Additionally, both insulin and leptin are inhibitors of dopamine (Palmeter, 2007), while application of dopamine agonists can induce a decrease in body weight in rodents (Chen et al., 2001). As TH mice show increased fat deposits, and increased leptin and insulin, and decreased efficacy of insulin (Kim et al., 2006), the body weight reduction observed in the current experiment can also be due to increased dopamine signaling in the brain, or a combination of the increased voluntary exercise and dopamine signaling. Ongoing study is determining the effects of wheel running on glucose levels in TH mice. Current results indicate that accessibility to running-wheel cage reduced diabetes symptoms such as high blood glucose and obesity. Our current experiment supports previous findings (Fig 7, 8). Exercise stimulates the glucose uptake, and there is an increase in insulin regulatable glucose transporters (IRGT), which induce glucose to enter cells (Vannucci et al., 1998). Additionally, cholecystokinin (CCK) inhibits neuropeptide Y (NPY) which increases insulin secretion. NPY has shown to increase adipose tissue. Access to running-wheels have shown to bypass CCK signal and directly inhibit NPY expression, which leads to a decrease adipose tissue (Bi et al., 2003). Thus, upon removal of the running wheel, body mass increases.

As there is a correlation between body weight and plasma glucose levels, future experiments will further analyze blood plasma insulin levels and blood glucose levels at different circadian times between B6 and TH mice, with and without access to running-wheels. One of the most important physiological adaptations is the variation of the daily glucose tolerance and how it disrupts the circadian oscillation of glucose uptake. Studies suggest that metabolic and circadian mechanisms are directly connected (Marcheva et al., 2010). Thus, future studies will aim to uncover differences in the circadian rhythms of physiological processes that underlie metabolism and diseases that affect metabolism, such as Type II diabetes.

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References


Who Wants to Play Sadisticube?

Danica Baker

Logic puzzles and games are popular amongst many people for the purpose of entertainment. They also provide intriguing questions for mathematical research. One popular game that has inspired interesting research is Rubik's Cube. Researchers at MIT have investigated the Rubik's Cube to find the maximum number of moves, from any starting position, needed to win the game [6]. Another logic puzzle that has recently become very popular is Sudoku. Sudoku is a Japanese number game where a 9x9 grid is set up with a few numbers scattered on the grid. Mathematicians have been investigating Sudoku, exploring questions such as the number of possible Sudoku grids there are [7].

Sadisticube is a newer logic puzzle, created by a mathematician. A Sadisticube set is made up of eight separate blocks that form a 2x2x2 cube when placed together. The individual blocks can be rotated and swapped with each other to any position in the cube. The goal of the game is the same as in Rubik's Cube where each face of the cube needs to be one color. However, because there are trillions of ways to arrange the blocks and we do not know what our solution will look like, Sadisticube is far more difficult than Rubik's Cube to solve by hand. Fortunately, we can use mathematics to find solutions. Graphs can be used to model the cube so that a solution can be determined for any particular set of blocks. The methods used to create the matrices were adapted from a paper by Jean-Marie Magnier [5]. We will describe how to generate the matrices and their corresponding graphs and will then focus on the graphs in the second half of the paper. After describing how to generate graphs, we will discuss the analysis done on several graphs and the results we found while searching for characteristics common to all graphs.

Even though the final goal of Sadisticube is the same as the Rubik's Cube, the game is played differently. Each of the eight separate blocks is painted with one of six different colors: red (R), orange (O), yellow (Y), green (G), blue (B), or purple (P). To play the game, the individual blocks can be swapped and rotated to any position in the cube to get each face of the cube to be one color, as show below in Figure 1.
Figure 1. The cube on the left is unsolved while the cube on the right is solved.

Trying to win the game by trial and error is impractical. Since there are 185 trillion ways to arrange eight blocks in the form of a cube and the solution to the set of blocks is unknown, it is unimaginable luck if a player wins by trial and error. For example, say it takes ten seconds to put the blocks together in one formation. If there is one solution and it is the very last configuration put together, the 185 trillionth configuration, it would take approximately 58,000,000 years with no sleeping, eating, or doing anything other than configuring the blocks to reach the solution. Since people do not live for millions of years, it seems reasonable to represent the puzzle using math in order to solve the puzzle more efficiently.

As mentioned earlier, the blocks are painted with one of six different colors. There are 30 unique ways to color a block with six different colors, where each face of the block is a different color. Consider a single block: to count the number of ways to color a block, we will fix purple to the bottom face of that block. There are five colors used for the top and side faces of the block. Coloring the top face first, there are five choices for the color of the top face. Once the top face has a color, there are only four colors left to place on one of the faces on the side, then three colors to place on another side, two colors on the third side, and one color on the last side. In this way, we find there are $5 \times 4 \times 3 \times 2 \times 1$, or 120, ways to color the block with no restrictions on rotation. However, each rotation of an individual block does not change the way it is colored. With purple fixed to the bottom face, there are only four rotations for a block. Taking the number of colorings and dividing by the number of rotations, we find there are $5 \times 4 \times 3 \times 2 \times 1)/4$, or 30, ways to color any one block.

Thus, there are 30 different blocks from which we choose eight blocks to make a game set (Figure 2). To show the different ways to color the blocks, we represent a block two-dimensionally as a flattened box showing the top and sides of the block. In the figure below, purple is fixed to be the bottom color while the middle square gives the color of the top face and the other four colors shown are the side colors. The blocks are displayed with numbers instead of colors, as seen in Figure 2. We use the following colors and numbers interchangeably: Blue = 1, Red = 2, Green = 3, Yellow = 4, Orange = 5, and Purple = 6.

Figure 2. Thirty different ways to color a block (picture from [5]).

Since there are thirty ways to color a block, and the solution could also look like any of these blocks, this also means that there are thirty possible solutions for any set of blocks. Previous research has indicated that a set of blocks can have anywhere from zero to five different solutions [5]. Since trial and error is an impractical approach to winning the game, other methods are useful in analyzing and solving the game. We will use the method described in [5] to generate the matrices that will be used to draw graphs. The graphs represent the relationship between a set of blocks and its possible solution cube.

We will use the diagram from Figure 2 to create sets of numbers that represent the 30 different individual blocks. To generate these sets, we look at the corners of the blocks to form three digit numbers, or triples, which represent the colors of the faces that are adjacent to each corner. Each block will have eight triples associated with it, one for each of the eight corners of the block. Figure 3 shows the diagram of block 13. On the left side of the figure is the top of the block in two-dimensional form while the middle is a similar image with the center replaced by 6, or purple, giving a representation of the bottom of the block. These diagrams are used to generate triples.
Figure 3. The block on the left is the top of block 13. The image in the middle shows the bottom of the block as it would be viewed through the top. The image on the right shows the cube, all eight blocks, three-dimensionally with the corners numbered.

The corners of the blocks were arbitrarily labeled from 1 to 8, but kept in the same order for all of the blocks. The image on the right of Figure 3 shows the block in 3-dimensional form. The corners are numbered to correspond to the 2-dimensional display on the left. Triples for the top of the cube are generated first. Starting with Corner 1, we list the numbers in clockwise order beginning with the smallest number in that corner. So, the first triple we find for the block in Figure 3 is 153. This process is repeated for corners 2, 3, and 4 around the top of the block, shown on the left in Figure 3, giving the triples {153, 235, 243, 134}. To find the bottom four corners, imagine the top color replaced by purple, as shown in the middle diagram in Figure 3. Starting from the center color in corner 5, we now read counterclockwise, giving the first triple for the bottom of the block as 651. Continuing in this manner, we find triples representing corners 6, 7, and 8 of the block, giving the last four triples of the set {651, 625, 642, 614}. So the complete set of triples that represents the block in Figure 3 is {153, 235, 243, 134, 651, 625, 642, 614}.

We can now use these sets of triples to generate matrices by comparing each of the blocks in the set to each of the possible solutions. Since each Sadisticube set contains eight blocks, a game set will have eight sets of triples associated with it, resulting in a matrix with eight rows, one row for each block. As an example, we consider a game set that contains blocks 3, 6, 8, 12, 13, 20, 22, and 25 from Figure 2, and compare each block to cube 8 as a possible solution. Figure 4 below gives the sets of triples for each block in the set and the possible solution cube. The row labeled B3 gives the triples for block 3, B6 gives the triples for block 6, and so on. The row labeled C8 gives the triples for cube 8, the possible solution cube to this set of blocks. The numbers 1 through 8 above the columns represent the eight corners of the cube.

We also use the chart in Figure 4 to see if there are any similarities between the corners of the possible solution cube and the blocks. Similarities between the blocks and the cube show that the blocks can be placed in a particular spot to create the solution. The underlined triples in the chart represent the corners that the cube and blocks have in common. If there is a block that does not have any triples in common with the cube, then that block cannot be placed in any corner of the solution cube, so the cube is not a solution to that set of blocks. Each block has either 0, 2, or 8 similarities to the cube [5]. In Figure 4, each of the blocks has something in common with the cube, so there is a possibility that cube 8 is a solution to the set.

After finding the similarities between the blocks and the solution cube, we generate a matrix, $A$. When a corner between a block and the solution cube are the same, a 1 is placed in the column and row that corresponds to that corner of the cube, while corners that do not match have a 0 placed in the column corresponding to that corner. Rows in the matrix will contain 0, 2, or 8 ones based on the number of similarities [5]. Consider the solution cube and block 3 from Figure 4. This block has two triples in common with the cube, 125 and 634, so the block matches corners four and six of the cube. Since this triple represents corner 4 of the cube, a 1 is placed in the fourth column of the matrix in the row corresponding to block 3. Similarly, we will place a 1 in the sixth entry of the row since the sixth triple, or corner, in cube 8 also appears in block 3. The resulting initial row of matrix $A$ is $[0 \ 0 \ 0 \ 1 \ 0 \ 1 \ 0 \ 0]$. We repeat this process for each of the blocks, resulting in the matrix.
The matrices that we find in this way will be used to draw graphs that represent the relationship between the blocks in the set and the possible solution cube.

Each row of the matrix represents a block of the game set and an edge on the graph. Columns represent a corner of the 2x2x2 cube and correspond to vertices on the graph. Remember that each of the rows will only have zero, two, or eight “1”s in the row. If the rows can be swapped so that the main diagonal of the matrix has a one in each entry, then the cube is a solution to the set of blocks. If there is a “1” in the main diagonal, the block represented by the row will fit in the corner of the cube represented by that column. So if there are all “1”s in the main diagonal, a block will fit in every corner of the cube, meaning there is a solution. If the rows cannot be swapped to have a one in each entry of the main diagonal, the cube is not a solution to the set of blocks because some corners of the cube will not have any blocks that match the coloring of the solution. In our example, it is possible to swap the rows of matrix $A$ so that the main diagonal is all ones, indicating that cube 8 is a solution.

Graphs can be used to represent the cubes instead of using matrices. Since there are thirty possible solutions, each set of blocks has thirty graphs we call Sadisticube graphs. We find each of the Sadisticube graphs for one set of blocks by comparing the set to all 30 possible solutions and then use these graphs to determine if a particular cube is a solution to the set of blocks. If the graph indicates the cube is a solution, we call that graph a Sadisticube solution graph, or simply, a solution graph.

The matrices we find using the procedure outlined above are used as adjacency matrices and tell us where to place edges on the graph. To draw the graph for our example set of blocks, consider the first row of the example matrix $A$. In this row, there are “1”s in the fourth and sixth column of the matrix. This means the block represented by this row of the matrix and edge of the graph has Corners 4 and 6 in common with the solution. So on the graph, an edge is drawn between vertices 4 and 6.

We draw an edge in this way for all the rows that have two “1”s. When a row of all “1”s appears, as we see in the third row of the matrix $A$, we must do something a little different. A row of all ones indicates that each corner of that particular block is identical to the solution being considered. So this block could be placed in any of the corners of the cube. This means that we are allowed to draw an edge between any two of the eight vertices. If there is a row of all zeros, implying the block shares nothing in common with the possible solution cube, we do not draw an edge and the cube is not a solution. The graph for our example is shown below.

$$A = \begin{bmatrix}
0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 \\
1 & 0 & 0 & 0 & 0 & 1 & 0 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 \\
0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\
0 & 0 & 1 & 0 & 1 & 0 & 0 & 0
\end{bmatrix}$$

The matrices that we find in this way will be used to draw graphs that represent the relationship between the blocks in the set and the possible solution cube.
find the diameter of a graph, we first determine the length of another interesting characteristic of graphs is the diameter. To consider this to be a defining characteristic for solution graphs. Since this characteristic was seen in both solution and non-solution graphs, we did not find any upper bound on the number of edges in a Sadisticube graph.

As stated before, every set of eight blocks has thirty possible solutions and thirty corresponding graphs. Since not all of these graphs are solution graphs, we looked closely at the graphs to determine the characteristics that are present in solution graphs but are not present in non-solution graphs. This gives us a set of identifying graph characteristics that can be used to determine if the corresponding cube is a solution cube for that set of graphs. In order to generate a large number of matrices and corresponding graphs, we wrote two programs using Maple. The first program generates matrices given a set of blocks. The second program uses these matrices to draw the corresponding graphs. Figure 5 above is one graph that was generated by these programs.

After the graphs were drawn, we considered several different characteristics that are typically observed in graph theory. One characteristic we observed was planarity. A graph is planar if the vertices can be rearranged so the edges of the graph do not cross. All of the Sadisticube graphs we looked at are planar whether or not they were solution graphs. Since this characteristic was seen in both solution and non-solution graphs, we did not consider this to be a defining characteristic for solution graphs.

Another interesting characteristic of graphs is the diameter. To find the diameter of a graph, we first determine the length of the shortest path between each pair of points on the graph. The diameter is then the longest of these lengths. Diameters for the Sadisticube graphs ranged from 1 to 7 while the diameters of solution graphs varied between 2 and 7. Since the range of possible values for the diameters was similar for solution graphs and non-solution graphs, we did not consider diameters to be a defining characteristic for solution graphs either.

However, after analyzing nearly 1,000 graphs for over 20 different characteristics, we did find three characteristics that are always present in solution graphs. All Sadisticube graphs have eight vertices because the vertices represent the eight corners of the 2x2x2 cube, so solution graphs also have eight vertices. By the theorem above, Sadisticube graphs have at most 8 edges. Each edge of a graph represents a block that can be placed in the solution cube. Since we must be able to place all 8 blocks in the cube to have a solution, solution graphs must have exactly 8 edges. Solution graphs also have at least one cycle as a result of the following lemma.

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Recall that if a matrix has a row of all “1”s, we can place an edge between any two vertices on the graph. In the remainder of this paper, if there is a row of all ones, we will draw an edge between vertex 1 and a vertex that remains isolated after drawing the other edges of the graph. If there is no isolated vertex after we have drawn the other edges, we will simply place an edge between vertex 1 and vertex 8. The graph in Figure 5 is drawn using this convention.

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Theorem: Suppose a graph $G$ is a Sadisticube graph. If $G$ has an isolated vertex, then the corresponding cube is not a solution to that set.

Proof: Suppose $G$ is a Sadisticube graph. Then it has eight vertices. Assume $G$ has an isolated vertex. We will show the cube is not a solution to the set. Since there is an isolated vertex, there is a column of zeros in the matrix. Since the matrix has a column of zeros, there must be one zero on the main diagonal after swapping rows, implying the cube is not a solution. Thus, if there is an isolated vertex, the cube is not a solution to the set of blocks.

Sadisticube graphs represent the relationship between the blocks in a game set and its possible solutions. There are characteristics that help determine if a Sadisticube graph is a solution graph or not. We have seen that solution graphs always have eight vertices, eight edges, and at least one cycle. However, these characteristics are not enough to define a graph class since some graphs have these three characteristics but are not solution graphs. Since an isolated vertex in a graph implies the corresponding cube is not a solution, solution graphs cannot have isolated vertices. Thus every Sadisticube solution graph has eight edges, eight vertices, at least one cycle, and no isolated vertices.

References


Introduction

Single-stranded DNA-binding proteins (SSBs) are keystones in the processes involving DNA, the genetic blueprint of all living organisms. Maintaining the integrity of the DNA code is crucial to life. Alterations in DNA can result in malfunctioning proteins which lead to cellular abnormalities, potentially instigating debilitating diseases.

DNA is most stable in its double-stranded form, commonly described as a double helix. The double helix is formed from two single-stranded DNA (ssDNA) chains that are held together by hydrogen bonds between complementary bases. However, many of the processes, which manipulate this critical molecule, require the two strands to be separated in order for the genetic material to be copied or processed. In this single stranded form, the DNA is highly prone to the attack of nucleases, enzymes that will cut and essentially
destroy the genetic material (Shereda et al., 2008). There is also a high potential for the two strands to rejoin before any operation with DNA can be completed. SSBs provide a solution for both problems by binding to and stabilizing the single-stranded conformation, while also shielding ssDNA from nucleases (Shereda et al., 2008). They also facilitate replication, recombination and repair by removing DNA secondary structures that impede the progress of all enzymes involved in these DNA transactions (Shamoo, 2002). Another critical role of SSBs is recruitment of specialized proteins involved in DNA manipulations in cells (Shereda et al., 2008). Due to this critical role in the maintenance of DNA, SSBs are present in all cells and are essential to life. In addition, viruses code for their own ss-DNA-binding proteins despite the fact that their host already expresses these critical proteins (Borjac-Natour et al., 2004). The way in which SSBs work is elucidated by their structure.

All known ssDNA-binding proteins share a similar 3D-structure referred to as the oligosaccharide/oligonucleotide-binding fold or OB fold domain (Shamoo, 2002), as depicted in Figure 1. A protein domain is a specific structural component that is responsible for one of the important tasks in a protein’s overall function. Domains are analogous to the parts of a car. For instance, steering wheels are specific structural features that are nearly identical in every type of car and perform the identical function of allowing a driver to direct the car’s movement. The contributing role of the OB fold in SSBs is to facilitate the recognition and binding of single-stranded DNA (Shamoo, 2002). The name, Oligosaccharide/oligonucleotide-binding fold, was termed for the part of DNA to which it binds. Oligosaccharides or sugars make up part of the negatively-charged backbone of DNA. The OB fold, consists of five anti-parallel Beta sheets constituting the shape of a barrel and capped by an alpha helix, contains a narrow cleft that is able to distinguish single-stranded DNA from the more expansive double stranded DNA (Shamoo, 2002). The positively-charged walls of the DNA-binding cleft interact with the negatively charged DNA backbone, while the aromatic residues of the cleft form stacking interactions with the nucleotide bases, ensuring the secure binding of ssDNA to the OB fold (Shamoo, 2002).

In addition, all prokaryotic type ssDNA-binding proteins have an acidic C-terminal tail which mediates protein-protein interactions with other proteins involved in the replication of DNA (Shereda et al. 2008). Furthermore, studies have suggested that the tail is critical for the protein to maintain a stabilized dimer configuration (Hollis et al., 2001). The C-terminal tail can be envisioned as a tail that hangs off of the end of the protein, terminating in a carboxyl group (Figure 2). This C-terminal tail is also very flexible and negatively charged. In the absence of DNA, the C-terminal tail interacts with the positively-charged fissure of the OB fold, protecting the DNA-binding cleft from randomly sticking to negatively-charged molecules (Figure 2). As a result of this interaction, the C-terminal tail shields/competes with DNA for this site (Marintcheva et al., 2008). The effect of this competition has been extensively studied on the model of bacteriophage T7 ssDNA-binding protein, which is considered a prototype for prokaryotic ssDNA-binding protein.

![Figure 1. Three-dimensional Structure of Gp2.5, ssDNA-binding Protein of Bacteriophage T7.](image1)

Gp2.5 is a typical prokaryotic ssDNA-binding protein containing an OB fold and flexible negatively charged tail. The OB fold contains the ssDNA binding cleft of the protein marked by a bracket. The C-terminal tail is depicted by the chain of letters at the end of the protein. These letters represent the sequence of amino acids building the tail. The letters “E”, “D” and “F” represent the amino acids glutamate, aspartate and phenylalanine that contribute to the negative charge of the tail. The determination of the structure of T7 gp2.5 is described by Hollis et al., 2001. The above figure appeared originally in Marintcheva et al., 2008.

![Figure 2. Proposed Mechanism of Action of Prokaryotic ssDNA-binding Proteins.](image2)

It has been proposed that in the absence of DNA (Panel A and B) the C-terminal charged tail of SSB fluctuates between bound and free state. In the bound state (panel A), it occupies the DNA binding cleft, whereas in the free state, the tail extends away from the protein (panel B). In the presence of DNA, the tail is displaced from the binding cleft and is continuously available for interactions with other proteins involved in DNA transactions. The area marked with a plus sign, represents the DNA-binding cleft. The area of the C-terminal tail marked with a minus sign depicts the portion of the tail that is negatively charged. The above model was originally proposed by Kowalczykowski et al., 1981. The figure panels were originally published in Marintcheva et al., 2008.
T7 is a bacterial virus that infects *Escherichia coli*, a common inhabitant of our gastrointestinal tract. Bacteriophage literally means bacteria eater, a definition that fits well with the fast pace of bacteriophage replication and cellular destruction. For example, once T7 infects *E. coli* it takes less than an hour for the cell to be destroyed and hundreds of new bacteriophages to be released to the extracellular environment. T7 is a well established model system to study the mechanism of replication due to the involvement of a minimal number of players and its rapid growth. Thus, T7 allows straightforward analysis and identification of basic principles that are applicable to the living world in general. For example, the basic principles of replication are the same in T7 and in human cells. However, T7 duplicates its DNA with only five players, whereas human cells accomplish the same job with a double digit number of players. Yet, in its essence, the process works the same way and what is learned about T7 guides scientists in what to look for in humans. In addition, studies of T7 replication have brought to light many molecular biology tools, including the enzyme used to sequence the human genome.

The T7 ssDNA binding protein is referred to as gene 2.5 protein or gp2.5 according to its position along T7 genome. The C-terminal tail of this SSB has been extensively mutated to identify key determinants of its function. Although the removal of the tail had detrimental effects on replication in *vivo*, this deletion increases the binding of the protein to ssDNA, presumably because it removes the competitive interaction between the DNA and the C-terminal tail. In addition, it has been demonstrated that the gradual removal of the tail also results in a gradual increase in the ability of the gp2.5 to bind to ssDNA (Marintcheva et al., 2006). Although the effects of removing and shortening the tail are well known, the performed experiments do not distinguish between the contribution of charge and the flexibility of the tail. Genetic data suggests that charge is important for function since a mutant in which negatively charged amino acids, the building blocks of proteins, are converted to non-charged ones fails to support viral growth (Marintcheva et al., 2008). However, the hypothesis has not been directly tested biochemically. The goal of this project was to test the hypothesis that negative charge is essential for the function of the C-terminal tail of gp2.5. We aimed to express and purify the Wild Type or the natural form of the protein, gp2.5-WT, a mutant with No Tail (gp2.5-NT) and a mutant with the full length tail but No Charge (gp2.5-NC) so that we can then compare the ssDNA-binding abilities of all three forms.

This study is expected to contribute to the general understanding of how flexible charged tails function in proteins that are associated with DNA transactions. This in turn may contribute to studies focused on using these proteins as potential drug targets. A recent study has revealed the potential benefit of utilizing SSBs as antibacterial targets. Results showed that all three of the tested compounds, designed to disrupt SSB activity, led to cell death for several evolutionarily diverse bacterial species (Marceau et al., 2013). This application holds the potential benefit of eliminating the barrier of prevailing antibiotic resistant strains of bacteria. Another potential application involves histone proteins that package DNA in human cells. These proteins have a flexible charged tail similar to that of gp2.5. Chemical modifications changing the charge of the histone tails regulate gene expression and are considered potential targets for cancer therapy (Cincárová et al., 2012). This project has the potential to contribute to these studies seeking to develop therapeutic agents, targeting SSBs or other similar proteins with flexible charged tails.

Materials and Methods

**Plasmids:** The following plasmids were used in this study: The plasmid pET-17.b-gp2.5-NC, encoding mutant gp2.5 with full size tail but no charge (Marintcheva et al., 2006), pET-19.b-PPS-gp2.5 WT, encoding the His-tagged version of the natural form of gp2.5; pET-19.b-PPS-gp2.5-Δ26C, coding for the His-tagged version of gp2.5 lacking the C-terminal tail (Hollis et al., 2002). For the purpose of our study we are naming this version of gp2.5 “gp2.5-No Tail” or gp2.5-NT for short. All plasmids were a gift from Dr. Charles C. Richardson (Harvard Medical School).

**E. coli Strains:** The DH5α strain was used to propagate all plasmids and BL21 (DE3) strain was used for protein expression.

**Transformation:** Transformation for the purpose of plasmid propagation and protein expression was conducted by pipetting 50µl of competent cells into a 1.5 ml ependorf tube with 1µl plasmid of interest, followed by 10 minutes of incubation on ice. Following heat-shock at 42°C for 40 seconds, the reactions were cooled on ice and supplemented with 500µl of Luria Broth (LB) media. The cells were grown for 1 hr while shaking at 37°C and plated on LB/ampicillin to grow overnight at 37°C.

**Plasmid Preparation:** Single colonies of cells were incubated overnight in LB supplemented with 100µg/µl ampicillin at 37°C. Plasmid DNA was purified using the QIAGEN plasmid purification kit as recommended by the manufacturer.

**Cloning of gp2.5-NT:** Cloning of Gp2.5-NC into a pET19.b PPS vector was attempted, so that the protein could be purified using His-tagged technology. Vectors, pET 19.b PPS-
gp2.5-NT, and 17.b-gp2.5-NC were digested with restriction enzymes, BamHI-HF and NdeI. Digestion reactions were run on a 0.8% agarose/1X TBE gel at 100 volts for verification. The desired fragments were extracted from the gel and purified using QIAquick Gel Extraction kit as recommended by the manufacturer. Fragments were ligated using the New England BioLabs Quick Ligation kit in accordance with the manufacturer’s recommendations. Ligation reactions were transformed into DH5α cells and single colonies selected. The subsequently isolated plasmids were sequenced at Eurofins MWG Operon.

**Protein Expression:** Single transformants were inoculated in LB media/ampicillin supplemented with 1% glucose and grown overnight. 10 ml of overnight cultures were added to 300 ml of fresh LB/ampicillin (100µg/ml) and were grown to an optical density of 0.7 at 600 nM. Protein expression was induced with 1mM final concentration of IPTG (isopropyl-1-thio-β-D-galactopyranoside) for 3 hours. Cells were collected via centrifugation at 4°C and 5000rpm for 10 minutes. Pellets were resuspended in 5 ml of Buffer B containing 70mM Imidazole, 500mM Tris-Cl and 500mM NaCl, as previously described in Rezende et al., 2002. All buffers used for purification contained 1mM (final concentration) AEBSF, 1X Complete EDTA-free protease inhibitor cocktail tablets, and 1mM DTT.

**Protein Purification:** The protein purification procedure was performed as previously described in Rezende et al., 2002. In brief, cells were broken open with addition of 1mg/ml lysozyme and were rocked at 4°C for 2 hours. Benzonase (6.25units/ml) was added to reduce viscosity and samples were warmed to 20°C in a 37°C water bath. Soluble proteins were separated from cell debris by centrifugation at 8,000 g and 4°C for 30 minutes. Supernatant was loaded on a 2ml nickel-NTA agarose column. Non-specific proteins were washed away with 20 ml of Buffer B. Gp2.5 protein was eluted with 2 column volumes of Buffer B supplemented with 500mM imidazole. Gp2.5 protein was dialyzed against Buffer S containing 50mM Tris-Cl, 0.1mM EDTA, 50% glycerol, and 1mM DTT. Buffer S was supplemented with 150mM NaCl for dialysis of gp2.5-NT, and gp2.5-NC. All protein samples were stored at -20°C.

**DNA-binding Activity Assay:** The activities of gp2.5-WT and gp2.5-NC were assessed using M13 circular ssDNA as a template. The 20µl reactions contained 1µg M13 ssDNA, 15mM MgCl₂, 5mM DTT, 50mM KCl, 10% glycerol, and 20µM of either gp2.5-WT or gp2.5-NT. 1X loading dye (final concentration) was added to each sample. Proteins were diluted with buffer containing, 20mM Tris-Cl (pH 7.5), 1mM DTT, and 500µg/ml bovine serum albumin. The samples were run on a 0.8% agarose/1X TBE gel in 0.5% Tris-Glycine buffer. The gel was run on ice at 100 volts.

**Results**

**Cloning of gp2.5-NC into pET 19bPPS**

The following plasmids were digested with restriction enzymes, BamHI-HF and NdeI: pET 19.b PPS–gp2.5-NT, and pET17.b-gp2.5-NC. The digested products were run on a 0.8% agarose/1X TBE gel at 100 volts (Figure 3). The gel was stained with ethidium bromide and analyzed under ultraviolet light. The backbone of pET 19.1PPS appeared as a single band at approximately 6kb (lane 1, Figure 3). The fragment of pET 17.b containing the region coding for gp2.5-NC appeared as a single band at approximately 0.7kb (Figure 3, lane 2). Both fragments were extracted, purified, and ligated using the NEB Quick Ligation kit. The ligation reactions were transformed into a DH5α strain of E.coli cells and single colonies selected. The sequencing results of the plasmids isolated from the selected colonies, obtained from Eurofins MWG Operon, identified all isolated plasmids as uncut 19.b PPS–gp2.5-NT.

**Protein Expression**

Plasmids coding for gp2.5-WT and gp2.5-NT were transformed in BL21 (DE3) competent cells. Single colonies were used to grow an overnight starter culture, which was subsequently diluted into 300ml of LB/ampicillin. Protein expression was induced by the addition of IPTG. Three hours following induction, cells were harvested by centrifugation and the samples were analyzed on a 4-20% mini-PROTEAN TGX/1XTris Glycine gel at 100 volts (Figure 4), followed by staining of the gel with Bio-Safe Coomassie Blue G-250. The expected mass of gp2.5-WT and gp2.5-NT, calculated from the amino
acid sequences is 25.7 kDa and 22.68 kDa respectively. A dark band between 25 and 37 kDa was observed in the induced (the lanes marked with + as depicted in Figure 4) gp2.5-WT sample and between 20 and 25 kDa in the induced gp2.5-NT sample (as represented by "*" in Figure 4). As expected the proteins of interest were found to be soluble (the lines marked with "+s" in Figure 4).

**Protein Purification**

Purification of gp2.5-WT and gp2.5-NT was evaluated on a 4-20% mini-PROTEAN TGX/1X Tris-Glycine buffer gel at 150 volts (Figure 5), followed by staining of the gel with Bio-Safe Coomassie Blue G-250. As expected, several dark bands appeared in lanes loaded with Lysate (L), Flow-Through (FT) and Wash (W) fractions (lanes 1-3). A dark band was resolved between 25 and 37 kDa, along with several other faint bands, indicating the elution of gp2.5 with contaminants in eluted fractions 1, 4 and 7 (lanes 4, 5, and 6, respectively) A single dark band appeared for eluted fractions 11, 13, and 15 (lanes 7, 8, and 9, respectively) between 25 and 37 kDa.

To ensure that pooled and subsequently dialyzed fractions contained pure gp2.5-WT or gp2.5-NT, one microgram of each purified protein was run on a 4-20% mini-PROTEAN TGX/1X Tris-Glycine gel at 100 volts (Figure 5), followed by staining of the gel with Bio-Safe Coomassie Blue G-250. Samples were loaded as follows: 1 – lysate (L), 2 – Flow Through (FT), 3 – Wash (W), 4 – Eluted fraction (EF) 1, 5 – EF 4, 6 – EF 7, 7 – EF 11, 8 – EF 13, 9 – EF 15, 10 – Precision Plus Kaleidoscope Protein ladder.

**Isolation of Pure and Active gp2.5-WT and gp2.5-NT**

To verify that pure gp2.5-WT and gp2.5-NT was successfully isolated without compromising their activity, purified gp2.5-WT and gp2.5-NT were run on a 0.8% agarose gel/1X TBE buffer gel at 100 volts in the presence of circular single-stranded DNA (Figure 6B). DNA incubated with gp2.5-WT and gp2.5-NT (lanes 2 and 3 respectively (Figure 6B) moved through the agarose gel more slowly than free DNA (lane 1 Figure 6B). Gp2.5-NT movement through the gel was slower than that of gp2.5-WT.

**Discussion and Conclusions**

Gel electrophoresis of purified His-tagged gp2.5-WT and gp2.5-NT confirmed that both gp2.5-NT and gp2.5-WT were selectively retained on the column and successfully eluted when high concentration imidazole was applied (Figure 6, lanes 4 - 9). In contrast, the flow through (FT) and wash (W) fractions did not contain significant amounts, if any, of the protein of interest, demonstrating that the entire amount of His-tagged protein was purified.

Purity of the dialyzed and pooled fractions was confirmed by gel electrophoresis. All lanes loaded with either gp2.5-WT or gp2.5-NT showed a single distinct band aligning with the appropriate molecular weight (MW) marker for their expected sizes.
Pure gp2.5-WT and gp2.5-NT were determined to have maintained the function of binding ssDNA. Both complexes (labeled with “*” and “**” in Figure 6B) moved through the agarose gel more slowly than free DNA (--) thus demonstrating that the isolated proteins are able to bind ssDNA. Consistent with literature, gp2.5-NT caused a bigger shift in DNA mobility, which reflects its ability to bind DNA with higher affinity compared to the wild type.

Gel electrophoresis confirmed that the desired digestion products of pET19b PPS and pET17b, coding for gp2.5-NC was successfully produced (Figure 3). Currently, the selection process for the clone containing the correct and pET19.b PPS-gp2.5-NC plasmid is still in progress. Once obtained the DNA binding abilities of all three versions of gp2.5 will be evaluated. The results of these studies will further the understanding of the molecular interactions of ssDNA binding proteins as well as other proteins with flexible charge tails which holds promise to impact the fields of bacterial resistance and cancer biology.

References


Julie Boucher is a senior majoring in Psychology and minoring in Social Welfare. Her research on women veterans with posttraumatic stress disorder was completed under the mentorship of Dr. Arnaa Alcon of the Social Work department. This research is a continuation of work presented at the 2012 National Conference on Undergraduate Research in Ogden, UT; and was recently presented at the 2014 National Conference on Undergraduate Research in Lexington, KY. Julie is thankful to her mentor and the staff of the Office of Undergraduate Research for providing her with the opportunity for personal and academic growth.

**Treatment of Women Veterans with PTSD**

**Julie Boucher**

This study addresses the question, what is the most effective treatment method for female veterans of Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) diagnosed with Post Traumatic Stress Disorder (PTSD)? Female veterans experience unique difficulties when dealing with symptoms of PTSD that their male counterparts do not. Some of the causes of their PTSD are different as well. Evidence suggests that treatment programs should be developed in a manner that tailors to gender-specific needs. This research consisted of a thorough review of the literature, including peer-reviewed articles.

The purpose of this research is to evaluate the top three conventional treatment methods for veterans with PTSD and analyze them according to the particular needs of female veterans. The top three treatments are addressed in detail. Prolonged Exposure Therapy (PE) and Cognitive Behavioral Therapy (CBT) are the most widely used therapies by the Veteran's Health Administration (VHA) for female veterans of OIF and OEF with PTSD. Eye Movement Desensitization and Reprocessing Therapy (EMDR) is close behind. PE consists of four major parts: psycho-education, breathing skills, real-world practice, and talking through the trauma repeatedly. CBT is a psychotherapeutic treatment that addresses dysfunctional thoughts and feelings that occur from PTSD. EMDR is a form of psychotherapy with eight phases, each dedicated to tackling the current symptoms and the triggers that the patient experiences.

Analysis of the research indicates that PE may be most effective for treating PTSD in women. In general, women are more receptive to treatments that involve talking about their emotions and interpersonal problems, which is the specific focus of PE. It helps to bring back memory of the trauma that may be missing, and it decreases many symptoms when successful. PE also costs less than other treatments and can be accomplished in a short amount of time, as little as one to three months.

Research on Posttraumatic Stress Disorder (PTSD) has mainly included male subjects. It is only recently that researchers are focusing closely on the unique aspects of females with PTSD, specifically female veterans. Interestingly, at the same time PTSD research was being conducted on male veterans of the conflict in Vietnam, those who studied women who had experienced sexual
assault found an almost identical symptomology (Vogt, D., 2007). That being said, it is widely known today that women who experience any form of sexual assault are at great risk of getting PTSD.

Women also may experience Military Sexual Trauma (MST) which the National Center for PTSD defines as “any kind of unwanted sexual attention, including insulting sexual comments, unwanted sexual advances, or even sexual assault” (NCPTSD, 2010). Studies have shown that military women are much more likely than military men to experience all forms of sexual harassment (Street, Gradus, Stafford, & Kelly 2007). Another aspect of PTSD that is much more prevalent among women than men is eating disorders. While eating disorders have not typically been considered a part of PTSD, researchers have found they are common in women with PTSD (Forman-Hoffman, Mengeling, Booth, Torner, & Sadler, 2012).

This literature review focuses on American female veterans of OIF and/or OEF who have been diagnosed with PTSD as a result of their military service overseas. PTSD is defined by the American Psychiatric Association (APA) in the Diagnostic and Statistical Manual of Mental Disorders, Fourth edition, Text Revised (DSM-IV-TR) as “exposure to a traumatic life event or string of events that brings upon symptoms such as intrusive recollections, avoidance/numbing, and hyper-arousal” (DSM-IV, p. 468).

Women’s roles in the military are rapidly changing. In 2013 Defense Secretary Leon E. Panetta lifted the ban against women serving in combat roles in the U.S military (Bumiller, Shanker, Connelly, & Baker, 2013). Although women have only recently been authorized to hold combat positions they have been exposed to combat directly and indirectly in OIF and OEF, more than in any other war in the past. One study published in 2010 concluded that “OIF/OEF women were younger, received more hostile/friendly fire… than PER [Persian Gulf veteran] women” (Fontana, Rosenheck, & Desai, 2010, p.755). There is also evidence that women veterans of the Vietnam conflict were less susceptible to direct combat since they were behind clearly drawn enemy lines, whereas in Iraq and Afghanistan there are no clear lines; the enemy could be anywhere and everywhere (Turner, Turse, & Dohrenwend, 2007).

There are conflicting reports regarding the prevalence of PTSD among veterans, especially the specific population of female veterans who have served in OIF and/or OEF. For example, one nationally representative study reports that, regardless of gender, anywhere from 14.7% to 30.9% of returning military veterans have PTSD (Sundin, Fear, Iversen, Rona, & Wessely, 2010). Despite a lack of agreement on the prevalence rate, even at the low end, estimates of frequency of the disorder demonstrate that significant numbers of women veterans are experiencing PTSD.

Female veterans have unique problems with PTSD. One result of PTSD among women can be the effect it may have on their parenting skills. As mentioned before, Military Sexual Trauma (MST) is much more common among women than men. As a result of MST, women are more likely to walk around with feelings of numbness and emotional detachment, and acting as if they do not care about the ones they love. These behaviors can have negative consequences for their children, for example, because children are too young to understand the symptoms and may internalize the lack of emotion as their mother not loving them.

When a woman experiences MST from a fellow soldier in her unit she feels betrayed. She has to protect herself not only from the enemy but from her “brothers in arms” next to her. This can also carry over to her parenting style, as she can become detrimentally over-protective of her children, attempting to compensate for when she could not protect herself (Mason, 2010). Society implies that women should refrain from showing aggression, so the angry emotions about what has happened often become repressed, until the woman cannot take it any longer and easily flies off the handle toward the people she loves. Often these women do not realize when they are yelling or what exactly it is they are yelling about, which can also have negative effects when directed toward their children. (Mason, 2010).

There are many reasons why PTSD is a problem in female OIF/OEF women veterans and why it is necessary to find a tailored treatment program for this cohort. For example, women are more likely to have experienced trauma pre-military, which leaves them open for and exacerbates a new military trauma. Women struggle more with interpersonal problems in a combat zone more so than men. “Gender harassment,” which is defined as “behaviors that are not sexually based, but are hostile or degrading and occur on the basis of one’s biological gender” are reported as a problem by many women (Street, Vogt, & Dutra, p. 690). Such behaviors often reinforce traditional gender roles and cause women to work harder than their male counterparts for the same recognition and respect of co-workers and higher-ups.

The lack of a social support system and positive interpersonal relationships within the military is also a problem primarily for this cohort, as sometimes they are the only female soldier in their company and are oftentimes overrun by a male presence. Some researchers have said that socially supportive relation-
Prolonged Exposure Therapy (PE) and Cognitive Behavioral Therapy (CBT) are the two most widely used therapies within the Veteran's Health Administration (VHA) for female veterans of Operation Iraqi Freedom and Operation Enduring Freedom. Eye Movement Desensitization and Reprocessing (EMDR) Therapy is a third empirically-supported treatment of PTSD. Various group and couples treatments also have been found to be effective. Researchers are now exploring various mindfulness techniques that can be incorporated into PTSD treatment, such as Acceptance and Commitment Therapy (ACT), Dialectical Behavior Therapy (DBT), Mindfulness-based stress reduction, Mindfulness-based cognitive therapy, and Mindfulness-based relapse prevention (Vuganovic, Niles, Pietrefasa, Potter, & Schmertz, 2011).

Prolonged Exposure Therapy (PE) is most commonly used as an intervention for patients with PTSD. One particular study (Tuerk, Yoder., Grubaugh., Myrick, & Acierno, 2011) goes as far as affirming that PE is especially helpful not only to veterans with PTSD, but specifically to those who have served in Iraq and Afghanistan and seek services in a VA hospital setting.

Prolonged Exposure Therapy (PE) generally consists of 90-minute sessions held once a week. Major components of PE are as follows: psycho-education regarding common reactions to the trauma one has experienced, along with a detailed description of the treatment; self-assessment of anxiety using subjective units of distress (SUD's), a common tool in the measuring of emotions; repeated in-vivo exposure to places otherwise avoided because of the trauma; and repeated, prolonged, imaginal exposure to traumatic memories, followed by the discussion of the memories (Tuerk, et. al 2011).

In-vivo therapy provides exposure to any objects, activities, or situations that a patient may be anxious about due to the trauma. This exposure allows the patient to confront their anxieties head on. It is experienced through “homework assignments” given to the patient to complete between sessions. These assignments gradually expose patients to their fears in a safe process. For example, if one was shot, he or she might gradually be introduced to visiting a shooting range, as this is a common aversion for someone who experienced PTSD after being shot in the line of duty. In addition to the in-vivo session(s), imaginal exposure is done during weekly sessions. In these sessions, the patient re-visits the traumatic episode in their mind repeatedly, while talking through the experience with a counselor. This type of imaginal work becomes incredibly detailed and intense. Counselors guiding this therapy must approach the details of the trauma cautiously with their patient, as the patient may pull away and become withdrawn. These treatment sessions are sometimes recorded by the counselor so the patient can review the recording in between sessions if they think it will help (Tuerk, et. al 2011).

Research shows that PE has more evidence for effectiveness than any other therapy (Jackson, J., Thoman, L., Suris, A.M., & North, C.S. 2011). This consensus includes the fact that PE intimately targets the avoidance symptom cluster of PTSD that is so evident and debilitating. This is one of the main criteria for PTSD that causes the patient to avoid anything associated with the trauma and brings about emotional numbness that was not evident before the trauma (DSM IV, 2000). Anger and hostility are also symptoms significant to PTSD. In one meta-analysis of treatments for PTSD that specifically target anger-related problems it was discovered that PE was more effective in alleviating anger with female sexual assault survivors when compared to Cognitive Behavioral Therapy (CBT) (Galovski, T.E., Elwood, L.S., Blain, L.M., & Resick, P.A., 2013).

In 2011, Tuerk, et. al published a particularly strong evaluation study which examined the effectiveness of PE for this specific cohort. This was a large-scale study conducted by the Veteran's Health Administration (VHA). They found that many existing studies support the efficacy of PE for veterans, and the Institute of Medicine discloses that exposure therapies are “the only treatment approach with sufficient efficacy data for combat-related PTSD” (Tuerk et al, p. 397). Treatment retention was sufficient, suggesting that although this can be an intense therapy to go through, it is well handled by veterans with PTSD.

A second treatment for women veterans with PTSD is cognitive behavioral therapy (CBT), which focuses on “realistic thinking.” A Greek philosopher, Epictetus, was quoted as saying “People suffering a major trauma are, it seems, disturbed in the long term, not so much by the trauma as by the consequent view which they take of themselves and their world” (Joseph, 2011, p. 31). This age-old interpretation stands as the basic principle behind CBT (Joseph, 2011).

PTSD is both an anxiety and stress disorder; therefore, those affected face a vicious cycle. It causes more difficulty for the PTSD patient to deal with current stressors in their lives than the person who does not have PTSD. If the patient with PTSD is in a negative or anxious mood, memories of the trauma may arise, causing dysfunctional thoughts about oneself and the world surrounding them. CBT attempts to break this cycle by targeting the negative and dysfunctional thinking, and teaching the patient how to translate these thoughts into realistic thinking (Joseph, 2011).
In CBT, the patient self-reports their thoughts and behavior to the therapist. This is a structured counseling session with an agenda and various homework assignments. Homework assignments are created by the patient and therapist. These assignments target specific distressing and dysfunctional thoughts that the client reports, and are created with the purpose of modifying these thoughts into a more healthy, realistic way of thinking. Homework is always reviewed in detail during the next session. In CBT the therapist is always active “in helping the client by posing questions to evaluate critically the thinking that is leading to distress” (Scott & Stradling, p.32). This approach is the contrast of a psychotherapeutic approach as it is direct and emphasizes the present time. (Scott & Stradling, 1995).

There are many studies on the effectiveness of CBT that specifically target military veterans from Iraq and Afghanistan, yet as with many studies targeting these veterans, few are dedicated exclusively to women. The majority of studies tend to be only about men or about men and women together. An open trial of PTSD treatment presented in couple’s format was published in 2004. This was a Cognitive Behavioral Conjoint therapy, which was shown to improve the dynamics of the patient’s family and significant relationships. This is just one example of the evidence existing that CBT can improve family relationships (Schnurr, P.P., Lunney, C.A., Bovin, M.J., & Marx, B.P., 2009).

This form of CBT is specifically designed for trauma survivors, and has been proven effective in additional studies as well. These studies showed evidence of a reduction in negative trauma-related assessments and symptom reduction during trauma-focused CBT for PTSD (Kleim et al, 2012).

Eye Movement Desensitization and Reprocessing therapy (EMDR) is another evidence-based treatment used to take care of veterans with PTSD, including this particular cohort of females, which consists of eight phases of psychotherapy. EMDR does not address the retrieval or remembrance of the trauma as Prolonged Exposure does. Instead EMDR targets current symptoms and triggers, as well as possible complications the veteran may run into in the near future.

The first phase of EMDR can be identified as “client history gathering.” This is when the therapist and client identify the presenting problem, as well as triggers and cognitive blocks that affect daily functioning. The second phase is client preparation. Here the client receives information about EMDR and how it may help them. This phase can sometimes become the gateway to something called adaptive information processing (AIP). AIP is defined as a process a client goes through that helps them understand the normalcy of their reaction to trauma (Silver, Rogers, & Russell, 2008).

The third phase, assessment, provides a “baseline of the client’s disturbance that is used throughout treatment as a comparison tool” (Silver et.al, 2008). The fourth phase is desensitization, when bilateral stimulation is used, coupled with elements of the assessment phase. Typically bilateral stimulations such as eye movements, sounds, and physical taps are used to keep the client grounded in the present situation, where they can focus on the therapeutic moment (Silver et.al, 2008).

The fifth phase is installation, which aims to install positive cognitions in the client regarding their trauma. For example the client may switch from “it was all my fault” to “I did the best I could, it was not my fault” (Silver et.al, 2008). For a female this example may come into play if she was raped in the battle zone, or if she was unauthorized to go out on a combat mission while her brothers in arms went without her, and her comrades were hurt or killed in action. These are both frequent occurrences.

The sixth phase is known as the body scan. As described by Silver (2008), “While maintaining a focus on the original trauma experience and the newly integrated positive cognition, the client identifies any disturbing physical sensations”. Bilateral stimulation is then used again to dissipate negative associations. The seventh phase is focused on closure – the client is preparing to end his/her EMDR therapy. The eighth and final phase, termed reevaluation, assesses progression and prepares for the end of treatment. (Silver et.al, 2008). These eight phases are only briefly described, as this is an overview of the aspects of EMDR.

Numerous studies have been conducting on the effectiveness of EMDR use on veterans who battle PTSD, including different case studies and controlled research. One multiple case study consisted of four veterans that requested immediate attention pertaining to their PTSD. Although this study has many strengths it was performed in an abbreviated form due to the restricted time frame the study was granted, and was made up of all men. Regardless of these limitations, it was found that this single, immediate session of EMDR resulted in significant improvement of symptoms, and was said to possibly be more effective than earlier interventions such as Prolonged Exposure therapy (Russell, 2006). According to research done by Leiner, A.S., Kearns, M.C., Jackson, J.L., Astin, M.C., & Rothbaum, B.O. (2012), “EMDR appeared to be beneficial for women who frequently engage in avoidant coping responses following rape.”
The results of said case studies are promising but require further research. It is this author’s opinion that treatment providers should have these abbreviated sessions when nothing else is available—especially since the measurements they used, such as the Structured Clinical Interview (SCI), Impact of Events Scale (IES), and the Subjective Units of Disturbance Scales (SUDS), are more than sufficient to analyze results. This short form of treatment allows a soldier to retract from the battlefield and recharge, so they are able to perform their job efficiently. It is certainly not the most desired approach, as thorough treatment would be the best option.

It is suggested that researchers concentrate on female veterans in particular, as the ways in which they obtain PTSD overseas in a combat zone are not equal to those that their male cohorts typically run into (Street et al., 2009). As previously mentioned, because of the different origins of PTSD between male and female veterans, the VA needs to tailor treatments to the needs of females. For example, many female soldiers battle Military Sexual Trauma (MST). Also, due to the differences between the male and female gender, attention should be paid to women who have specifically witnessed or come into contact with direct combat.

For women living with PTSD from service in Operation Iraqi Freedom and Operation Enduring Freedom, Prolonged Exposure Therapy (PE) is one of the top evidence-based treatments. In general, women are receptive to treatments that involve talking about emotions, relationship problems, and other personal problems (Street et al., 2009). With this in mind, PE is beneficial to this cohort because it focuses specifically on the trauma itself and gives the patient a chance to discuss it in a safe and supportive environment.

These women obtain PTSD and MST most often due to personal attacks by people they trust, causing them to lose trust in others, including their family members. They repress a deep sense of betrayal that they often do not even know exists. They can explode at their loved ones for no apparent reason and, most often, report they have no idea what they are doing. This can have detrimental effects on their children; especially if a woman with PTSD is a single mother and the only caretaker at home (Walsh, 2009). It is for this reason that the most intense therapy is the greatest benefit to female veterans from Iraq and Afghanistan with PTSD.

A study published by Tuerk, et al. 2011 presents particularly valid and thorough methods that PE is, in fact, one of the best treatments for female veterans. This effectiveness study was “the first of its kind”; with a small, diverse sample of OIF and OEF veterans in an urban setting who all participated in PE. Archival data was used by patients treated in the local VA, by the PTSD Clinical Team (PCT). These researchers used the PTSD Checklist – Military Version (PCL-M) and the Beck Depression Inventory-II (BDI-II-II). Both of these tests were administered frequently to keep track of the subject’s symptoms, adding to the strength of the study (Tuerk, et. al, 2011).

PE is arguably the most intense therapy, proven to get to the root of the trauma. The therapist must approach cautiously and be sure a strong rapport is established before treatment begins. The patient must be willing to face their biggest fears. One thing about PTSD is that the client doesn’t always remember every aspect of what happened: there are often chunks of time missing, which can be frightening and add to the feeling that the trauma was “no big deal,” as some patients believe they have overreacted (Joseph, 2011). One of the reasons PE is shown to work so well on patients is that it can dig deep into the memory and pull out the missing pieces. For example, it can help the patient realize something as simple as whether or not a certain person was in the vicinity when the trauma occurred. Offering the patient this clarity helps them to feel more at peace about what happened, as there is less “unknown” attached to the trauma.

Intrusive recollections, which can come in the form of intrusive thoughts, flashbacks, nightmares, etc., are an ever present aspect of PTSD. Increased arousal is also a pertinent symptom which shows up as random irritability or anger outbursts, difficulty concentrating, and an exaggerated startle response, just to name a few. Emotional numbness and avoidance of any stimuli associated with the trauma is prevalent (DSM IV, 2000). As PE works to desensitize the client of the traumatic episode these symptoms begin to decline. Cognitive therapy also helps to relieve these symptoms; however this researcher believes PE gets to the core of the problem more rapidly, causing the patient to really face their demons. Cognitive therapy is more focused on the “here and now” thoughts, and not the detailed aspects of what is really bothering the client (Klein, et. al., 2012).

An additional benefit of PE is that it requires very little financial backing and not a lot of time. Sessions are not limited to a VA clinical setting, as it is designed to proceed at the patient’s pace. However, it can take as little as one month, or as long as three months for symptoms to subside and the veteran’s quality of life to drastically improve (NCPTSD, 2009). According to the VA’s Office of Mental Health Services, the VA has recognized this as one of the most effective treatment methods for PTSD, consequently developing a national training program for VA providers across the country (NCPTSD, 2009). It is for these reasons that PE is arguably the most effective treatment method for female veterans with PTSD. Further research...
should be conducted to maximize women veteran’s benefits.

The results of this research review may benefit the thousands of women veterans returning from Iraq and Afghanistan that suffer from PTSD. When they return in need of reintegration support, it is this type of information that can help put them on the road to recovery.

References


James Wilson’s Judge as Agent-Plus

GEENA BOURNAZIAN

James Wilson’s theory of constitutional interpretation is based on a multi-dimensional view of sovereignty, both principled and derived. While the American people serve as the principle sovereign, they delegate authority to the Court (their agents) to uphold the Constitution and educate the American people about the Constitution, its principles, and the duties of the sovereign people. In rendering their decisions, Wilson argues that judges should apply principles of common sense natural law and natural right that informed the sovereign people’s original understanding of the Constitution. By applying Wilson’s multidimensional concept of sovereignty, the role of the judge can be used as a guide to understanding Wilson’s overall theory of constitutional interpretation.

According to Wilson (2007, 304), a constitution is that supreme law, made or ratified by those in whom sovereign power of the state resides, which prescribes the manner, according to which the state wills that government should be instituted and administered. From this constitution the power of government must be directed and controlled: of this constitution no alteration can be made by government; because such an alteration would destroy the foundation of its own authority.

Wilson’s definition of a constitution relies upon the idea of sovereignty as a multi-dimensional concept, based on a principle-agent relationship. The Constitution is the supreme law. The people, as principle sovereign, both make the Constitution, and will their power to the agents of the government which they have created. These agents are designed to pursue the will of the people, and limited by the division of powers, and the boundaries set in the Constitution, in order to prevent tyranny. According to this logic, a judge serves as an agent of the people. A judge is to represent the wants and interests of the people. However, the nature of a judge cannot be treated the same as the nature of a representative in Congress. Representatives in Congress are supposed to be the most accurate voice of the people, with little or no alteration. Judges, on the other hand, are entrusted with the job of upholding the Constitution, while simultaneously educating the people on the law. Therefore, they can be considered as agents-plus. Judges serve as both an agent and educator of the principle sovereign, aiding the people in understanding their position as principle sovereign. Judges help educate the people to make them...
better citizens through their decision making and interpretation of the Constitution (Zink 2009).

Here, I address Wilson's conception of judges as an agents-plus in three different roles. The first role is as agents. Judges are not to serve as political agents, in order to preserve the proper balance between the three branches of government. Wilson stresses the importance of an independent judiciary in completing the duties necessary of judges. Wilson also believes that as agents, judges should rely on scientific reasoning when making their decisions. The second role is as representatives. Wilson designates three jobs for judges as a representative: (1) Not to make law, but to interpret it in light of the Constitution, (2) To promote a true science of law and to follow precedent grounded on scientific principles instead of Aristotelian prudence, and (3) Judicial review must be textually based. The third role is as educators. According to Wilson, judges have the social responsibility of educating the people (the principle sovereign) through their judicial decisions. This education not only clarifies the Constitution and the law, but also serves to educate the people about the nature of their responsibilities as principle sovereign. Included in this is Wilson's concept of the moral sentiment, and its relationship with reason (the science of law). Wilson clarifies this relationship with his idea of judgment and its relationship with reflection, memory, and reason.

Judges as Agents

Since judges are representatives of the people, it is important that they are independent from the other branches of government. Wilson (2007, 704) argues that the Courts “ought to be completely independent… They should be removed from the most distant apprehension of being affected, in their judicial character and capacity, by anything, except their own behavior and consequences.” Important to Wilson is that judges are not political agents. Where the executive and legislative branches have popularly elected members, either directly or indirectly, they become political agents that are restrained by the will of the people. This forces political agents to change their platform according to trends in the general populace. Since Supreme Court judges are appointed for life, they do not have concern with reelection, and therefore can make their decisions according to the Constitution. This does not mean that judges are not agents of the people, it simply means that they are held above the fray of politics, and serve only to protect the Constitution, which is the original expression of the people’s will. Wilson asks:

Can dignity and independence be expected from judges, who are liable to be tossed about by every veering gale of politics, and who can be secured from destruction, only by dexterously swimming along with every successive tide of party? Is there not reason to fear, that in such a situation, the decisions of courts would cease to be the voice of law and justice, and would become the echo of faction and violence? (Wilson 2007, 704-05)

The independence of the courts is crucial to maintaining a boundary between not only the three branches, but between the courts and politics. Since the Court is not supposed to be a political body, its authority and power is very constricted. Hamilton describes this issue stating “The judiciary, on the contrary, has no influence over the sword or the purse; no direction either of the strength or of the wealth of society; and can take no active resolution whatever. It may truly be said to have neither force nor will, but merely judgment; and must ultimately depend upon the aid of the executive arm even for the efficacy of its judgments” (Federalist #78, 402). The Court’s authority relies upon the Constitution, rather than the current politics of society. This jurisdiction allows for judges to take on the responsibility of maintaining the Constitution, and most importantly, maintaining the boundaries between the three branches.

Maintaining these boundaries is one of the Supreme Court’s most important jobs. Wilson (2007, 705) states “Liberty and security in government depend not on the limits, which the rulers may please to assign to the exercise of their own powers, but on the boundaries, within which their powers are circumscribed by the constitution.” The enforcement of boundaries ensures that government will not become tyrannical. The most important boundary to enforce is between the judicial and the legislative departments. Wilson (2007, 743) argues “In consequence of it, the bounds of the legislative power – a power the most apt to overleap its bounds – are not only distinctly marked in the system itself; but effectual and permanent provision is made, that every transgression of those bounds shall be adjudged and rendered vain and fruitless.” Using the power of judicial review, the Court can strike down a law if it conflicts with the Constitution. This allows the judiciary to maintain this boundary between the two branches. Wilson (2007, 743) explains when he states “This regulation is far from throwing any disparagement upon the legislative authority of the United States. It does not confer upon the judicial department a power superior, in its general nature, to that of the legislature; but it confers upon it, in particular instances, and for particular purposes, the power of declaring and enforcing the superior power of the constitution – the supreme law of the land.” According to Wilson, an act should be declared unconstitutional by the Supreme Court if it violates the spheres of power (on an institutional level), or if it usurps power for the legislature. James Madison shares the same sentiment on the maintenance of
of equity and law should remain separate entities, Wilson does although others have tried to make the argument that courts interpreting constitutional issues stating: the combination of a court of equity and a court of law when decide without equity, and that the latter decides without law. Such a conclusion, however, is greatly erroneous.” He describes a court of law and a court of equity placed in contradistinction to each other, how natural is it to conclude, that the former decide without equity, and that the latter decides without law. Such a conclusion, however, is greatly erroneous.” He describes the combination of a court of equity and a court of law when interpreting constitutional issues stating:

It has, indeed, been said, concerning a court of equity, that it determines by the spirit, and not by the letter of a rule. But ought not this to be said concerning a court of law likewise? Is not each equally bound – does not each profess itself to be equally bound – to explain the law according to the intention of those, who made it? In the interpretation of laws, whether strictly or liberally, there is not a single maxim, which is not adopted, in the same manner, and with the same force, by both courts. Hitherto, then, we find no difference between a court of law and a court of equity. (Wilson 2007, 925)

Although others have tried to make the argument that courts of equity and law should remain separate entities, Wilson does not agree. Wilson (2007, 933-34) states “law and equity are in a state of continual progression; one occupying incessantly the ground, which the other, in its advancement, has left. The posts now possessed by strict law were formerly possessed by equity; and the posts now possessed by equity will hereafter be possessed by strict law.” Here, Wilson appears to separate law and equity on the one hand, and science on the other. Science is grounded and proven, and informed by reason. This supports the theory of Hobbes, who believes scientific reasoning should be applied to the law. Hobbes (1994, 26) says “reason is the pace; increase of science, the way; and the benefit of mankind, the end.” This suggests that both Hobbes and Wilson believe the use of scientific reasoning is the driving force which should solidify the law, justice and equity. For Wilson, applying scientific reasoning with equity helps to aid judges in translating the Constitution while simultaneously improving society. This idea of equity is also consistent with Hobbes. Hobbes defines equity in the role of a judge as “a precept of the law of natural that he deal equally between them. For without that, the controversies of men cannot be determined but by war” (Hobbes 1994, 97). In a similar sentiment, Wilson (2007, 934) states “equity may be well deemed the conductor of law towards a state of refinement and perfection.” The idea of equity serving as a tool to refining and perfecting society, also suggests that equity can serve as an end of government and society. While Wilson attributes the creation of government as the agent for the will of the people, equity can serve as one of the ends government is designated to achieve.

Judges as Representatives
The second job of judges is to serve as representatives of the will of the people. On this front, Wilson identifies three important jobs designated for judges. The first is that they should not make the law (Wilson 2007, 738). Making the law is the job of the legislature. Judges have only the function of interpreting the law in light of the Constitution. Wilson (2007, 738) argues “In the United States, the judges stand upon the sure basis of the constitution: the judicial department is independent of the legislature.” A judge can determine the constitutionality of the law, and strike it down with the power of judicial review, if and only if it is found to be unconstitutional. A judge has no other power to strike down a law other than this power, limiting their ability to create the law. However, Wilson(2007, 738) argues “In many cases, the jurisdiction of the judges of the United States is ascertained and secured by the constitution; as to these, the power of the judicial is coordinate with that of the legislative department.” The coordination between the legislative branch and the judiciary was of particular importance to Wilson. Since the judiciary serves as the final check on a new law, judges must coordinate with lawmakers in order to best serve the needs of society, in accordance with the Constitution.
The second role of judges as representatives is that judges “should implement principles and rules of genuine policy and natural justice for the purpose of promoting a true science of law” (Wilson 2007, xxiii). According to Wilson, the term “science” is viewed as progress in reflection of enlightenment principles. For Wilson, the use of precedent is seen as necessary, but not in every situation. Each new case and new decision improves upon or uses precedent, almost like a science experiment. In science, a result is only deemed legitimate if it can be replicated. This is the same for the law. If precedent cannot be applied to more than one case that is similar in nature, then the decision should be improved upon and changed. Wilson uses his knowledge of the natural sciences and applies them to the law using the writings of Lord Francis Bacon. Wilson describes the science of law while mentioning the importance of Lord Bacon in the following:

I think I may venture the position – that in no science can richer materials be found, and that, in no science, have rich materials been more neglected or abused, than in the science of law – particularly of the common law. Listen to the sentiments of my Lord Bacon, in his book on the advancement of learning. It is well known, that the vast object of this exalted and most comprehensive genius was, to erect a new and lasting fabric of philosophy, founded, not on hypothesis or conjecture, but on experience and truth. To do this effectually required knowledge and discernment, exquisite and universal; such were happily employed in the arduous task. (Wilson 2007, 1026-1027)

The use of science for Wilson is very important in the interpretation, as well as the teaching of the law. Wilson looks towards the law, as well as the interpretation of it, as an advancement of learning. Applying the science of law is important to the overall job of judges, because they are entrusted with clarifying the law of the Constitution for the people. The science of law serves as a way of improving the existing law, as well as an aid in interpreting what the law intends through replication. The use of science and the emphasis on replication suggests that through the use of scientific principles and reason, a judge can better clarify the law, leading to uniformity in the interpretation of it. If interpretation of the law, and more importantly the Constitution, is more uniform, it will be easier to educate the people on its meaning. This also supports Wilson’s idea that the law and its application is universal in nature, which should facilitate, on one hand, the perfection of society and the cultivation of American citizens, on the other. For example, if similar laws are interpreted differently in two different states, then two different lessons are learned by the people. This works against Wilson’s national impulse. Therefore, for Wilson, a scientific grounding for precedent is surer than the grounding of precedent currently and historically found in the common law.

The science of law also helps to maintain the idea of the judiciary as a pyramid. The courts, according to Wilson (2007, 945) should resemble a pyramid where there is “a regular, progressive gradation of jurisdiction.” The gradation of jurisdiction provides options, as well as limits them. The higher up the pyramid, the more limited the power of the Court becomes. This is helpful in maintaining the boundaries of the Supreme Court. Giving the Supreme Court the final authority is potentially dangerous, therefore the pyramid provides limitations on the Court’s power. The potential danger is seen in the fact that the Court is not popularly elected, and is not accountable for its decisions. The fear is that an empowered court could degenerate into an aristocracy. In addition to this, he states “a supreme court prohibits the abuse, and protects the exercise, of every inferior judiciary power” (Wilson 2007, 945). The creation of the United States judicial system allows for the science of law to function properly. Each district has its own federal court, and appellate court to which the law is interpreted and applied. However, the Supreme Court has the ultimate authority, and makes the ultimate decision of whether or not a decision, or law is constitutional.

The third responsibility of a judge as representative is that judicial review should always been textually based (Wilson 2007, xxiii). This should be seen as a limitation. Although the power of judicial review is an implicit power with the function of ascertaining the validity of a statute, Wilson limits this implicit power by requiring judge’s decisions involving judicial review to be strictly text based. Since the Constitution is the supreme law of the land, and is the will of the sovereign people, Wilson believes it provides the proper criteria for making this determination. Wilson (2007, 897) describes judicial review as:

If the validity of a statute or treaty of the United States, or of an authority exercised under them, be drawn in question, in any suit in the highest court of law or equity of a state, in which a decision of the suit could be had; and a decision is against their validity – if the validity of a statute of any state, or of an authority exercised under that state, is, in any suit in such court, drawn in question, as repugnant to the constitution, treaties or laws of the United States; and a decision is in favor of their validity – if the construction of any clause of the constitution, of a treaty, of a statute of the United States, or of a commission held under them, is,
in any suit in such court, drawn in question; and a decision is against the title, right, privilege or exemption, specially set up or claimed by either party under such clause – a final judgment or decree, in all these cases, may, upon a writ of error, be reexamined and affirmed or reverse in the supreme court of the United States.

The power of judicial review is used when the Constitution is not clear about a certain issue, or if there are conflicting principles. Grounding judicial review in text also limits the power of the Supreme Court from overstepping their jurisdictional boundaries. It also allows for a legitimate check on the acts of the legislature. In recognition of this, Hamilton refers to the judicial branch as an “intermediate body between the people and the legislature, in order, among other things, to keep the latter within the limits assigned to their authority” (Federalist #78, 404). Maintaining the proper balance between the three branches of government constitutes a significant part of a judge’s responsibilities. A judge wants to promote a true science of law, and reach natural justice according to Wilson, therefore the power of judicial review works towards that goal, by refining the wants and needs of the people, by limiting them with the Constitution. Hamilton, picking up on this point, goes further and says “the interpretation of the laws is the proper and peculiar province of the courts. A constitution is in fact, and must be, regarded by the judges as fundamental law. It therefore belongs to them to ascertain its meaning as well as the meaning of any particular act proceeding from the legislative body” (Federalist #78, 404). Judicial review stands as the strongest check against legislative encroachment, and aids in the enforcement of boundaries between these two branches.

**Judges as Educators**

The third function of a judge is to serve as an educator of the sovereign people. Judges are entrusted with this education, because they are seen as knowledgeable individuals, enlightened by studying the law and what Wilson refers to as the science of law. In the example that the people ask Congress to do something that is outside the government’s derived power, or is inconsistent with the ends of government, the Court has the job of recognizing that this is unconstitutional, and has the job of educating the people on why they are asking is inconsistent with the ends of government as designated by the Constitution. Wilson (2007, 447-48) describes a judge as “He who is qualified to teach, is well qualified to judge; and he, who is well qualified to judge, is well qualified to teach.” According to Wilson, a judge has the social responsibility of bettering society. A judge does this by educating the people on the law through their decisions.

When interpreting the Constitution, judges use what Wilson (2007, 819) refers to as “common sense.” This “common sense” is informed by Wilson’s concept of the moral sentiment, which is used to resolve the tension between natural right principles and common law principles. Wilson (2007, 458) states that when making decisions, a judge must “pry into the secret recesses of the human heart, and become well acquainted with the whole mortal world, that they may discover the abstract reason of all laws.” This implies two important concepts for Wilson. When he refers to “the secret recesses of the human heart,” he is referring to the moral sentiment. Wilson (2007, 512) states that the moral sentiment “from its very nature, is intended to regulate and control all our other powers. It governs our passions as well as our actions.” For Wilson (2007, 512), the concept of the moral sentiment is “In short; if we had not the faculty of perceiving certain things in conduct to be right, and others to be wrong; and of perceiving our obligation to do what is right, and not to do what is wrong; we should not be moral and accountable beings.” Therefore, according to Wilson, the moral sentiment serves as our internal check on right and wrong, placed in the hearts of individuals by God.

Another way of conceptualizing the moral sense is as conscience. This is an important quality of a judge, because judges require the proper understanding of right and wrong while making decisions. According to Wilson (2007, 514), “His conscience or moral sense determines the end, which he ought to pursue; and he has intuitive evidence that his end is good: but the means of attaining this end must be determined by reason.” Reason is the second part of Wilson’s understanding of the “common sense,” as well as judicial decision making. Once a judge has consulted with the moral sense to determine what is right or just, they must use reason in order to execute what the moral sense is telling them to do. Wilson (2007, 514) states “Thus, though good and ill, right and wrong are ultimately perceived by the moral sense, yet reason assists its operations, and, in many instances, strengthens and extends its influence.” Reason and the moral sense work together to find the best possible outcome for a situation. The moral sense cannot act without reason, because reason provides what the moral sense cannot. Wilson (2007, 514-515) states “reason serves to illustrate, to prove, to extend, to apply what our moral sense has already suggested to us, concerning just and unjust, proper and improper, right and wrong,” while in addition, “reason contributes to ascertain the exactness, and to discover and correct the mistakes, of the moral sense… It considers the relations of actions, and traces them to the remotest consequences.” However, this is not to suggest that reason is superior to the moral sense. According to Wilson (2007, 519), “the ultimate ends of human actions, can never, in any case, be accounted for by reason.” However, the fault of reason is that it “presents false appearances to our moral sense” (Wilson 2007, 518). Although it may seem that
reasoning can be used to solve an issue in the natural sciences, in the science of law, the moral sentiment is required. According to Wilson (2007, 517), “the dictates of reason are neither more general, nor more uniform, nor more certain, nor more commanding, than the dictates of the moral sense.” Therefore, it is important, given the strengths and weaknesses of both the moral sense and reason separately, that the two work together.

According to Wilson’s conception of the moral sense, it would seem that using a pure science of law if inadequate when making decisions. Wilson believes good judges need the combination of the science of the law and the moral sense in order to arrive at the right decision. Wilson (2007, 469) asserts “Truth may, indeed, by reasoning, be rendered evident to the understanding; but it cannot reach the heart, unless by means of the imagination.” This suggests that science is silent on the question of right and wrong. However, the moral sense also cannot be the only influence on judicial decision making either. Wilson (2007, 470) states “Laws may be promulgated by reason and conscience, the divine monitors within us.” Both coordinate with one another in order to arrive at a just and equitable decision. The moral sense, without the use of reason appears to have no restrictions. This tension between the moral sense and the science of law is solved by Wilson’s conception of judgment.

The first important part of Wilson’s conception of judgment is reflection. Wilson believes that experience, as well as reflection on the experience of others is a very important influence on judicial decision making. Wilson (2007, 586) describes the action of reflection: This way: “By this power, the mind makes its own operations the subject of its attention, and views and examines them on every side.” While reasoning and the moral sense both used when making decisions, reflection serves as the best restriction against the passions of the moral sense. Wilson (2007, 586) states “how utterly impossible is it to make any clear and distinct observations on our faculties of thought, unless the passions, as well as the imagination, be silent and still.” Once reflection has restricted the overbearing passions the moral sense can sometimes present, one can apply the science of law and come to a decision that is consistent with the dictates of natural justice. Reflection allows for the discovery of truth, and therefore the right and best answer for a given situation.

A second component of Wilson’s conception of judgment is the relationship between judgment and memory. According to Wilson (2007, 599), “Judgments are intuitive, as well as discursive, founded on truths that are self-evident, as well as that are deduced from demonstration, or from reasoning of a less certain kind. The former, or intuitive judgments, may, in the strictest sense, be called the judgments of nature.” When Wilson refers to demonstration, he is referring to experience, or memory. According to Wilson, judgment and memory are mutual assistants. Wilson (2007, 597) states “Memory furnishes the materials which judgment selects, adjusts, and arranges. Those materials selected, adjusted and arranged are more at the call of memory than before: for it is a well known fact, that those things, which are disposed most methodically and connected most naturally, are the most distinct, as well as the most lasting objects of remembrance: hence, in discourse, the utility as well as beauty of order.” Without memory, judges would not have the ability to collect and organize information in a particular case. Memory also allows for reflection, not only on personal experience, but also on evidence and precedent. Judgment uses memory in order to make affirmative or denial distinctions. This ability is keen when relying upon the moral sense for a scale of right and wrong. Wilson (2007, 599) describes judgment as “an important operation of the mind; and it is employed upon the material of perception and knowledge. It is generally described to be, that act of the mind, by which one thing is affirmed or denied of another.” However, he believes this definition is too limited, while at the same time too extensive. Wilson sees judgment as limited, because it can only be expressed by either affirmation or denial. There is no true gray area. He believes it is too extensive because it includes testimony as a conjuncture to judgment, when they are two completely different concepts with different implications. Judgment, in addition to memory, requires reasoning in order to function.

The third component of judgment for Wilson is the connection between judgment and reason. Wilson (2007, 600) states that “with the power of judging, the power of reasoning is very neatly connected.” Wilson sees judgment and reasoning as corresponding with one another in order to reach the right decision. This coincides with Aristotle’s practical judgment (See Ethics, 1142a-1142b). According to Wilson (2007, 600), “reasoning is strictly the process, by which we pass from one judgment to another, which is the consequence of it. In all reasoning, there must be one proposition, which is inferred, and another, at least, from which the inference is made.” Reasoning is the bridge between memory and judgment. Reasoning allows for judgment to make the necessary connections, and helps to organize and analyze the information contained within memories. This organization allows for a judge to think about memories in a restrained form. This restrained form is less likely to be overly passionate, and can aid a judge in his/her decision making in a clear and logical sense. However, Wilson (2007, 600) points out that “reason, as well as judgment, has truth and falsehood for its objects: both proceed from evidence; both are accompanied with belief.” Therefore, accord-
ing to Wilson, reasoning and judgment cannot stand alone. Both have the ability to reach the wrong conclusion. Wilson's solution to this is the moral sense. Wilson (2007, 803) states "Our knowledge of moral philosophy, of natural jurisprudence, of the law of nations, must ultimately depend, for its first principles, on the evidence and information of the moral sense." The combination of the moral sense with judgment and reason is very important in understanding and interpreting the Constitution. According to Wilson (2007, 615), the Constitution contains common sense moral principles. The Constitution does not explicitly state these principles, but it is required of a judge to identify them using reason. One of the strongest common sense moral principles contained within the Constitution is the protection of the innocent. Wilson (2007, 627-28) states "the moral sense restrains us from harming the innocent: it teaches us, that the innocent have a right to be secure from harm. These are two great principles, which prepare us for society; and with regard to them, the moral sense discovers peculiar inflexibility: it dictates, that we should submit to any distress or danger, rather than procure our safety and relief of violence upon an innocent person." The Constitution deals with common sense moral principles in a limited approach. It places restraints upon individuals in society through the use of a common sense. Each individual has a common, moral sentiment that tells them what is right and wrong placed in them by God. The Constitution, as well as the governmental institutions it creates, is intended to inform the people on this moral sentiment, and aid them in discovering it. The Constitution cannot simply be looked at as the will of the people, but as the will of the people that embodies and presumes and argument on certain moral principles.

**Discussion**

Having distilled Wilson's theory of how judges make decisions, it can now be placed alongside the other schools of thought. Although each has similar qualities to Wilson's thought, each has significant differences as well. The first school is the natural law. According to the natural law, law and morality cannot be divorced from one another. The natural law also provides principles for how one ought to live, based on substantive moral reasoning that defines right and wrong. The natural law is universal, but not in the same sense as Wilson understands universality. Arkes (1990) and George (1999) attempt to incorporate Thomistic natural law principles into a theory of jurisprudence, where Wilson grounds a theory of jurisprudence on scientific principles. Since the natural law argument focuses on the Thomistic idea of right and wrong, Wilson does not fit within its confines. Wilson believes that God has placed within each individual the dictates of right and wrong, he uses common sense, the moral sentiment, and reasoning rather than a strict reliance on the divine. Wilson focuses on the common sense, reaching inside ourselves for the dictates of morality. The traditional natural law argument, in contrast, argues that the source of natural law is external to man, in the form of a divine God. For Wilson, the natural law does not provide a thorough basis for decision making, but instead creates a very limited understanding of right and wrong based on divine reasoning.

The second school is natural right. According to natural rights theorists, if a law is against natural rights, judges should reject it as government has the job of protecting the inalienable rights of individuals. Natural rights theorists also believe that legitimacy in government is gained by the proper protection of rights, not the consent of the governed. Barnett (2004, 30) states "a duty to obey the law cannot be grounded on the consent of the governed when there has been anything less than unanimous consent and that, obviously, no government legal system can claim this degree of consent." According to the natural rights argument, the job of government is to secure individual rights, unless everyone, unanimously, can all agree that government does not have the means to execute a given action. Barnett goes on to claim that the phrase "We the People," is a fiction, as well as the idea of popular sovereignty itself. This idea is in direct tension with Wilson's idea of popular sovereignty. Wilson's political thought focuses heavily on the importance of consent, as well as the people as principle sovereign. Wilson agrees that the government, as an agent of the people, and as part of their social responsibility should protect individual's natural rights and improve society. This implies a trust between the sovereign people that the government will actively protect their natural rights. For Wilson, the government is simultaneously empowered and limited by this trust. For Barnett and other natural rights theorists, the government is limited. Natural rights theorists also believe that popular attachment is based on what an individual's conscience dictates. If an individual believes a law, or the government is not protecting them properly, they have the right to deny/disobey that law. Wilson would disagree with this concept of political attachment, given the multiple provisions provided in the Constitution to ensure that the laws created and passed by the legislature will be good laws. However, Wilson would agree that conscience is a necessary factor in determining right and wrong. Wilson's moral sentiment, based on common sense principles, provides guidance on right and wrong, in the same way individual conscience does.

The third school is of the common law in America. According to Stoner (1992), the common law requires judges to make decisions using prudence and precedent. A heavy reliance on precedent allows for judges to make decisions based on the prior decisions of other judges, while accounting for new evidence presented within a case. Wilson agrees with the use of precedent, but does not place a heavy reliance upon it. The com-
mon law is adaptable, changing with each generation to fit the needs of the people. The common law is unwritten, therefore allowing for flexibility. For Wilson, the common law does not provide a solid basis for judicial decision making. Instead, Wilson favors grounding the Constitution and its interpretation on scientific principles. Science is proven. The common law is dynamic and unstable. Although the common law has been perfected over time, science allows for replication. The common law does not rely on scientific reasoning, and is therefore nonreplicable. This creates tension within the law, and therefore a problem with popular attachment to the law. This tension is commonly seen within interstate law. If a given action is legal in one state, but illegal in another, the people can become confused, therefore undermining the ability of the sovereign people to perform their responsibilities. If the law is universal, and grounded on scientific principles, it will be more solidified, and therefore the people will be more likely to consent to it.

Wilson’s position on judicial decision making blends natural law and natural rights principles, based on a scientific grounding of the law. Wilson’s science of law is ultimately a scientifically-informed understanding of precedent and judicial reasoning. Where the three competing interpretations of how judges should decide go wrong is in viewing the act of decision making as having to fall exclusively into a single intellectual camp. This requirement is inconsistent with what is generally regarded as the fundamental starting point to the study of American political thought. A single body of philosophy cannot accurately explain or describe the American political thinking as Americans draw on multiple, often contradicting, intellectual traditions (Gibson 2007, 130-164; Gibson 2006, 7-63). Wilson’s multi-dimensional concept of popular sovereignty, as well as his understanding of what judges should have recourse to when making decisions serves as the perfect example of how multiple influences affect the political thought of our Founding Fathers.


**Endnotes**

1 Wilson was also a strong advocate for a Council of Revision, which would create a larger check on the legislative power when creating laws by determining whether or not a particular piece of legislature was consistent with the Constitution. Having this check would ensure that no law passed by the legislature would be unconstitutional. However, the Council of Revision was eventually rejected by the delegates at the Constitutional Convention.

2 This limitation on the Supreme Court’s power is best seen in the case of *Marbury v. Madison* 1803. In *Marbury*, the Supreme Court denied cert because Marbury had filed for original jurisdiction. The Supreme Court only has the power of appellate jurisdiction, therefore making Marbury’s claim outside the sphere of the Supreme Court’s jurisdiction.

**References**


Advanced Computing Systems for Scientific Research

JARED BUCKLEY, JASON COVERT, AND TALIA MARTIN

An advanced computing system was constructed at Bridgewater State University to provide students access to computing machines tailored to the purpose of computational scientific research. This paper provides an overview of the construction, design, capability, and future potential of the computing system.

Project Reasoning
During the course of projects utilizing a numerical weather prediction (NWP) model, it became evident that the desktop computing machines provided to students in computer labs were not capable of yielding results in a reasonable amount of time for non-standard applications. The standard configuration of computers in the Conant Science and Mathematics Center at Bridgewater State University is sufficient for the majority of student purposes; however, these standard computers become insufficient for more comprehensive applications. Because of this insufficiency, it became necessary to seek better performing computer systems to support research applications.

Project Execution
To increase the computational power of computing systems on campus, two distinct steps were taken. The first step was the upgrade of a standard desktop computer. This upgrade provided a single desktop machine with superior computing capability to the standard machines available to students. The second step was the construction of a Linux computer cluster from several networked previous generation machines.

Standard Desktop Computer Upgrade
To reduce the execution time of computationally heavy tasks, a standard desktop computer was upgraded using conventional computer upgrade methods. These methods included Central Processing Unit (CPU) upgrading and the addition of Random Access Memory (RAM). The standard computer used had an original CPU configuration of the Intel Pentium G850 dual-core processor and a RAM configuration of 8 GB. Upon upgrade, the standard computer had a CPU configuration of the Intel Core i5-2500 quad-core processor and a RAM configuration of 16 GB. The upgraded specifications allowed for faster computation and larger tasks. The standard computer’s main operating system was also changed from Windows 7 to CentOS 6 (a Linux distribution) to provide support for native Linux programs and development³.

Jared Buckley, Jason Covert and Talia Martin collaborated on developing a more efficient technology resource for scientific computing under the mentorship of Dr. Robert Hellström (Geography). Jared (’14) majored in Physics at BSU and is continuing his interest in using computing systems to study weather and climate at UMass Dartmouth. Jason is majoring in geography and has an interest in weather studies and GIS mapping. Talia is a physics major at BSU and enjoys astronomy. She was awarded a 2013 NASA Space Grant to conduct astrophysics research.
To provide a stable computer working environment for image processing, the program Maxim DL was installed onto the upgraded standard desktop computer. Maxim DL is an astrophotography software program used to analyze images in order to obtain information about the objects in the images. This process, called photometry, can have many uses such as determining the brightness of a star in an image. In working with exoplanets, photometry can be used to detect how bright a star is through several images over a period of time. When an exoplanet crosses in front of its parent star it blocks some of the light coming from the star and this change in brightness can be detected in the images. A light curve of this change is made to show when an exoplanet transits and can be used to gather other useful information, such as the size of the planet, the length of its orbit and in some cases, by using different filters (light curve shown in figure 1). Even what the planet is made of can be found.

| Figure 1. HD 189733b Light Curve |

Images of the transit of the known exoplanet HD 189733b were collected during the summer of 2013 at Bridgewater State University. The program Maxim DL was used to calibrate and analyze the images. This process requires using a series of calibration images that will remove background noise from the images to be analyzed. Once this was completed for all images, Maxim DL was used to analyze the brightness of the main object as well as three comparison stars. The comparison stars act as a control, making sure that the brightness of all the stars in the image are not changing, only that of the main object.

The length of the transit for HD 189733b is approximately two and a half hours and an image is taken about once every minute for the duration of the transit and for ten minutes before and for ten minutes after. This results in well over 100 images being taken, each with a rather large picture file size. The computer originally used to calibrate and analyze the images taken over the summer had 4GB of RAM. It took approximately two weeks, working between 2 and 4 hours a day on average to complete the calibration of the images. The program would freeze if an attempt was made to calibrate more than 10 images at a time, so the whole process had to be done in batches of 10, otherwise the program stopped responding and anything done previously was not saved.

The transit of HD 189733b was once again captured at Bridgewater in the fall of 2013. This time, however, the upgraded standard computer was used to calibrate and analyze the data. It did stop responding when it was asked to calibrate all of the open images at once. Splitting the images into two groups of approximately 70 images worked well and it took less than 2 hours to fully calibrate all of the images. The same task had taken two weeks with the previous computer.

Using the upgraded standard computer made the image analysis process faster, as more images could be open at a time, but the greatest benefit was the reliability. Even if only 15 images were open while analyzing previously, the program would still shut down randomly, causing loss of work. The program would then have to be restarted and those images analyzed again, wasting time and causing a fair amount of frustration. The upgraded standard computer allowed for larger groups of images to be analyzed at one time and continued responding for as long as was required.

Construction of a Linux Computer Cluster

Using 8 idle, previous generation computers and the upgraded standard computer, a 9 node (computer) Beowulf-style Linux computing cluster was constructed during the fall semester of 2013. The cluster is a distributed memory, heterogeneous computer cluster operating over a Fast Ethernet network consisting of a single network switch and 20 total CPU’s. Each individual machine runs the CentOS 6 Linux operating system. Nicknamed the Bridgewater State University Crystal Ball (BSUCB), this cluster provides a dramatic increase in program execution speed through the use of parallel processing.

Bridgewater State University Crystal Ball (BSUCB) Design

The BSUCB is setup with 9 nodes in total. The main (control) node is a quad-core system with 16 GB of RAM and the compute nodes are dual-core systems each with 2 GB of RAM. Although the use of the cluster resources is dynamic, the BSUCB cluster design allows for a 20 CPU parallel processing device.
The BSUCB nodes are connected via a single Ethernet switch and communicate over a Fast Ethernet Network. The BSUCB is in general closed off from the University computing network, but the main node retains access to the University network for Internet connectivity when data is required to be downloaded. The main node is physically accessible via a workstation setup so that the BSUCB can be controlled. This workstation also allows the main node to be used as a standalone machine.

**Figure 2. The BSUCB Design**

![Image of the BSUCB Design](image_url)

**Application**

The construction of the BSUCB arose from the use of the numerical weather prediction (NWP) model the Advanced Regional Prediction System (ARPS)\(^6\). The ARPS was built/written in the Fortran computer language by members of the Center for Analysis and Prediction of Storms (CAPS) at the University of Oklahoma\(^6\). The ARPS was used during the summer of 2013 to provide a foundation for short range cloud cover forecasting. The general performance of the ARPS at Bridgewater State University has been poor due to computing restrictions. Because the ARPS is natively coded (designed) to run across a Linux computer cluster for advanced parallel processing, the BSUCB became the perfect plan to reduce ARPS execution time\(^6\).

The BSUCB is capable of running the ARPS using Open Message Passing Interface (MPI)\(^6\). Open MPI is an open source adaptation of the MPI standard, a standard designed to allow networked computers to divide tasks and speed up program execution\(^7\). This execution time reduction will allow for more advanced projects using the ARPS to execute in a significantly more reasonable amount of time.

**Benchmarking**

Benchmarking, the assessment of the performance of computing systems, of the BSUCB was done using a 2 hour forecast supercell thunderstorm simulation run with the ARPS. To gauge the relative increase in performance of the BSUCB, the benchmarking of the BSUCB and the upgraded standard desktop computer were compared. The supercell simulation was run a total of 10 times on the BSUCB and on the upgraded desktop. Each run was made computationally more intense by increasing the size of the spatial domain of the simulation. The spatial domain determines the number of computational grid points in a simulation. Grid points are used by NWP models to hold information about the atmosphere\(^8,9\). This atmospheric information is used by NWP models in a series of calculations in order to predict a future state of the atmosphere\(^8,9\). Because the NWP models must perform calculations at each grid point, the larger the number of grid points, the more computationally intense the simulation. It is expected that an increase in the number of grid points increases the execution time.

Figure 3 displays the results of the ARPS benchmarking procedure. The line labeled “cluster” represents the results of the BSUCB benchmarking and the line labeled “single node” represents the results of the upgraded standard desktop computer benchmarking. Vertical lines are drawn to show where the BSUCB and upgraded desktop had identical performance and where the BSUCB and upgraded desktop performance were separated by a factor of 2. A horizontal line is drawn to show where the ARPS execution time is no longer faster than the weather it is simulating.

**Figure 3. Benchmarking Results**

![Image of Benchmarking Results](image_url)

The significance of figure 3 is that it proves the usefulness of the BSUCB as compared to a single computer. Once the number of grid points increases significantly, the BSUCB greatly outperforms the single computer. The BSUCB is also capable of performing more computationally intense live forecasting.

Despite the obvious advantages of the BSUCB, the beginning of the benchmarking graph reveals an important idea. The BSUCB is outperformed by the upgraded standard desktop
computer when the number of grid points is small. This is because it takes physical time for the nodes in a cluster to speak with one another and transfer tasks over a network. As constructing/writing computer code to execute across a cluster can be a time consuming process, this slow down during less intense operations suggests that such operations are better suited to run on a conventional computing setup.

Future Work
Projects that utilize the BSUCB and upgraded standard computer are planned for the future. The ARPS will continue to be run on the BSUCB for weather prediction projects. There is also some consideration for the installation of alternate NWP models, such as the Weather Research and Forecasting Model (WRF), and a long term climate modeler10. Physics students are also planning to use the BSUCB to perform computationally intense simulations, including space-time simulations. The upgraded standard desktop computer will also continue to be used to provide a stable computing system for astronomical image processing.

Personal Acknowledgements
Thanks are extended to Dr. John Santore (Bridgewater State University Computer Science Department) for allowing the use of idle computers for the construction of the BSUCB, to James Govoni for providing networking supplies and support, and to Dr. Robert Hellström for his support as mentor of this project.

Software Acknowledgements
Thanks are extended to CAPS at the University of Oklahoma for providing the ARPS for free and open source public use, the CentOS development team for providing a free, open source operating system, and to the developers of Open MPI for their free, open source adaptation of the MPI standard. Without open source software, projects such as the construction of the BSUCB may not be possible.

References
Victim Worthiness: The Effect of Media Coverage on the Portrayal of Homicide Victims

Danielle Christenson

In the last thirty years with the growth of 24-hour news channels, Internet only news sites and the decline of the newspaper, there have been tremendous changes in how the media covers crimes. Whether it is a catastrophic terrorist attack, school shooting or a low-profile homicide, violent crime is a staple of news coverage. The field of victimology has documented that the media does not portray all crime victims the same. The race and class of the victim as well as seemingly non-relevant factors such as their age, profession and the location of the crime as well as the demographics of the offender all influence public portrayals of crime victims. Scholars refer to these factors as influencing “victim worthiness.” Victim worthiness can have an influence on jury selection, prosecutorial discretion and sentencing (Stabile, 2006). Utilizing computer content analysis, this study examined three case studies of violent crime, analyzing the news coverage and its impact on “victim worthiness.” The hypothesis of this study was there would be media bias in the portrayal of homicide victims due to “extralegal” factors (e.g. race, age, status, etc) of either the victim (s) and/or the offender. The findings of this study suggest mixed findings in support of the hypothesis.

Research Question & Hypothesis
Is there a media bias in the portrayal of homicide victims?

This study examined whether there was a media bias in the portrayal of homicide victims. Our hypothesis was that there would be discernible media bias in the portrayal of homicide victims due to “extralegal” factors (e.g. race, age, status, etc.) of either the victim (s) and/or the offender.

Policy Relevance
This study is particularly important as most of the information the public receives about crime comes from the media and it is critical that the information be scrutinized and critiqued. According to the law all victims should be treated equally. In the media, however, victims are treated very differently. Media portrayal of crime victims and offenders can be objective or subjective. Scholars have documented that media coverage of crime victims and offenders tend to be biased (Callanan, 2012) (Greer, 2007). Media coverage of crime victims often focus on personal, situational and demographic characteristics, which had nothing to do with their victimization. As such media coverage affects jury selection and decision-making as well as public sentiment (Bing III, 2010).
Methods
This research used three different case studies as well as a computerized content analysis to answer the research question and test the hypothesis. A content analysis method is a way of evaluating text, newspapers, essays, etc. Computerized content analysis allows an electronic software package (Concordance® was used in this research) to assist in the identification of themes, keywords and patterns articulated by the researcher. As such computer content analysis allows for the quick and methodological examination of large sums of text. The data for the content analysis came from local and national newspapers and national news broadcast transcripts that were obtained from LexisNexis, ProQuest, and news websites. Local television news coverage due to was excluded due to the lack of available transcripts. Also excluded were radio, and online only news sources due to time constraint.

Each case study qualifies as a mass shooting according to the FBI's definition. All three case studies initially received significant media attention. They also had varying racial dyads between victim and offender. The three case studies chosen were the Mattapan Massacre (Boston) in 2010, the Tucson, Arizona shooting in 2011, and the Oak Creek, Wisconsin shooting in 2012.

Literature Review
The Federal Bureau of Investigation (FBI) presents national homicide data through the Uniform Crime Reports (UCR) and Supplemental Homicide Report (SHR). According to the 2009 and 2010 SHR’s, the majority of murder victims were male (77.6 percent). African Americans accounted for 50 percent of victims. Whites accounted for 45.2 percent of victims while 2.4 percent of the victims were of other races (Cooper & Smith, 2011). African Americans only constitute 13.1 percent of the U.S. population despite making up a majority of crime victims (State & County Quick Facts, 2011).

Fear of crime in America remains constant despite the declines and stagnant crime rates since the 1990’s (Drakulich, 2012). Drakulich conducted a study in 2012 on racial anxieties to determine whether those who possessed racial stereotypes would have a higher perception of criminal danger than those who did not possess racial stereotypes.

Drakulich found that respondents who did not report interacting with neighbors of other races or ethnicities were more likely to possess racialized crime stereotypes. Those who did interact with other races and ethnicities were less likely to possess racial crime stereotypes. For example, Drakulich found that interactions with members of a different race led to a decreased likelihood of stereotyping African Americans and Latinos as gang and drug involved (Drakulich, 2012).

Stereotypes are not created based on fact. Stereotyping can lead to false ideas about specific groups. For example, African Americans are often stereotyped as criminals; this leads people to fear them due to the false stereotype (Mears et al., 2011). This issue is important to consider due to the widespread growth of media. Stereotypes now have the ability to be spread very quickly and reach many people.

A majority of Americans rely on the mass media for information about crime as opposed to obtaining information through personal experience. It is important, that the media reports accurate information regarding crime to the public (Jewkes, 2011). News organizations serve the important purpose of informing the public; however, they also serve a conflicting role, which is to make a profit. In order for news organizations to make a profit they have to maintain high ratings and newspaper sales. This then leads to an emphasis on certain news stories that appeal to a mass audience known as newsworthy stories (Callahan, 2012).

Crimes that are considered newsworthy are those that include drama, a vulnerable victim, and are out of the ordinary (Callahan, 2012). Bing (2010) argues that the media constructs a connection between race and crime through social constructionism. According to Bing (2010), African Americans were twice as likely as whites to be shown under physical restraint by the police. This is true despite whites being accused of similar violent crimes.

According to Potter & Kappeler (1998), between 1991 and 1994 crime and victimization rates in the U.S. decreased. Despite the decrease in crime, all the major television networks consistently raised the number of violent crime stories they reported each year from 1991-1994. Despite the consistent drop in 1994 the public, when asked about their perception of crime, 88% answered that they thought it was at an all-time high. Politicians fueled this false perception of crime by proposing new laws that would combat the “crime problem” (Callanan, 2012).

Few crimes are considered newsworthy as mass murder. This is because it is shocking, infrequently occurring, and involves multiple victims. Mass murder attracts local, national and sometimes even international media attention. There are however, some mass murders that are considered more newsworthy than others. Past studies have suggested this is because of certain characteristics. One characteristic is that of a lone gunman who shoots strangers in a public setting. Less coverage is devoted to mass murders involving fire, family members of victims, and mass murders that were committed in connection with property offenses (Duwe, 2000).
Case Studies
The FBI defines “mass murder” as four or more murders occurring during the same incident, with no distinctive time period between the murders (Federal Bureau of Investigation, 2011). These events typically involved a single location, where the killer murdered a number of victims in an ongoing incident (Morton, 2008). Mass murders are rare but tragic crimes. Even in a nation which is becoming increasingly violent, mass killings demand attention.

This study examined three cases involving mass shootings to determine if there exists any media bias in homicide cases. The cases were all chosen because they were mass shootings (according to the definition of the FBI). The cases included mass killings in the Mattapan district of Boston, Tuscon, Arizona and Oak Creek, Wisconsin. These specific case studies were also chosen because they initially appealed to elicit differing levels of media attention. The Mattapan case received only local media coverage. The Sikh Temple shooting received local media attention and brief attention in the national media. The Tuscon, Arizona shooting received significant and prolonged local and national media coverage.

**Case Study #1. Mattapan Massacre (2010)**
On September 8, 2010 four people were killed and one severely injured on Woolson Street in the Mattapan district of Boston (Stout, 2012). According to Boston Police, three men, Kimani Washington, Edward Washington and Dwayne Moore went to 21 year old Simba Martin’s apartment to buy drugs (Swasey, 2010). Also in the apartment were Martin’s 21 year old girlfriend Eyanna Flonory, her 2 year old son Amahiotep and 22 year old Levaughn Washum-Garrison a friend of Martin’s (Stout, 2012). Edward Washington, Kimani Washington and Dwayne Moore robbed Martin of the drugs. Those inside the apartment were ordered to strip naked and marched down the street. They were then each shot (Stout, 2012).

Shortly after the police arrived at the murder scene, Kimani Washington was found near the alleged getaway car and admitted to being in it (Martin, 2012). Washington would later be arrested on a weapons charge in Manchester, New Hampshire on October 2, 2010 and charged in the Mattapan shootings (Swasey, 2010). Within a few weeks police arrested Dwayne Moore and the third suspect, Edward Washington (Swasey, 2010).

Kimani Washington admitted being involved in the robbery, but not the murders. He was given a plea deal in exchange for his testimony against Edward Washington and Dwayne Moore. The prosecutor chose to try Dwayne Moore and Edward Washington together as it was unclear who fired the fatal shots. The jury acquitted Edward Washington of all charges and a mistrial was declared for Dwayne Moore (Jones, 2012). Dwayne Moore’s retrial began on November 1, 2012 (Ballou, 2012). With the prosecution pursuing a different legal strategy, Moore was convicted of four counts of first-degree murder for which he will serve a life sentence (Cramer, Mattapan Slay Trial Back Before Jury, 2012). Kimani Washington was sentenced on January 25, 2013 after pleading guilty to robbery, carjacking, home invasion, and possession with intent to distribute drugs (Deehan, 2010). He received 16 years in prison (Cramer, Kimani Washington Pleads Guilty in Mattapan Attack, 2013).

Jared Lee Loughner was arrested at the scene by police and taken into custody. Originally Loughner pled not guilty to the 49 charges against him on March 9, 2011. On March 25, 2011 he was diagnosed with schizophrenia and the judge ruled him incompetent to stand trial (Bendery, 2012). After months of treatment, Loughner was ruled competent on August 7, 2012 to stand trial based on testimony from various medical personnel (Santos, 2012).

Assistant U.S. District Attorney Christina Cabanillas, offered Loughner a plea deal of life in prison without the possibility of parole. By accepting this plea, Loughner avoided the death penalty. He pled guilty on November 8, 2012 and was sentenced to seven life terms and an additional 140 years on federal charges (Martinez & Lah, 2012).

**Case Study #3. Sikh Temple Shooting (2012)**
On August 5, 2012 a gunman killed six people and injured three in Oak Creek, Wisconsin. The shooting happened during Sunday services at a local Sikh Temple (Romell, 2012). The victims included, Suveg Singh, Sita Singh, Ranjit Singh, Satwant Singh Kaleka, Paramjit Kaur, and Prakash Sing (Green, 2012).
The shooter was identified as Wade Michael Page, a 40-year-old white male. The first officer to arrive on scene was Brian Murphy. Upon his arrival the two exchanged gunfire. Page hit Murphy nine non-fatal times. One shot from Murphy hit Page, which immobilized him. Page then committed suicide by shooting himself in the head (Romell, 2012).

The Federal Bureau of Investigation’s Joint Terrorism Task Force, led by Special Agent Teresa Carlson and Oak Creek Police Chief John Edwards, investigated the shooting as an act of domestic terrorism because of the tattoos found on Page’s body (Pearce & Bennet, 2012). The Southern Poverty Law Center (SLPC) a hate crimes research organization had been watching Wade Michael Page for over ten years. In contrast with the FBI, in the SPLC’s final report labeled the shooting an act of domestic terrorism. They also suggested that the attack was motivated by hate (Elias, 2012).

**FINDINGS**

**Part I- Type & Quantity of News Stories**

The following tables analyze both the quantity and type of local and national media coverage. Each case study is presented in the first column. The second column in the table is the number of total stories dedicated to each incident. The final column represents the predominant area of the media’s focus labeled “Top Category.” Each article was divided into categories based on the predominate subject of the article. These categories were victim, offender, incident, investigation, trial and other.

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As evidenced in Tables 1 and 2 the local media in the Wisconsin Sikh Temple and Tucson shootings focused more of their coverage on the victims. Boston focused a majority of its coverage on the trials of the Mattapan murder defendants. It is difficult to interpret these results most notably because there was no trial in the Sikh Temple Shooting due to Page’s suicide.

What is clear is that the victims in Tucson and Oak Creek warranted more coverage than those in Mattapan. As discussed in the full report, media will emphasize homicides involving strangers, minimize the murder of African Americans and will rationalize inner-city violence. Both Oak Creek and Tucson were stranger-based shootings. Mattapan involved the murder of four poor African Americans in the inner city.

An explanation for the differences in coverage between the Sikh Temple victims, Tucson victims and the Mattapan victims could also be based on the victim’s backgrounds. The victims of the Mattapan shootings were described by local media as being involved with drugs or having previous criminal histories. The only victim described as “innocent” was Amanihotep, the two-year-old boy who was shot, (Cramer, Mattapan Slay Trial Back Before Jury, 2012). In contrast, the Tucson victims were all white victims. Gabby Giffords received the most coverage out of all of the victims and this could be directly related to her status as a congresswoman (Nowicki, 2011).

Unlike the Mattapan Massacre victims, the victims in the Sikh Temple Shooting and Tucson case did not know their attacker (Green, 2012). It has been reported that the media are more likely to cover cases if the victim and offender are strangers (Potter & Kappeler, 1998). This could explain why the Sikh Temple Shooting and Tucson were national stories whereas the Mattapan shooting was not.

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As evidenced in Tables 3 and 4 the Mattapan case did not receive any national coverage. This is true despite Mattapan
qualifying as a mass killing consistent with Tucson and Oak Creek. The results from the second column in Tables 3 and 4 are consistent with our hypothesis of media bias and victim worthiness.

The Sikh Temple and the Tucson shootings both received national coverage however they differed significantly in terms of quantity of coverage. Tucson received more coverage than the Sikh Temple. As discussed in the full report, race does affect the coverage of crime. White victims are favored over minority victims. The victims in the Sikh Temple shooting were originally from India and all were immigrants to the United States. This may have also affected their status as victims.

In Tucson, the media coverage was primarily about the victims. Although focusing on the victims, the media prioritized some victims over others. Although Gabby Giffords was not the only person injured in the shooting the media often referred to the killing as the “Gabby Giffords Shooting” in many of their headlines. The Sikh Temple shootings’ top category was the incident itself. This is inconsistent with my hypothesis because national media covered this case in a mostly objective manner.

Part II- Intercase Study Analysis: Computerized Content Analysis:
The results of the computerized content analysis are presented in the following section. Data for the content analysis came from local newspapers, national newspapers and national television. Table 5 shows the coded keywords searched in the articles and the number of times those words appeared in each case study.

Coverage of the Tucson shooting used more subjective language than any of the other case studies. The Tucson shooting also received more national coverage than Oak Creek and Mattapan (which received none). Although it is not clear why, previous research can aide in our interpretation. Typically, high profile cases involve white victims. High profile cases also tend to be covered if they are considered stranger-based. Also, cases are more likely to be covered when the victims are of a higher status. The Tucson case, more than any of the other case studies, contained these themes.

One interesting data point can be found in the analysis of table 5. The media used the term “tragedy” nearly 200 times in describing the Tucson killings. This occurred in nearly 1 out of every 5 stories (18.6%). More than any other phrase this term demonstrates media bias and victim worthiness. Despite the death and destruction occurring in each shooting, the media clearly portrayed the Tucson killings as “worse.” This demonstrates positive support for the hypothesis.

In conclusion, the findings yielded positive results in support of the hypothesis that there would be a media bias in the portrayal of homicide victims due to extralegal factors of the victim and or the offender. The limitations of the study included the time limit allowed for the research (10 weeks). Also, the content analysis was completed by only one coder thus allowing for possible misinterpretation. There was also insufficient time to ground the research in the media and crime literature. The lack of local television news transcripts also may have eliminated a sufficient set of data that may or may not have changed the results.

References
Massachusetts County Government: A Viable Institution?

BRENDAN CONCANNON

County government has had an impact on the lives of the people of Massachusetts since 1643, predating the American federal system by well over a century. The various services that county government provides, and has provided in the past, are essential to the residents of those counties. Despite such an extensive history, counties in Massachusetts, and New England as a whole, are distinct from other counties throughout the nation. Deviating from many states, the functions and duties typically performed by a county are performed by the state government or by cities in Massachusetts. In an era where we continually seek to “trim the fat” from all aspects of government, taking a look at what our counties do, and what others have done is an important exercise in the world of state and local government.

Originally, 14 counties existed in Massachusetts. Yet in recent years, half of those counties chose to take advantage of a provision in the Massachusetts General Laws that gives counties the ability to dissolve themselves. Those county governments that remain in existence have found they are left with less authority and fewer services to provide, as more and more county services are absorbed by state government, with some responsibilities going toward local government as well. To some, county government is a reminder of Massachusetts’ colonial past, while others argue that county government exists in the Commonwealth “just to exist.”

In 2010, Plymouth County Commissioner John Riordan called on the Plymouth County Commission to consider dissolving the county government, stating that “It is an unnecessary third layer of government that the taxpay- ers should not finance.”(Riordan, 2000) Feelings like this gained traction as counties lost autonomy over the years, with a major blow hitting on January 1, 2010, when a reform bill signed by Governor Deval Patrick took effect, taking control of the Sheriff’s Department away from the county and turning it over to the state. This move was so significant because law enforcement is one of the many important services that county government has historically provided. Removing this service was a significant blow to the power of Plymouth County government.

One thing to consider is what exactly Americans expect county governments to provide. According to the National Association of Counties (NACO) county government can wear many hats. Counties perform state mandated
duties, such as the assessment of properties, record keeping, the maintenance of rural roads, the administration of elections, law enforcement, and various public resources such as utilities and reservoirs. This breadth of services is considerably more diverse than what the existing Massachusetts counties offer today. Transit and planning is not something covered by county governments in Massachusetts, where those services are provided by a coordinated regionalization of resources, a move that many former counties in Massachusetts took with their services after their own dissolutions.

In 1998, using the powers granted in MGL 34B, the residents of Hampshire, Berkshire, and Essex Counties voted to dissolve their county government. They became part of a group of seven former counties in Massachusetts. But just because that layer of government was removed did not mean that a new one did not take its place. Hampshire County became a non-political geographic identifier, and the Hampshire Council of Governments took on the service-providing role.

Membership in that body was voluntary, with the cities and towns of the former Hampshire County sending representatives from their municipalities to serve on this council. In fact, some municipalities elected to not join the group. Unlike a county government, this unusual approach to governance receives no state aid, collects no taxes, cannot bond or borrow, and receives funds solely from membership dues and user fees. Despite the drastically diminished revenue, regional service, electricity services, sustainability resources, health and human services, as well as an insurance trust are all provided by this government entity. Notice a lack of law enforcement and judicial capacities, two elements that county government is typically responsible for. It is clear the emphasis of this alternative to county government puts more authority in the hands of local government, as well as gives more power to state government. Yet that is not the direction that every county has moved in.

In 2011, Plymouth County decided not to abolish county government, and instead called for the creation of a new charter. Despite a failure to pass, the idea did generate some important discussions. There was lamentation at a lack of control over the Sheriff’s Department and prison buildings, both things which brought a lot of money into the depleted coffers of county government. But this action by the County Commission did generate a different response to dealing with county government in Massachusetts. Some in Plymouth County are seeking a reform, rather than a complete abolition similar to that seen in other Massachusetts counties. Yet a call for a new charter presents an alternative to this relatively weak style of county government.

By studying the services provided by county governments in Massachusetts, as well as the necessity of county government in the delivery of those services, we can have a better idea of what the next steps should be for county governments in Massachusetts. The goal of this research is to be a resource of citizens, taxpayers, and local officials to use when concerning themselves with county affairs. It is also important to examine just what place Massachusetts county governments have, if any, in modern society—are counties a crucial layer of government, or are we witnessing the gradual demise of an institution that has spanned five centuries in our Commonwealth? Examining this question will help the citizens understand what counties do for them, as the services provided by a county are not always immediately obvious. By peeling back this layer of government, we can gain more knowledge about this arm of authority, knowledge which may be a helpful tool in discussions that are bound to take place on the future of county government in Massachusetts.

**Literature Review**

Research into the viability of Massachusetts County government is a blend of many different components. While literature on the topic itself is difficult to track down, many works that that focus on on the state of county government in the United States do exist (Menzel, 1992). Literature on American counties primarily concerns the reform of the style of government, as many U.S. counties have made the switch from the traditional commission-style form of government, to the more modern form of a government with a charter. This style of government is becoming prevalent in the U.S., with over half of the population of the United States living in chartered counties. While this conversion has its positives and negatives, we can understand that modernization is a trend that shows little signs of stopping.

Currently, there is a lack of relevant research, especially on county government in Massachusetts. As quoted by many public officials interviewed for this article, “county government works in 49 out of 50 states,” with the minority being our own Commonwealth. Yet Massachusetts may not be entirely resistant to change. The fact that Massachusetts is home to two chartered counties shows that there may be a desire among some stakeholders to join the trend. There were also attempts to charter some of the remaining counties as well. The huge potential for counties to make changes and be laboratories of innovation is available, yet it is vital to explore the various arguments for preservation as this process moves forward.

To prove viability, counties need to show their stakeholders what they are actually doing with the money that they receive. Performance measures are a good way to show and measure
what exactly a county is doing. However, performance measures are good only if they are actually used, and that their use is high. The Berman-Wang study on performance measures found that only one third of counties over 50,000 use performance measurement, and among those that use performance measurement, one third have adequate capacity (Berman & Wang, 2000). Also, one-fifth of the one-third of counties that use performance measures utilizes them to a high level (Berman and Wang, 2000). This may be a possible explanation of why counties are considered “the dark continent of American politics,” considering how only one-third of major counties measure their performance (Berman & Wang, 2000).

Since many counties do not have adequate ways to measure performance, never mind actually undertake the measurement of performance, many people may feel that county government is a mysterious body without a clear purpose. People need to be informed of the outputs of county government in order to consider them viable, as the people with the stake in government may ultimately be the ones who are charged with demonstrating the need for it.

Original Research and Analysis

Chapter 34B of the MGLs gives counties the ability to abolish or reorganize themselves. The state also reserves the ability to step in and assume control of a county. Many counties have chosen to go this route, or have been taken over by the state themselves. A wide variety of reasons, from inefficiency and out-datedness, to corruption and mismanagement contribute to the calls for the abolition of counties. Of the 14 counties in Massachusetts, only five remain in county form, while one (Nantucket), exists as a county-city style government, fulfilling both the duties of municipality and county on the small island.

County Abolition in Massachusetts

Abolishment by state control is either seen as an industrious move by the state meant to stamp out corruption and inefficiency, or perceived as a greedy takeover of county assets, depending on one’s perspective. When the state assumes control, some things, like locally elected officials, do not change, since elections and geographical boundaries remain unchanged in the face of abolishment. It has also been the most prevalent action when it comes to Massachusetts County government.

The abolition movement of county government first began in in the early 20th Century, when the functions of Suffolk County’s government were absorbed by the city of Boston. This move left the Boston City Council as the de-facto County Commission, and the Treasurer for the city fulfilled the function of County Treasurer as well. In 1999, the county government was officially abolished after nearly a century of non-function, one of many counties to go during the abolition era (City of Boston).

Middlesex County was the first of the counties to go during modern times, and control was assumed by the Legislature in 1997. Health services and hospitals are something that many consider to be essential services that counties should provide, but this is not so in Massachusetts. Middlesex County had a public hospital, and mismanagement of the hospital was just cause for the state to take control. According to Joe Callanan, a former Weld administration official, “Middlesex County ran into financial problems, and the state opted to take control rather than let the county go bankrupt. Scandals were also taking place within the county to damage its credibility.” With the county in insolvency, the Legislature abolished Middlesex County as a government entity, as well as Hampshire and Worcester Counties. Interestingly enough, the commission of Franklin County took advantage of MGL 34B, and voted themselves out of existence in 1997. Upon abolishment, many things had to be done to ensure the continuity of government. This law was amended to include the abolishment of Hampshire County in 1999. The Sheriff’s Office and Registry of Deeds were absorbed into their respective state counterparts, with their elected administrative heads remaining concurrent with the geographical electorate that they continued to represent. The County Commission and Office of the Treasurer were abolished as well, and the ownership of courthouses went to the state (Comm. of Mass.).

According to Dan Pallotta, Chairman of the Plymouth County Commission, “There was a tremendous amount of scandals revolving around Middlesex, Essex, and even Plymouth counties regarding pensions and fraud and the whole county system took a bad name from it.”

According to Callanan, “There was very little criticism for the abolition of the counties that were abolished.” Yet when the effort to abolish all county government in Massachusetts received pushback from some relatively successful counties, the
The county system remained alive. “The remains of county government will be visible for a long time,” Callanan adds, “We still hold elections along county lines and even as those lines change, we will still see the remnants of the county system for many years to come.” He points out that “the same lines that the original Puritans in Massachusetts drew up are not contingent with the Massachusetts that we have today. Although this meant the end of many county governments, we are able to see that there is life after counties, and communities also do retain the right to form regional compacts to share services, which two other abolished counties in Massachusetts ended up doing. Both Franklin and Hampshire Counties created regional Councils of Governments, bodies that do not require mandatory membership, and communities decide themselves whether or not to join. This alternative to county government offers the benefits of regionalization without the potential downsides of county government. These regional Councils of Governments handle a wide variety of services that the counties used to provide. In the former Franklin County, administrative and financial services, a youth development program, a co-operative purchasing program, an economic development and planning department, an emergency preparedness division, a cooperative inspections program, GIS data utilization, a land use planning and zoning department, natural resources planning, regional health, town accounting, and transportation planning are all provided for. Regionalization is very helpful in Franklin County, which is sparsely populated (72,000 inhabitants in 26 communities). This alternative to county government seems to be a good match in Franklin County (Franklin Council of Governments).

Yet in the former Hampshire County, the Executive Director Todd Ford expressed disappointment in the lack of a county system there, saying that he wished the system was still in place. Unlike the former Franklin County, the Hampshire Council of Governments does not represent all of communities in the former county, as some have elected to remain independent of regional government, yet it provides many of the same services found in the Franklin Council of Governments. The politics of the entire debate are important to note as well. According to Todd Ford, the Executive Director of the Hampshire Council of Governments, “The governor was conservative, and saw the counties as an additional layer of government and a waste of taxpayer dollars. He wanted to make a statement, and he did. It was politics.

“The movement to end Massachusetts county government is not yet over,” Joe Callanan added. “In 2010 the state took over the administration of sheriff’s departments, a major blow to the county system”, he said, “and Registers of Probates have also been absorbed by the state.” Also, he adds, “the void that the abolished counties left behind was filled without major disruption of service. Increased efficiency was also a product of abolition, as many formerly independent Registries of Deeds were moved under the administration of the Secretary of the Commonwealth into one uniformed structure.”

Traditional “Commission Style” Counties in Massachusetts

The traditional style of county government found in Massachusetts may be familiar to many. This style, often referred to as the “commission” style is generally overseen by a three-member County Commission, which acts as the executive branch of county government. This is true for Bristol, Norfolk, and Plymouth Counties, the three counties which remain relatively unchanged. Although these counties range in population and demographics, one thing to notice is that they are all in the eastern half of the state, and within reasonable distance from Boston. The geography of counties is very important to note, since the western counties have been abolished, the eastern counties have remained the same, and the Cape & Island area counties (excluding Nantucket) have adopted charters.

A home-rule charter is the document that allows counties to reform. The traditional style of county government typically does not have a charter in that manner. Sure, a county may have a charter dating back to the 17th Century granting them land, but that is certainly not the same thing as a home-rule charter. A home-rule charter gives counties a lot more independence when it comes to acting independently, and in Massachusetts, there is a strong correlation between the existence of a home-rule charter, and the lack of one, in terms of the depth and scope of services provided by counties.

Services provided by counties that lack charters are still broad. These services include record keeping and Registries of deed, the administration of courthouses, financial administration services, parking ticket management (Plymouth), a common purchasing cooperative, many education services such as Norfolk Agricultural High School and a 4-H extension program in Plymouth, regional fire control and training services, regional engineering and planning, and most importantly, county-funded retirement systems. While these are certainly a broad array of services, many officials in these counties feel that there is a lot more that they could do if given the tools by the state.

Norfolk County Treasurer Bill Connolly spoke on behalf of the benefits of regionalization. He believes that state government is too big, and that counties can more easily work with localities. He also believes that counties can be doing a lot more such as taking care of seniors and libraries, and sharing employees such as dog catchers and veteran coordinators within the county, rather than having one employee for each municipality. Moves
According to Treasurer Connolly, “the passage of these bills is likely for the counties, there are six bills before the Legislature for the pensions of retired employees, despite the fact that they belonged to the county, the counties were still on the hook for payments like the Sheriff’s Office, which includes the prisons that the courthouses. Also, whenever the state absorbed a department, the county then rents to the state. Specifically, 10.625% of revenues from land sales, and 25% of recording fees are retained by the county, while the Commonwealth of Massachusetts retains the rest. Counties do not have the appropriate revenue streams, and are blocked by the state from raising more money. Register Buckley does not believe that the state would do as good of a job providing the services that counties do, especially since the innovative nature of counties is an excellent breeding ground for change. He also believes that counties can expand their services: “Everything that you can provide regionally to the point where there is pushback from municipalities are things that county government should be doing.”

Other county officials are very quick to defend the necessity of county government. In Plymouth County, the Commission Chairman Dan Pallotta blamed the former commission for most of these conversations. An “anti-county commission,” he faults them for laying back while the state seized control of county assets. He also offers criticism of the state for its encroachment on the county system. “Unfortunately it is an archaic system of how the state can use the county to collect funds. We are nothing more than bagmen for the state of Massachusetts. We are trying to correct that, and Barnstable did by charter, we had our charter together, but it has not passed the legislature yet. They are not going to pass it, why would they pass it?” said Chairman Pallotta.

Former Commissioner John Riordan brought up the topic of abolition in 2010, and his motion ultimately failed, and he was voted out of office in the next election. Another interesting piece of Plymouth County knowledge is the efforts that they have taken to reform themselves. In 2010, the Plymouth County Charter Commission was elected to examine Plymouth County government and make recommendations, as well as draft a charter. While the charter failed to pass by voters in 2012, the Charter Commission is still active today. Plymouth County has a desire to expand its scope of services, and the current officials in the county are certainly receptive to the idea of strengthening the county.

The counties have also been facing extreme difficulties regarding the role of the state within the debate. According to Chairman Pallotta, one of the many services that the county provides is the maintenance and administration of courthouses that the county then rents to the state. However, the state is routinely late and pays insufficient amounts to county in exchange for the courthouses. Also, whenever the state absorbed a department like the Sheriff’s Office, which includes the prisons that belonged to the county, the counties were still on the hook for the pensions of retired employees, despite the fact that they were no longer under the management of the county. Luckily for the counties, there are six bills before the Legislature that seek to rectify these issues, as well as strengthen the counties, giving them the ability to expand their scope of services. According to Treasurer Connolly, “the passage of these bills is necessary for county viability.”

Representing an important county function, Plymouth County Register of Deeds John Buckley explained the function of the Registry. The Registry is a special place, a beautiful, self-funded building that is very cohesive to the needs of the county. Within the Registry, along with its satellite offices, citizens are able to record land transactions and access records in a customer-friendly and technologically-advanced environment. The building was paid for by the recording fees and a tax on land sales, despite the fact that the majority of that revenue goes to the state. Specifically, 10.625% of revenues from land sales, and 25% of recording fees are retained by the county, while the Commonwealth of Massachusetts retains the rest. Counties do not have the appropriate revenue streams, and are blocked by the state from raising more money. Register Buckley does not believe that the state would do as good of a job providing the services that counties do, especially since the innovative nature of counties is an excellent breeding ground for change.

He also believes that counties can expand their services: “Everything that you can provide regionally to the point where there is pushback from municipalities are things that county government should be doing.”

Plymouth County Treasurer Thomas O’Brien has also been a vocal supporter of county government. This is an example of a “government doing more with less,” he says, and according to him, the annual cost to the taxpayer is $2.73 to receive the wide range of services provided by the county. He also brings up a valid argument for the preservation of the county structure. There are many grants from the federal government that are only available to counties. If there is no county system in place, then the communities of Massachusetts lose out on the opportunity to benefit from those grants. He also asserts that regionalization is the “wave of the future,” and the regional structure is the most efficient form of government worldwide.

Reformed (Chartered) Counties in Massachusetts

As evidenced by the literature, there is a growing movement to reform counties by way of a home-rule charter. A charter gives a county the ability to act independently of the state, and retain more independence when it comes to decision making and service provision. Chartered counties may still have a commission, but the commission only serves as a check to the powerful administrator or executive, who runs the county in a streamlined, (hopefully) more efficient manner, rather than a non-unified county commission acting as an executive. Although counties that are chartered tend to spend the most money per capita, they also have the broadest range of services.

Barnstable County is often spoken of as the model of chartered counties in Massachusetts (although Dukes County is the only other one). A conversation with their county admin-
administrator, Mark Zielinski, yielded results to back up that claim. Barnstable County itself comprises of the geographical area of Cape Cod. In an area like the Cape, regionalization certainly has its benefits. Like the dilemmas faced in the traditional-style counties of Massachusetts, the state is reluctant to perform services that are necessary for communities. Barnstable County interjects and provides services that far exceed in quantity those provided in traditional counties, though at a much higher cost-per-capita. These services include the Cape Cod Commission (a regional planning entity), a health department, emergency planning, an AmeriCorps program, the Cape Light Compact, a waste water treatment program, as well as septic inspections and loans. These services are more than necessary in the small towns along Cape Cod who only experience large populations during the summer months.

According to Administrator Zielinski, “Barnstable has rather stable finances compared to other counties, with a $27.9 million budget, which is nearing a return to a pre-recession high point. This budget must cover all of those services, but this is also due the funding system found within the charter. They use performance-based budgeting to fund their programs, which is not perfect, but it is certainly helpful. They are also on track to move to a program-based performance budgeting system.” This is certainly different than the way traditional-style counties are funded, yet these two types of counties are doing different things.

Their streamlined government also lumps in the Treasurer position as a portion of the appointed County Administrator’s position. The appointment of an administrator also increases their accountability and takes a step back to separate the administration of the county from politics. According to Administrator Zielinski, “reform is better, and having a county makes you ahead of the game.” Barnstable County recognized their desire to reform far before the abolition movement took place in Massachusetts, as they adopted their charter in 1988. They believe that their constituents are the towns and municipalities within their territory, and according to their administrator, the people recognize the need for and express desire for county government. They have not heard calls for abolition at all similar to those in Plymouth and those heard during the 1990s. The towns ask for the services that the county supplies, and even the state approaches Barnstable County to do some things.

Although Barnstable County has been able to operate with a charter to some degree of success, Dukes County has also been successful in achieving their charter’s mission. Like Barnstable County, Dukes County adopted their charter before the abolition movement, in 1992. Their charter “empowered the county to develop modern, innovative programs addressing regional needs that cannot be met easily by the individual towns” (Dukes County).

Conclusion
There is no one size fits all approach to the question of county government viability in Massachusetts. Despite the limited functions that county government fulfills in the state, Massachusetts actually has a diverse range of counties. Whether one decides to include the former counties of the western and northern portions of the state, the traditional counties of the metro Boston area, and the reform-style counties of the Cape and Islands, one can definitely come to the conclusion that these are all different regions with different needs. Assessing the value of the county system is a very challenging task, and the lack of assessment can readily support that claim. Politics are also an encumbrance on the issue of county government, with some people favoring bigger government, and some favoring smaller, limited government. Both perspectives have played major roles in the debate over the past two decades, and the debate continues to this day.

Public opinion should play a larger role in the future of Massachusetts County Government, but addressing the issue of public participation is a major hurdle to overcome. While there is tremendous value in the scholarly opinion of academics, public opinion on Massachusetts County Government has been very difficult, if not impossible to measure. A simple way to gauge the level of engagement that voters have with county government would be to look at voter turnout. However, as the Chairman of the Plymouth County Commission Daniel Pallotta mentioned, voter turnout in county elections is nearly identical to turnout in the major elections, but only because county elections are conducted on the same ballot as gubernatorial and presidential elections, elections which generate high levels of voter participation. The only relevant public opinion data out there could quite possibly be the voter-mandated abolition of several Massachusetts counties, which happened over a decade ago. The lack of data for assessing public opinion has been the biggest challenge in conducting this research, but hopefully as this issue gains more exposure, adequate polling on public opinion can be conducted.

There is no logical reasoning for dismantling county government that is as strong as it needs to be, and provides the services that need to be provided. What must be acknowledged is that county government is a way for many communities to provide services and save money. What must also be acknowledged is that not every community has the need for county government. Political debate stemming from scandals surrounding county government in the 1990s fed the anti-county movement, with
services such as septic inspection and dredging, two of the government to work with communities and provide valuable vast array of services. The Cape and Islands do not have the in-Barnstable counties are able to help meet those needs with a region falls under the reformed style of county government, which allows for the strongest model of regionalization in Mas-

In the case of the Cape and Islands, one sees that this entire region falls under the reformed style of county government, which allows for the strongest model of regionalization in Massachusetts. Due to the unique needs of the cape, Dukes and Barnstable counties have either absorbed the former county services into a method of provision via the state or various municipalities, or through other methods of regionalization. These areas clearly did not see the need for the stronger regionalization that county government provides, as there was very little pushback from these areas when county government was abolished. Since people did not see the need for county government, they lost it, whether it was via voter initiative or the legislature. Communities close to Boston saw the need for regionalization, yet without the strong need for a reformed style of county government. Plymouth, Bristol, and Norfolk counties do not need the strong county support for infrastructure that we see in the Cape and Islands due to their geography, relying on their proximity to urban areas for their economic, transportation, and infrastructure needs. These places have cities and towns which provide several services, and the also rely on state services. Yet they also have a need for county services. Voter feedback has not been indicative of strong support for abandonment within these communities. Norfolk County has not felt the same calls for abolishment that Plymouth County has heard which were ultimately rejected. People in these communities do want county government, but not on the grand scale. As put perfectly by Plymouth County Registrar John Buckley “these counties should be doing everything that they can do until there is pushback from the cities and towns.”

In the case of the Cape and Islands, one sees that this entire region falls under the reformed style of county government, which allows for the strongest model of regionalization in Massachusetts. Due to the unique needs of the cape, Dukes and Barnstable counties are able to help meet those needs with a vast array of services. The Cape and Islands do not have the infrastructure that the rest of the state has, so they rely on county government to work with communities and provide valuable services such as septic inspection and dredging, two of the many things necessary to residential needs in that area.

Recommendations for County Government:

1. Regionalization is a cost-effective way for communities to band together to save money and resources and bring a less expensive and more efficient array of services to constituents. Despite calls for the dismemberment of the county system, the county system serves as the main body for regionalization throughout the state. The counties that survived in Massachusetts have been clearly attempting to strengthen the regional ties between their communities. As in the Cape & Islands, strong regionalization makes sense, and they are able to combine the resources and strengths that each community has, and create a better region based on mutual cooperation. The benefits of regionalization is also very clear when you examine the former Hampshire and Franklin counties, whose regional Council of Governments stepped in to fill the void left by the departure of the county system.

2. The county system should continue to be preserved where it works, to do work on the regional level. The county system does not work in every part of Massachusetts, as evidenced by corruption and mismanagement in counties such as Middlesex. However, corruption and mismanagement can be fixed. Yet in counties like Barnstable, Plymouth, or Norfolk, county government is a valuable resource with much support. Dismantling the county system would deny communities the fixed vehicle for regionalization. Communities have experienced regionalization outside of the county system, in the form of Councils of Governments. These bodies provide optional regionalization services to communities without county government. However, this alternative to county government is not as broad as county government itself, and many within these communities wish to see a return to the county system.

3. There must be more research into both Massachusetts county government, as well as American county government as a whole. People remain unfamiliar when it comes to county government, and are not aware of the roles that it plays in their own daily lives. A lack of sufficient public opinion polling available certainly is an indicator of the public’s knowledge of county government, and the lack of such information has certainly been a difficult challenge to overcome. County governments can be laboratories of innovation, but only if people are interested in seizing the opportunities that lie in county government. Also, having been referred to as “the dark continent of American politics,” it is well worth the effort of further research on the topic. Even the comprehensive research found in this endeavor barely scratches the surface of the intricacies of centuries of government in the United States. Far too little
attention is paid to the importance of county government, and academics could provide a great service to the rest of the country by focusing their attention on this area of American government.

To wrap it all up, county government in Massachusetts is still viable, but only where county government is desired. People working within the political system in Massachusetts found a way to solve the problem of counties that were not viable, and they did that by abolishing most of the system. For the counties that remained, their viability was acknowledged by way of strength-enhancing home-rule charter, or by passing a vote to remain a county, which is a significant measure of viability. Also, some counties just have not heard the calls for abolishment, which is another indicator of the value some people place on county government. In sum, county government works where people want it to work, regionalization makes sense, and future conditions can change the attitudes that people have towards it.

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With Additional Interviews provided by:

Plymouth County Registrar of Deeds John Buckley
Plymouth County Treasurer Thomas O’Brien
Plymouth County Commission Chairman Daniel Pallotta
Norfolk County Treasurer Joseph Connolly
Barnstable County Administrator Mark Zielinski
Hampshire Council Governments Executive Director Todd Ford
Former Weld Administration Official Joseph Callanan
LGBT Homeless Youth in Boston MA: Experiences Regarding Resources and Potential Barriers

Brittney Connery

LGBT youth are at an escalated risk of leaving home, mental health concerns, victimization, substance abuse, and risky sexual behavior. However, research shows a lack of LGBT-specific resources. This raises concern as LGBT youth comprise 20 to 40 percent of homeless youth – disproportionate to the general youth population which is only 10 percent LGBT. The purpose of this research was to gain a deeper understanding of the experiences of LGBT homeless youth in Boston, Massachusetts regarding their use of resources and any potential barriers they may face. Furthermore, this study examined whether or not current resources are safe, welcoming and productive for LGBT homeless youth. Data were collected using a semi-structured interview guide at a drop-in center for homeless youth, located in Cambridge, MA. Interviews were audio recorded, transcribed, and analyzed for themes. Findings indicate that LGBT youth tend to become homeless as a result of being runaway, throwaway, or systems youth. Then, guidance toward resources is gained from peers on the street or “systems referrals”, with an overwhelming majority being peer referrals. Drop-in centers were found to be the most viable and effective resource in comparison to shelters. Participants reported that accessing resources was difficult for them due to their identification as LGBT youth. Reported barriers included: disrespect, lack of comfort, differential treatment, judgment, staff conduct, and safety concerns and were categorized as either program-level, staff-related, or peer-related barriers. The concern is that LGBT youth are left to struggle with the stress, frustration, and anger associated with being both homeless as well as being LGBT. Wherein, the cycle of homelessness is not broken and homeless LGBT youth are at risk of walking away from resources and/or giving up all together. This study implies that all current resources need to become as safe, welcoming, and productive as possible so as to better serve this vulnerable population and modifications need to happen on all levels, including: direct practice, programming, and policy.

Introduction

According to the U.S. Department of Health and Human Services, the estimated number of homeless youth in the United States ranges between 575,000 and 1.6 million annually (Ray, 2006). The exact number of youth experiencing homelessness in our nation is unknown. Because estimates vary depending on the definition of homelessness (United States Interagency Council on Homelessness, 2010), many if not most of our homeless youth presumably go uncounted (United States Interagency Council on Homelessness, 2010).
According to the National Gay and Lesbian Task Force, between 20 and 40 percent of all homeless youth self-identify as lesbian, gay, bisexual and/or transgender (Ray, 2006). The National Alliance to End Homelessness (n.d.), reports 10 percent of youth in the general population self-identify as lesbian, gay, bisexual or transgender. Therefore, LGBT youth seem to be significantly overrepresented in the homeless population (National Alliance to End Homelessness, n.d.).

The National Alliance to End Homelessness reported that in 2005 the total number of individuals in Massachusetts experiencing homelessness was estimated at 14,700 encompassing adults and children (Fact Sheet: Homeless lesbian, gay, bisexual and transgender (LGBT) youth in Boston, Mass., n.d.). According to the National Gay and Lesbian Task Force, the city of Boston had over 750 individuals between the ages of 18 and 25 engaged with emergency shelter providers in the year 2002 (the most recent data available) with an estimated 150 to 300 who were LGBT (Fact Sheet, n.d.).

LGBT homeless youth face not only the challenges of survival and vulnerability while out on the streets, but also the stigma and discrimination attached to and experienced by sexual minority groups. Therefore, while the very nature of being a homeless youth entails multiple risk factors, many if not all of those factors are significantly increased by also identifying with the LGBT community (Van Leeuwen, Boyle, Salomonsen-Sautel, Baker, Garcia, Hoffman, and Hopfer, 2006). Cochran, Stewart, Ginzler, and Cauce (2002) found indication of negative outcomes concerning multiple domains for LGBT homeless youth. Those outcomes included more frequent departures from home, more mental health concerns, greater vulnerability to both physical and sexual victimization, higher rates of substance abuse, and riskier sexual behavior in comparison to their heterosexual counterparts.

At this time, there is no federal funding allocated for LGBT-specific resources. Nevertheless, lack of funding has not been the only obstacle for LGBT homeless youth in receiving necessary services. In 2002, President George W. Bush permitted federal funding for faith-based organization (FBOs) to provide social services. But, overall funding levels for homeless youth services did not increase at all. It is possible FBOs, which typically oppose legal and social equality for LGBT people, do not offer an environment that is accessible, safe, or nurturing for LGBT youth (Ray, 2006). In addition, the potential stigma faced by homeless LGBT youth may limit their ability to access or utilize available resources.

For the purpose of this study “LGBT” was defined as an acronym and umbrella term standing for and encompassing lesbian, gay, bisexual, and transgender individuals. Specifically, the terms lesbian, gay, and bisexual describe one’s sexual orientation which is a person’s emotional and sexual attraction to others based on their gender, while the term transgender describes a person who’s felt sense of being either male, female, neither, or somewhere in between differs from their biologically, birth-assigned, sex (Hulstein, 2012).

“Homeless” was defined as a lack of familial support, living in shelters, on the street, in the homes of others for short periods of time or any other place that is unsuitable or unintended for human habitation such as cars, abandoned buildings, or similar settings (Incidence and Vulnerability of LGBTQ Homeless Youth, n.d.). This population can and may be comprised of numerous subgroups. These subgroups include ‘runaway youth’ who have made the choice to leave their home, ‘throwaway youth’ who have either been abandoned by or made to leave by parents or caregivers, ‘systems youth’ who have spent the majority of their lives in either foster care of the juvenile justice system, or ‘ orphaned youth’ who have been left alone due to the death of their family and/or caregivers – all of which are often referred to as ‘unaccompanied youth’ in various forms of literature (Dorsen, 2010).

Finally, “youth” was defined as individuals between the ages of 18 and 24 years old. Typically, homeless youth are defined as unaccompanied individuals between the ages of 12 and 24 (Incidence and Vulnerability of LGBTQ Homeless Youth, n.d.). The parameters of the term are potentially vague; nonetheless, in general, it refers to a population left underestimated by categories such as children and adults. Furthermore, and most importantly, by focusing on youth between the ages of 18 and 24, this research was less confined by ethical limitations pertaining to the study of legal minors.

The purpose of this research was to gain a deeper understanding of the experiences of LGBT homeless youth in Boston, Massachusetts regarding their use of resources and any potential barriers they may face. Interviews were designed to gain first hand data on what LGBT homeless youth perceive to be helpful, productive, and available resources as well as inform the public of barriers to resources and how to better address them in the future. This thesis will build upon this topic’s limited field of research, outline the methods used in conducting the study, discuss both the findings as well as their implications, and acknowledge the limitations of the research.
METHODOLOGY

Approach
This study was guided by a grounded theory approach. As explained by Kathy Charmaz (2006), “grounded theory methods consist of systematic, yet flexible guidelines for collecting and analyzing qualitative data to construct theories ‘grounded’ in the data themselves” (p.2). By adopting these methods, it was possible to direct, manage, and streamline the collection of data before constructing original analysis (Charmaz, 2006). Sociologists Barney G. Glaser and Anselm L. Strauss proposed, in their book The Discovery of Grounded Theory (1967), that this type of systematic qualitative analysis has its own logic and can generate its own theory (Charmaz, 2006). Therefore, given the limited amount of research regarding LGBT homeless youth and their experiences with resources, this study utilized grounded theory methods as opposed to deducting a testable hypothesis from other existing (or non-existing) theories.

Ultimately, this approach was utilized because (1) it offered a way to learn about the lived experiences of LGBT homeless youth as well as (2) provided a method for developing a model with the potential to enable society to better understand those experiences and best serve this population. It is unequivocally assumed that any rendering is simply an interpretive portrayal of the population’s experiences and, most likely, not an exact picture of the experiences themselves.

Sample
Eight in-depth interviews were conducted with male and female participants between the ages of 18 and 23. All participants identified as lesbian, gay, bisexual, and/or transgender and were experiencing or had experienced homelessness in the Boston area within the last five years. Interviews took place at Youth on Fire in Boston, MA. Youth on Fire – a program of AIDS Action Committee of Massachusetts – is a drop-in center for homeless and street-involved youth, ages 14-24, and is located in Harvard Square.

Procedure
A semi-structured interview guide was created for the purpose of inquiring about the first-hand experiences of LGBT homeless youth – specifically what they perceived to be helpful, productive, and available as far as resources; but also to identify any perceived barriers to current resources. The interview guide consisted of open-ended questions.

Six different Boston-area LGBT social support organizations, community centers, and drop-in centers for homeless or street-involved youth were contacted via email. Initial contact requested assistance with identifying possible participants and permission to distribute IRB-approved recruitment flyers in their respective spaces. Ultimately, contact was only established with one of the six agencies, after multiple attempts were made via e-mail and phone. The respondent agency was Youth on Fire. After communication was solidified, a meeting was held with the agency’s Safe Spaces Coordinator in order to explain the study and distribute recruitment flyers.

Recruitment was carried out via convenience and snowball sampling, on-site at Youth on Fire. Subsequently, interviews were scheduled and then also conducted on-site, in a private room which interviewees were familiar with. Before interviews began, all participants were asked and agreed to sign an Informed Consent Form. Further, upon the signing of an Audio Consent Form, all interviews were audio recorded and then transcribed in order to interpret the qualitative data. All participant names included in this thesis have been changed to ensure confidentiality.

Data Analysis
Participant experiences brought forth during interviews were simplified through a process known as ‘coding’ in order for results to be organized into themes and later communicated effectively (Bentz & Shapiro, 1998; Padgett, 2004; Padgett, 1998). According to Charmaz (2006), “Coding means categorizing segments of data with a short name that simultaneously summarizes and accounts for each piece of data” (p. 43). The coding process shaped an analytical frame from which to build by creating a pivotal link between data collection and data analysis (Charmaz, 2006).

This study consisted of three phases of grounded theory coding: initial coding, focused coding, and axial coding. During initial coding, line-by-line codes were assigned in order to identify the embedded concerns as well as plain statements of participants. During focused coding, the most significant or frequent initial codes were utilized in order to sort, synthesize, integrate, and organize the data from all eight interviews (Charmaz, 2006). Throughout this focused phase, a constant comparison method was used wherein data was compared to data. By comparing data to data, themes began to reveal what participants viewed as problematic as well as productive in terms of resources. Finally, during axial coding, categorical dimensions were specified by using the categories of data from the focused phase and relating them to subcategories. Essentially, axial coding served to reassemble the data that had previously been broken down during the initial phase in a way that resulted in clear and logical emerging analysis (Charmaz, 2006). Each transcript was re-read multiple times in order to assure accuracy of the themes and analysis ultimately revealed an emerging model.
Demographics
Participants’ ages varied from eighteen to twenty-three with a mean age of twenty-one. Reported gender identity was fifty percent male and fifty percent female. Forty-three percent reported at least some higher education with one participant gaining a bachelor’s degree as well as part-time employment. Of particular interest may be the fact that more than half of the participants identified as belonging to minority ethnic groups and all female participants identified as bisexual. Both characteristics may imply more specifically unique lived experiences and are worth acknowledging for future purposes.

Available Resources
There are two primary types of resources that LGBT homeless youth are accessing or attempting to access in Boston: shelters and drop-in centers. Shelters provide homeless individuals with shelter, food, clothing, meals, and safety, along with access to a wide range of support and services - all designed to help young people overcome difficult circumstances, become self-sufficient, and obtain transitional or permanent housing. Beds are available both on an emergency basis and for longer periods of time as “contract beds” for individuals who are actively working toward independence. At this time, there are no LGBT-specific shelters in the Boston area.

Drop-in centers are establishments that are open during certain hours of the day and provide support services to address a variety of needs; however, they themselves do not supply shelter outside of business hours which is typically 35-40 hours per week at best. Their primary goals are to respond to the basic and urgent needs of homeless and street-involved youth at highest risk of disease and victimization, connect homeless and street-involved youth to age-appropriate services including on-site mental health and medical care, partner with community and civic organizations, local businesses, public officials, and advocacy groups to address the short and long-term effects of youth homelessness, and foster a space for youth to meet friends, talk to staff or participate in formal personal development programming. At this time, there are at least three LGBT-specific drop-in centers in the Boston area.
Results
Collected data depicts an emerging model via grounded theory techniques (See Figure 1). According to participant responses, there were three different avenues by which these LGBT youth became homeless. Those avenues were comprised of the aforementioned subgroups: runaway, throwaway, and systems youth. In the cases of runaway youth, individuals made the choice to leave their home. Conversely, throwaway youth were either abandoned by or made to leave by parents or caregivers. And, systems youth had spent the majority of their childhood in either foster care of the juvenile justice system.

Once participants became homeless, they naturally had the choice not to pursue resources. However, all participants did attempt to find and access resources. There were two reported ways in which they did so – either by following peer referrals or by following “systems referrals” (ie: previous case managers). Peer referrals consisted of referrals to both drop-in centers as well as shelters while systems referrals only consisted of referrals to shelters.

Finding Resources
Five of the eight participants (63%) reported that it was difficult to find or locate resources once they became homeless. The reason most frequently reported was simply a lack of knowledge as to where to go, who to talk to and/or what to ask for.

“I was about seventeen when I was like, ‘I don’t know what to do. I don’t have anywhere to go.’” – Jaishon

“I did not know who to talk to, or who to ask, or how to ask for the things that I needed….There’s not a real guideline for being homeless.” – Aida

Notably, four of the eight participants (50%) directly referenced obtaining initial information and guidance from their peers out on the street – meaning individuals who had already found resources themselves.

“[Resources are] hard to find in regular populace. You have to go to the people who you think might know the answers and they’re not necessarily the people who work [at them]. They’re the ones who [go] and use the space[s].” – Aida

“I [asked] kids on the street that I ran into.” – Finn

One of the eight participants (13%) reported that it was easy for him to find or locate resources once he became homeless. This individual’s experience differed in that he received a systems referral – supplying him with a place to go for emergency shelter, guidance with employment, and the means to obtain health insurance.

“When I first became homeless, I had [a case manager from a group home I had previously lived in] who [told me about a youth shelter]. So, I found somewhere right away. She [also] helped me find a job [and] get my MassHealth.” – Duncan

LGBT-Specific Drop-In Centers
When describing their lived experiences at drop-in centers, participants described an environment that was knowledgeable, respectful, comfortable and safe. More specifically, participants described the space and people as open, understanding, welcoming, and free from stigma. They also pinpointed the fact that there were people to relate to and staff who were accessible.

“There are plenty of programs that don’t run themselves as well as this place – as politely. Everyone’s human here. Not everywhere you go, everyone’s human.” – Aida

“When I went to [an LGBT-specific drop-in] it was kinda easy because it was like –you know - you see a lot of different kinds of genders and how they identify and what their sexual preference is and it was just very – it was – it wasn’t like, it wasn’t scary…so it made me feel welcomed.” – T amicka

“There’s openness here. Everyone’s non-judgmental…it’s refuge.” – Finn

“Here, I talk to a lot of the staff. I get along with all of them. I feel comfortable with everyone.” – Duncan

Non-LGBT-Specific Shelters and Potential Barriers
In describing their lived experiences at shelters, participants described an environment with a severe lack of knowledge, ability and respect for LGBT youth. All participants reported that accessing these resources (ie: shelters) – wherein they were actually able to make use of the services – was difficult for them as LGBT youth. Numerous barriers were reported including: disrespect, lack of comfort, differential treatment, judgment, staff conduct, and safety concerns. Many of these barriers are a result of program-level issues, staff-related issues, and peer-related issues.

Program-level barriers. Participants reported frustration regarding incorrect recommendations, wherein they were led to believe a shelter was LGBT and/or youth friendly only to find that it was not – making them uncomfortable and unsure of their safety.
I've been to shelters that they call 'youth shelters' and it hasn't actually, like, been youth around... they also have flyers [that direct you to] shelters for LGBT youth and the shelters I've been in that they recommend are not LGBT youth... They're not friendly but they try to say it is.” – Nick

Others reported that shelters do not know where to place transgender individuals and/or are unable to confidently assure ones safety.

“I've been in shelters that would accept me for being trans[gender] and some that won't. Um, recently I just got an interview for a shelter that's willing to work with me because I'm trans[gender]; but they're kind of 'iffy' about it because they don't know, like, where I should be, if I'm gonna be safe, and all that.” – Nick

Staff-related barriers. Participants frequently reported that poor staff conduct was a barrier to accessing resources. The poor conduct included being unfriendly, unaccommodating, and unsupportive toward LGBT youth. Most specifically, numerous participants reported staff routinely used incorrect pronouns and names as well as provided incorrect personal care supplies to LGBT youth.

“They'll call you the wrong pronouns even though you've told them thirty times. Or they'll, like, give you the wrong [supplies]. And you're like, 'I already told you, I'm not that.' And they're like, 'Oh, we have to go by what your legal name is.' [eventhough] that's not the name I go by... it's been really stressful.” – Nick

Numerous participants also reported feeling as though staff were unknowing, underequipped or simply unable to relate to them and their realities as LGBT homeless youth.

“I feel as though everyone says that they're gonna help; but they really just don't know how to do it yet because it's hard.” - Jaishon

“I don't [want to] talk to [a] straight man about all my problems. [T]hey can't understand. They don't really know how.” - Duncan

Peer-related barriers. The most commonly reported peer-related barrier for participants was fear. Numerous participants expressed fear of judgment as well as fear for their personal safety with regards to other individuals accessing the same resources.

“I don't like tellin' [the kids] what [or who] I like because it's like a lot of people are judgmental about that...and I feel bad because I don't want to be judged.” – Tamicka

“When you walk into a place, when you're readin' people, it's just like they're gonna judge me, they're gonna think this about me, they're gonna think that about me – even if they don't. We come from two different worlds. So, when you talk to a person like me, it's not necessarily someone that [you see] on a daily basis and it's not something that [you're] used to. [So,] I guess I approach [resources] being nervous and being doubtful.” – Jaishon
According to this study, these lived experiences have resulted in LGBT youth preferring to access drop-in centers - meaning that they live and sleep outside only to utilize these provided spaces when they are open.

"I'm trying to find [shelters] that are LGBT youth friendly and not finding any. With [this drop-in space] you can sleep here during the day, when they're open. But, like, they're [only] open until five. So, if I don't sleep at night - which I usually don't because it's kind of weird sleeping on the street with people walking by you - I'll sleep here and then stay up all night." – Nick

Therefore, the cycle of homelessness is not broken. In fact, it may be perpetuated. Furthermore, participants reported feeling stressed, frustrated, and angry after continual short-comings were experienced in shelter settings. So, LGBT youth are left depressed, with low self-esteem, walking away from resources and/or giving up all together – again, perpetuating the cycle of homelessness.

"[Kids] turn away. They give up. They do. They take darker paths because the one that seemed like and should have been the right path didn't end up working out so well for them." - Aida

**DISCUSSION**

The purpose of this study was to gain a deeper understanding of the experiences of LGBT homeless youth in Boston, Massachusetts regarding their use of resources and any potential barriers they may face. All participants were candid in discussing their lived experiences with homelessness, available resources, and barriers to those resources. During interviews, participants were able to indicate both positive and negative experiences with available resources. They were also able to identify what they perceived to be the biggest obstacles to resources and went so far as to suggest what might be helpful for service providers to do differently in the future.

The findings of this research indicate that LGBT youth tend to become homeless as a result of being runaway, throwaway, or systems youth. Once they find themselves homeless, they experience difficulty with initially locating resources. It was reported that participants either obtained guidance from peers on the street or past case managers (ie: systems referrals). An overwhelming majority of the time, LGBT homeless youth are tasked with guiding peers to safe, welcoming, and productive resources. Drop-in centers were found to be more viable and effective for resource assistance in comparison to shelters. However, shelters are more often referred by systems referrals. In describing their lived experiences at shelters, participants reported that accessing resources was difficult for them due to their identification as LGBT youth. Reported barriers included: disrespect, lack of comfort, differential treatment, judgment, staff conduct, and safety concerns and were categorized as either program-level, staff-related, or peer-related barriers. These findings are important because participants reported feeling stressed, frustrated, and angry after continual short-comings were experienced in shelter settings. Therefore, LGBT youth are left to struggle with the stress, frustration, and anger associated with being both homeless as well as LGBT. Notably, the cycle of homelessness is not being broken. Instead, these youth are at risk of walking away from resources and/or giving up all together.

Clearly, the findings of this research indicate that LGBT-specific resources offer more knowledge, respect, and safety when servicing LGBT homeless youth. However, given the limited amount of LGBT-specific venues and the restricted reach of their services, all current resources need to become as safe, welcoming, and productive as possible so as to better serve this vulnerable population.

**IMPLICATIONS**

**Direct Social Work Practice Implications** A true commitment from social work practitioners as well as policy analysts and advocates alike toward increasing their understanding of the realities and concerns of LGBT youth and the struggles associated with homelessness could go a long way in terms of intervention endeavors. This study has shown that LGBT homeless youth experience significant discomfort and difficulties while attempting to access resources. Social workers are likely to come across LGBT homeless youth - given the reported prevalence - and it has been shown that special considerations may need to be taken when this happens.

Crisp & McClave (2007) advised social workers to employ a culturally competent and affirming approach when working with LGBT youth in an attempt to avoid further reinforcement of the stigma they already experience (Gattis, 2009). The bottom line is that licensure alone is not sufficient in order to assure cultural competence regarding LGBT youth and this truth expands and compounds when working with LGBT homeless youth. Therefore, professionals and agencies that are in a position to respond to and work with LGBT homeless youth ought to be required to demonstrate that they have been
properly trained regarding the needs of the population (Gattis, 2009).

**Policy and Programming Implications**

Hunter (2008) suggested numerous modifications to the regulation of resources for homeless youth in order to deem them more welcoming, more productive, and safer for LGBT youth (Gattis, 2009). Those suggestions included: prohibiting discrimination against LGBT youth in the provision of services, requiring nondiscrimination and sensitivity training, and promoting the creation of LGBT-specific homeless youth programs (Gattis, 2009; Hunter, 2008). Perhaps the most fundamental and necessary policy change would be the addition of sexual orientation, gender identity, and gender expression to the list of categories which shelters are prohibited to discriminate by (Gattis, 2009; Hunter, 2008).

The National Gay and Lesbian Task Force recommended the establishment of funding, at both the state and local level, toward the provision of resources for all homeless youth. However, the task force also recommended that any and all recipients of such funds be required to display full commitment to the respectful, competent, and safe treatment of LGBT homeless youth (Gattis, 2009). This study has confirmed the need for resources to be held to a high standard of competence and nondiscrimination. In fact, when asked what they felt would be helpful for service providers to do, the most common participant response regarded staff and their abilities.

“Hire people that can understand what [we’re] going through or [who can] comprehend what [we’re] trying to say – like pronouns and what [we] go by. At least listen!”
– Nick

Overall, these findings imply that LGBT-specific resources offer more knowledge, respect, and safety when servicing LGBT homeless youth. However, it is important to acknowledge that the development of LGBT-specific youth shelters may only serve as a band-aid and create a “separate but equal” scenario. So, realistically, the ultimate goal should be for current resources to become as safe, welcoming, and productive as possible so as to best serve this vulnerable population. This will require thorough training and reliable regulation. As these measures are introduced, systems referrals ought to include more drop-in center involvement, enabling LGBT youth to benefit from more specific service types as well as the more positive experiences reported at such resources. Also, because LGBT homeless youth are often tasked with guiding peers to safe, welcoming, and productive resources, LGBT-specific resources need to increase their visibility and youth need to be well-informed about available resources.

**Limitations**

Perceived limitations of this study include a small sample size as a result of some initial recruitment difficulties and a narrow focus of location – given that recruitment and interviews were held at one resource site which also happened to be a drop-in center. Additionally, there was a lack of saturation especially in reference to participant demographics like sexual orientation and ethnicity. However, this research can be of use by (1) supplementing the extremely limited amount of research relating to the topic of LGBT homeless youth and (2) informing the public of barriers to resources so that they can better address them in the future.

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**References**


The Social Construction of Literary Understanding in a 3rd Grade Classroom During Interactive Read-Alouds

Adriann Flint

Read-alouds are a commonly used tool in elementary classrooms. Teachers read aloud for a variety of purposes, including helping students to better understand a topic, promoting students’ enjoyment of reading, examining an author’s craft, and developing students’ literary understanding. There are two main types of read-alouds that are used in classrooms: traditional read-alouds and interactive read-alouds. Traditional read-alouds include a text being read by the teacher to the class with little student participation during the reading, but an in-depth, or grand conversation about the book at the end of the reading (Eeds & Wells, 1989). The second type of read-aloud, an interactive read-aloud, is different in that the students and teacher converse during the read-aloud, and the students are encouraged to make comments and discuss the text during the reading (Barrentine, 1996). An interactive read-aloud includes the teacher encouraging “the children to interact verbally with the text, peers, and the teacher during book reading” as well as the teacher asking “questions throughout the reading that enhance meaning construction” (Barrentine, 1996). Interactive read-alouds are useful because they help students vocalize and discuss their questions and thoughts while the book is being read aloud rather than having to wait and add their comments at the end of the reading (Barrentine, 1994; Fisher, Flood, Lapp, and Frey, 2004). These interactions during read-alouds have been shown to help develop students’ literary understanding and meaning making or comprehension (Sipe 2000a, 2000b, 2001, 2008). Read-alouds can be conducted simply to increase a love of reading, but they are also used during writing instruction in order to provide students with an example of a mentor text. Students can then create their own work using methods and ideas from the mentor text that has been read aloud.

According to Fisher, Flood, Lapp, and Frey, (2004) there are several characteristics of effective read-alouds. First, the chosen book must be developmentally, socially, and emotionally appropriate. Second, the teacher should practice reading the book so that the story can be read emphatically and fluently. A purpose for the read-aloud must be established, and the teacher may stop occasionally to ask the students questions regarding the storyline and their thoughts or feelings about it. Finally, during the reading, connections must be made between the text and other reading and writing activities (Fisher, Flood, Lapp, and Frey, 2004). Teachers conducting interactive read-alouds should carefully find a balance between the amount of reading and discussing, and should be careful to keep students’ conversations related to the story or topic.
Literary scholars have been in favor of interactive conversation during read-alouds for many years. In her book *Literature as Exploration*, Rosenblatt (1938) discusses the way in which readers approach stories differently and introduces reader response theory. Previously, it had been assumed that every text had one correct interpretation, but Rosenblatt made it clear that books can often be interpreted differently because everyone approaches stories from their own lives and experiences. She explains that “the same text will have a very different meaning and value to use at different times or under different circumstances” and there is not one correct interpretation (Rosenblatt, 1938, p. 34). This connects to the transactions that occur while someone is reading. Every person approaches a text differently, but as they read their interpretations vary as well. According to Rosenblatt, every person approaches a text “with certain expectations” about what is to come, but as the story unfolds their interpretations and hypotheses will vary (1938, p. 26). This explains “why meaning is not ‘in’ the text or ‘in’ the reader” but instead that both are “essential to the transactional process of meaning making” (Rosenblatt, 1938, p. 27). Rosenblatt’s transactional theory argues that the reading of a text involves a transaction between the reader, the author, and the text. Rather than using the term “interaction,” Rosenblatt (1938/1995) used the term “transaction” to emphasize the influence of both the reader and the text in the making of meaning. Therefore, reading is a transaction during which the reader and the text are continuously affecting one another.

In addition to reader response theory and transactions, Rosenblatt also discusses two types of reading: efferent and aesthetic. Efferent reading refers to an individual reading for a practical purpose or to gain information “that will remain when the reading is over” (Rosenblatt, 1938, p. 32). Conversely, aesthetic reading is done for pleasure so that the reader can “live through” what is being created during the reading.” Aesthetic reading is done for the experience and often elicits emotions in the reader (Rosenblatt, 1938, p. 33).

Focusing on children’s responses to literature, Sipe (2000a, 2000b, 2001, 2008) conducted naturalistic, qualitative studies on the oral responses of first and second graders to picturebook read-alouds in order to develop a grounded theory of children’s literary understanding. He conducted these studies by observing and recording read-alouds in a class of first and second graders and analyzing the students’ and teacher’s oral responses. The interactive read-alouds were analyzed by the conversational turn, which Sinclair and Coulthard define as “everything said by one speaker before another began to speak” (Sipe, 2000, p. 263). Sipe used the constant comparative method (Glaser and Strauss, 1967) to develop categories from the data. He then examined the data further to see how frequently oral responses fell into each category. In doing this, he showed that the students, although very young, were making thoughtful responses and constructing an advanced literary understanding during interactive read-alouds.

Sipe (2000a) laid the foundation for a grounded theory of literary understanding, which states that student’s responses during interactive read-alouds fall into one of five conceptual categories. These categories for student responses are: analytical responses, intertextual responses, personal responses, transparent responses, and performative responses. Throughout the read-aloud, these responses interact with each other and at times, the lines can blur between the categories. Within Sipe’s (2000a, 2008) study, over 70% of student responses fell into the analytical category. The analytical category consists of all oral responses in which the students treat the text as an item to be analyzed and interpreted. This category also includes responses in which the students made narrative meaning. The second category consists of intertextual responses and these made up 10% of his data. These are responses that connect the text that is being read to a text that the students have previously read or experienced, as well as connections that students made to television programs, videos, movies, or similar media. The third category, personal responses, also consisted of 10% of the data and includes conversational turns that connect the text to students’ own lives or their life experiences to better understand the text. Sipe found that these responses occurred either from text-to-life or from life-to-text and show that the students are using the text to better understand their own lives. The fourth category consists of transparent responses, which show that the student has temporarily entered the world of the story and is reacting to it as though they are taking part in the story. According to Sipe, transparent responses are rare since they often only scratch the surface of what is going on inside of a student’s head. Transparent responses only made up 2% of the conversational turns within Sipe’s study. The final category, performative responses, which were also not very common, only made up 5% of the data. Performative responses show that the student has taken the text they are listening to and using it for their own purposes, such as to entertain their classmates (Sipe, 2000a, 2001, 2008).

Sipe conducted other studies that further attempted to understand interactive read-alouds and how the lines between the categories for students’ conversational turns can be blurred. He also dealt more in depth with intertextual responses and analytical responses to see how they differed and compared (2001). Sipe further analyzed intertextual responses made in a first and second-grade classroom and examined the way that students build understandings based on similar stories, such as variations of the same fairytales (2000b). In both of these studies,
he calls for further research. Understanding the connection between students’ reading and writing as well as studies in other grades are both areas in which Sipe hoped other studies would be conducted (Sipe, 2000b, 2008).

There have been many studies on interactive read-alouds, including how teachers can implement them, the characteristics of effective read-alouds (Barrentine, 1994; Fisher, Flood, Lapp, and Frey, 2004), and how a teacher and students construct literary understanding during read-alouds (Sipe, 2000a, 2000b, 2001, 2008). My study focused on further researching the students’ oral responses that occur during interactive read-alouds directly before writing workshop. Sipe’s studies have inspired much of the project I conducted. While there has been a variety of research on interactive read-alouds, no previous studies have been conducted that focus specifically on oral responses that occur during interactive read-alouds that take place directly before writing workshop. In addition, Sipe’s grounded theory focuses on students in first and second-grade classrooms; however, my study examined digital recordings and transcriptions of interactive read-alouds conducted with students in a third-grade classroom. By using Sipe’s theory of literary understanding to analyze the transcripts of the read-alouds in my study, I was able to compare the frequency of the conceptual categories within his theory for student conversational turns. In addition, I was able to determine how Sipe’s theory generalizes to different grades. The texts read aloud to the class in my study were shared as mentor texts. The students took part in the read-aloud knowing that they would soon be crafting a piece of writing during writing workshop that may be modeled in some way after the text currently being read aloud. My research focused on investigating the students’ oral responses during interactive read-alouds specifically read aloud prior to writing workshop and examined how the frequencies of the oral response categories compared to Sipe’s study.

Method
This six-month descriptive, naturalistic study examining third-grade students’ social construction of literary understanding was conducted in a third-grade classroom. This classroom was in a public charter school (kindergarten-eighth grade) in an urban school district in a large northeastern city in the United States. The school’s curriculum integrated reading and writing, and children’s literature shaped their literacy curriculum. The classroom teacher in this study conducted interactive read-alouds at least three times a day. The school also had very high behavioral expectations, which limited behavioral disruptions in the classroom. This classroom was made up of 14 students. There were 10 African American students, 3 Hispanic students, and 1 Asian student. All of the interactive read-alouds examined in this study took place immediately before writing workshop.

The six read-aloud transcripts that I analyzed within my study were archival data that were digitally recorded and transcribed verbatim by my mentor during a previous study examining how interactive read alouds prior to writing workshop influenced students’ writing. The texts read-aloud prior to writing workshop were considered mentor texts that the students and teacher read and examined in order to provide the students with successful models for their writing. I analyzed each of the conversation turns, which Sinclair and Coulthard define as “everything said by one speaker before another began to speak” (Sipe, 2000a, p. 263) using Strauss and Corbin’s open coding, axial coding and selective coding, and Glaser and Strauss’s constant comparative method (1990). Open coding consisted of breaking down, examining, labeling, comparing, and categorizing the conversational turns according to the five basic conceptual categories for student responses in Sipe’s grounded theory of literary understanding. I coded for Sipe’s five basic categories for students’ oral responses including analytical, intertextual, personal, transparent, and performative responses. Axial coding helped me to reduce the number of codes, interconnect the codes into broader concepts, and develop subcategories within the initial five conceptual categories of student responses. Using selective coding, I related the subcategories back to the original conceptual categories and analyzed the frequency of the different categories that were found in my study as compared to the frequency in Sipe’s study. In addition to my analyzing and coding of the students’ oral responses, my mentor also coded the students’ responses in order to ensure our inter-rater reliability.

FINDINGS
Within the context of interactive read-alouds prior to writing workshop, I found that some of the frequencies for the conceptual categories of student responses in my study were similar to Sipe’s, while some were different (Figure 1). In this study, nearly 80% of the students’ responses fell into the analytical category and 14% of the responses were in the transparent category. The remaining categories, intertextual, personal, and performative each made up less than 10% of the students’ oral responses.

Analytical Responses
Sipe defines analytical responses as those which involve the students making narrative meaning from words and pictures and focusing on interpreting the text (Sipe, 2008). Sipe’s analysis of his read-aloud transcripts demonstrated 73% analytical responses; while my data resulted in a slightly higher frequency of analytical responses. In my study, 76% of the student responses were analytical. Within the subcategories of the analytical responses, many responses dealt with the students attempting to
make narrative meaning, understanding the language of the text, and viewing the picturebook as an object. In a read-aloud of the book *Scarecrow* by Cynthia Rylant (2001), a student commented that he liked how the author was using the word borrowed:

Teacher: Yes, Osahru. We are going to be focused on what Osahru is about to share with us. Osahru: I like how she kept using borrowed so that we remember that it doesn't really matter that the stuff is borrowed that he is happy the way he is. Teacher: Yeah, it’s very interesting. We can certainly learn something from this book of scarecrows that the scarecrow does not mind that he’s made up of all borrowed things and that he can’t really close his eyes, and all these animals are making their home on him. He’s alright with that. He’s happy with who he is anyhow. Very interesting.

This student responded in a way that analyzed the text and attempted to better understand the story. Many other analytical responses also made reference to why the author wrote the book in a certain way. In the following example during a read-aloud of *Henry the Dog with No Tail* (Feiffer, 2007), a student commented on the author’s decision to use certain punctuation points:

Teacher: Yes, I love the word SCOFFED. What a great verb. It is kind of like…she must have said, (imitating the tone of the character in the book) “I told you that wasn’t a REAL tail,” she scoffed. See Mark, I just called on Jeremiah and now you’re talking which isn’t polite to Jeremiah. Go ahead. Jeremiah: I liked it when she put the exclamation point because it tells you like you saying something really loud. Teacher: Yeah. It’s a FAKE! With lots of excitement, right? Yes.

In this response, the student connects *Henry the Dog with No Tail* (Feiffer, 2007) to another book that had previously been read in class. At other times, they connected the story they were reading to books they had read on their own or to stories that had been read in class during previous grades. For example, in the following excerpt, a student connects the book they were reading, *Spiders* (Gibbons, 2005), to a book they had read previously:

Student: When you were talking about changing its colors, you made me think about adapting. Teacher: People are thinking about ADAPTING. It has adapted to catch its prey just like we read in *How Animals Adapt*. I’m glad you made that connection.

In this intertextual connection, the student refers back to a text that had a similar theme to the book they were currently read-
ing and made a connection through the word *adapting*. This is indicative of the intertextual connections in my study, as they most often connected the text currently being read to other works of literature.

**Personal Responses**

The third conceptual category includes personal responses. According to Sipe’s definition, personal responses occur when students are making connections between the text and their own lives (Sipe, 2008). In Sipe’s study, this category made up 10% of the students’ responses, but in my study these only made up 1% of the data. One example of a personal response in my study came while the story *Animal Dads* (Collard, 1998) was being read. One student made sure to ask if his teacher and classmates knew about one of his special areas of knowledge:

*Teacher: What is the opposite of shallow, Samone?*

*Samone: Deep.*

*Teacher: Yeah, deep. So deep means to go really far down and shallow is not so deep.*

*Yes, Jeremiah.*

*Jeremiah: Do you know I am an expert on turtles?*

*Teacher: Yes, you are an expert on turtles.*

*Michael: I’m an expert on wolves.*

In this example, the students were at the point in the text where readers learned that turtle babies never see their parents after they hatch. The student took this opportunity to share information about himself that was connected to the story. In another example, a student connects *Henry the Dog with No Tail* (Feiffer, 2007), the book that is about to be read, to their lives by informing their classmates that they have already read the story.

*Teacher: We are going to read Kate Feiffer’s book, Student: Oooh, I’ve already read that.*

*Teacher: Great, so you get to enjoy it again.*

In this example, the student connects the book to their own life simply because they have already read this book. Personal responses in my study were rare and often included brief comments such as these. Only once in my study did a student tell a personal story about something she had done that connected to the text, although they did this frequently in Sipe’s study. It is possible that personal responses were less frequent in this study because the interactive read-alouds took place immediately before writing workshop. Knowing that they would soon have a chance to share their personal stories during writing workshop, students’ personal responses may have often occurred in written form instead, limiting the number of oral personal responses in my study.

**Transparent Responses**

The fourth conceptual category, transparent responses, occurred rarely in Sipe’s study as well as in mine. Sipe suggests that transparent responses are rare because they often occur when the student’s world and the world of the text are the same momentarily. He also adds that these responses are automatic and not intended for an audience (Sipe, 2008). The frequency of the fourth category in my study was also different than in Sipe’s study. In Sipe’s study, transparent responses only made up 2% of his data, but in my study they made up 14% of the data. Within my study, transparent responses were often quiet, and consisted of “oohs” or gasps. These responses often interrupted the teacher as she continued reading, such as in this example from the read-aloud of the book *Spiders* (Gibbons, 2005):

*Teacher: Remember the nursery rhyme, “Little Miss Muffet”?*

*Students: Yeah.*

*Teacher: Little Miss Muffet was a real little girl. Her father was a spider expert /*Students: What! Blaugh!/*

*Teacher: who used to make her eat mashed spiders when she was sick. About 200 years ago, this was a common cold remedy.*

In this example, as with many, the students interrupted the teacher as if they could not contain their excitement and comments. This helped to categorize these comments as transparent, because it was clear that the students’ worlds and the world of the text had been combined. In other examples, it was as though the students did not realize they were speaking out loud. During the read-aloud of *Henry the Dog with No Tail* (Feiffer, 2007), one student let out a few responses that were very quiet and seemed to have no intention of stopping the read aloud:

*Teacher: (Reading aloud.) “Look,” he said, “I’ve got a new tail.”*

*Michael: Oh, my.*

*Teacher: (Reading aloud.) “Wow! Neat! Cool!” said Grady. “Does it do any tricks?” asked Pip. Remember we’re listening for cool, interesting sentences. Henry ran around in a circle and jumped over his tail. The first time he did a high jump, then he did a long jump, then he ran backward and jumped. He did a spin jump, a low jump, and a leap jump.*

Transparent responses were more common in my study than in Sipe’s, but they were still somewhat infrequent. It would be difficult to know if I was able to capture all of the students’ trans-
parent responses, as many occur within their minds. However, the transparent responses that are audible usually show that the students are engaged in the story and are not speaking to their class intentionally.

**Performative Responses**

Sipe describes the final category, the performative, as student comments that use the text as a platform for their own purposes, such as to express creativity or to entertain their classmates (2008). These responses were often accompanied by movements or dramatic motions. The frequency of this category was also slightly different in my study. In Sipe's study, these performative responses made up 5% of his data, but in my study it was only 2% of the data. During the reading of *Henry the Dog with No Tail* (Feiffer, 2007), a student gave this series of performative responses during a dramatic scene in the story:

Teacher: Something is about to happen and aren't you wondering what?
Students: (chorally) YES!
Teacher: I love how this author chose...She chose to end her page here. But she didn't just want you to flip and feel nothing. She wanted you to wonder what was going to happen. Are you ready?
Students -- (chorally) Yes!
Jeremiah: Close your eyes. (Covers eyes with hands.)
Teacher: Then...
Jeremiah: (Whispers.) Close your eyes.
Mark: No.
Teacher: Shhh, Jeremiah. We're waiting.

This student was trying to entertain his classmates and make the reading more exciting for them by putting on a bit of a performance. The percentage of performative responses found in my study may have been slightly lower than in Sipe's study because of the age of the students and the culture of the classroom. The school that my study took place in had very high behavioral expectations, and because of that it may have resulted in fewer performative responses because the students understood that these would not be acceptable.

**Conclusions**

These results indicate that it is important for students to interact with their teacher, peers, and the text during interactive read-alouds prior to writing workshop. During interactive read-alouds, students' responses help readers develop an understanding of the text including how texts work, how they are purposefully crafted, and why they may be crafted in a particular way. In a traditional read-aloud, the students are able to express their thoughts about the story during a grand conversation (Eeds & Wells, 1989) after the story has been read; however, many of the students' responses found in this study would likely not have occurred during a traditional read-aloud. For example, if the students were not able to discuss the story during the reading, their transparent responses may have been less common. The students knew that the texts being read aloud were mentors for their writing, and they must truly understand how the author crafted the text for this reader's understanding and enjoyment. This may have led to a higher number of analytical responses. Additionally, it is possible that students did not feel the need to tell as many personal stories because they knew they would soon have an opportunity to share their personal experiences in their own writing during writing workshop. In a traditional read-aloud, the students would have had to wait until the end of the story and would have possibly forgotten some of these valuable comments that together led to the development of an understanding of how authors intentionally craft their texts for their readers. Also, many of the students' analytical comments that took place during the read-alouds involved the students asking for a definition of a word or commenting on something that they noticed in the texts. Given that the books read in my study were read immediately before writing workshop and with a clear purpose in mind, this may have increased the number of analytical responses given by the students. Read-alouds which required the students to be quiet would have meant losing out on many of the great comments and thoughts of the students. The conversations that the students had amongst themselves and with the teacher throughout the read-alouds in this study were rich and, in most cases, created by the students. Additionally, the students could let their emotions out through transparent responses or contribute performative responses meant solely for entertainment.

The comments and questions that occurred during the read-alouds worked together to help the students form the basis of their literary understanding.

Allowing the students to converse with each other, their teacher, and the text during the read-aloud resulted in more responses that demonstrated a more advanced literary understanding and a better understanding of how the text was crafted for the reader. This corresponds with Rosenblatt's reader response theory because allowing the students to discuss the story while it is being read allowed them to comment based on their own experiences and understanding of the story, instead of requiring them to wait until the end of the story and listen to a grand conversation regarding the text. Encouraging the students to interact with the text as it was being read meant that they would be more prepared when their own opportunity came about to write a story modeled in a specific way after the mentor text.

There were some significant differences between Sipe's study and my study. Overall, his study featured small group and
whole-class read-alouds, and his study took place in the first and second grades. My study only featured whole-class read-alouds and took place in a third-grade classroom. The types of teachers featured in our studies also may have affected the frequency of the different categories of responses, based on what the teachers would accept or not accept as proper classroom actions. The types of books read in our studies differed, as well. Sipe’s study featured all fictional stories, often based on fairytales. My study featured fiction as well as expository texts, which may have resulted in different types of responses. However, the most significant difference between the two studies is the difference that perhaps had the greatest impact on the results. The read-alouds in Sipe’s study were read for enjoyment and for the overall experience. The texts read in my study were read immediately prior to writing workshop, and while they were read for the experience, they were also read with a specific purpose in mind to mentor the students’ writing. Using the books as mentor texts, the teacher in my study would guide the conversation toward a certain aspect of the author’s writing in order to teach this topic to the students. As the story was being read aloud, the students would work towards an understanding of not only the story being read, but the way it was written as well. By discussing the reasons why a text was written in a certain way, the students could better understand the way authors craft their writing. Then, immediately following the read-aloud, as they began writing in writing workshop, they would incorporate the author’s craft that they had just learned about during their read-aloud.

The findings in this study lead to many more questions regarding students’ oral responses and further analysis of teacher’s oral responses during interactive read-alouds. Research that could better show the connection between students’ responses during interactive read-alouds and their writing would help to demonstrate the effectiveness of conducting interactive read-alouds prior to writing workshop. Additionally, it would be helpful to see if interactive read-alouds prior to writing workshop often resulted in a higher number of analytical responses than in Sipe’s study, or perhaps how the classroom environment leads to differences in students’ and teachers’ oral responses. The performative responses in my study were rare, but often added a great deal of energy and direction to the conversation. Research investigating the writing of students who often offered performative responses could possibly be a great demonstration of the link between interactive read-alouds and voice in students’ writing.

Citations

Children’s Literature Cited
Size-Frequency Distribution of Orbitolina Texana Foraminifera

Jeremy Foote

This study examined size-frequency distributions for an extinct Cretaceous-age benthic foraminifera called Orbitolina Texana in order to determine the health of this foram community during the time of accumulation. Forams were collected from limestone outcrops of the Glen Rose Formation in central Texas. Based on paleontological and sedimentological evidence, Orbitolina Texana are interpreted to be a shallow water (<10 m) benthic organism that was most abundant in back-reef environments. Size-frequency distributions were generated from the diameters of 4,245 Orbitolina Texana fossils. The results indicate that the Orbitolina Texana population is characterized by a Gaussian (normal) size distribution. Size-frequency distributions of fossilized foraminifera in the stratigraphic record are controlled by two principle variables; environmental controls that affect the biology of the organisms (e.g., environmental stressors, like food availability and ambient conditions) and sedimentological controls that affect how the organisms are distributed (e.g., hydrodynamic parameters, like waves and currents). Based on a sedimentological characterization of the host limestone including lack of high-energy sedimentary structures, high mud content and back-reef position on the depositional profile, hydrodynamic parameters are interpreted to not have exerted a significant effect on the distribution of the forams preserved in the rock record. As such, the biological controls are interpreted to be the dominate control on the foram size-frequency distribution. Therefore, the Gaussian (normal) size distribution suggests that the mortality rate is independent of size/age, which is classified as Type II survivorship. As this result is consistent with similar taxon, the results indicate that this Orbitolina Texana population was a healthy biologic community, despite the low biologic diversity observed in the Glen Rose Formation.

Introduction

Geologists have used foraminifera (forams) and other single cell protists as a treasure trove of data for scientific research for many years (Barker, 1994; Emiliani, 1955; Shackleton, 1967; Peeters et al., 1998). As these small organisms grow, the size and composition of their exoskeletons reflect the surrounding environment. When they die, foram exoskeletons gather on the sea floor and this accumulation provides a stratified record of past environments and conditions. More specifically, size-frequency distributions can provide insight into the biology of the population as well as the environmental setting during the time of deposition. Previous work has utilized size-frequency distributions to examine the effects of current upwelling (Peeters et al., 2002),
effects of taphonomic (post-depositional) processes (Cummins et al., 1986), species variation between different environments (Peeters et al., 1998), and many others. Work done by Peeters et al. (1998) demonstrated that size-frequency distributions of modern foraminiferal communities resemble a Gaussian (normal) distribution. A normal size-frequency distribution indicates an equal mortality rate across the population. The goal of this study is to examine the size-frequency distribution in a single species population of ancient Orbitolina Texana forams from central Texas.

Orbitolina Texana Foraminifera (O. Texana) are an extinct species of foraminifera (single-celled protists) that precipitate a disk-shaped, external calcite test, or shell (figure 1). The forams create their tests by biomineralizing calcite or aragonite (CaCO$_3$), using calcium ($Ca^{2+}$) and carbonate ($CO_3^{2-}$) ions from marine water in which they live (Scholle and Ulmer-Scholle, 2003). O. Texana tests are multi-chambered, a characteristic of their modular growth. As the forams grow, they precipitate a slightly larger chamber to accommodate increasing size during its life cycle. Forams commonly measure less than 0.1 mm to 1 mm in diameter, but they can grow to nearly 20 cm in diameter (Scholle and Ulmer-Scholle, 2003).

Orbitolina Texana forams are exclusively found in the lower member of the Glen Rose limestone (Barker, 1944; Douglass, 1960; Behres, 1964) (Figure 2). O. Texana was extant during the early portion of the Cretaceous period in the Albian (100 MYA) and Aptian (126 MYA) Eras (Douglass, 1960). The lower member of the Glen Rose limestone extends from central Texas to southern Florida (figure 3). Further discussion of the Glen Rose limestone can be found in Barker et al. (1994), Foote et al. (1988) and Stricklin and Smith (1973).
The presence of benthic forams in the lower member of the Glen Rose formation allows a number of assumptions to be made about the depositional environment. Sustained benthic foram production requires water with a salinity level of 16‰ to 36‰, a temperature of 20-25°C, and proximity to currents that replenish food and nutrients. Optimal environments are also physically distant from a large influx of fresh water and siliciclastic material, like sand and mud (Schlager, 2005). Orbitolina Texana resided on the sea floor in the substratum region of a shallow marine environment (Figure 4). The natural distributions of benthic forams are controlled by two inversely co-varying parameters, which are the availability of food (diatoms) and oxygen (Koho, 2008), as well as other environmental conditions required for carbonate precipitation, such as water clarity, light, water temperature, depth and water salinity. If there is not a sufficient supply of diatoms, there will be a high mortality rate of juvenile forams (Koho, 2008). O. Texana forams are sessile, meaning that they lack the ability to move on their own. Therefore only two principle variables affect their distribution in sediments and rock, biological and environmental conditions.

It is generally understood that the size-frequency distribution of any population is dependent on the growth rate, mortality rate and processes that affect the species as they transit from the biosphere to the lithosphere by way of fossilization (i.e. taphonomic processes) (Cummins et al., 1986). For example, some taphonomic processes that could physically affect forams are high energy hydrodynamics processes such as wind-driven waves, strong currents and storms, which could enhance fracturing, abrasion and bioerosion. Diagenetic processes, like dissolution, cementation and micritization, could also change the morphology of foram tests after deposition. As a result, taphonomic processes could exert a strong control on the size-frequency distribution of a population of ancient forams.

This study focuses on investigating the controls on the size-frequency distribution of a community of O. Texana, and attempts to evaluate the trend in the size-frequency distribution of that community in the context of biological and taphonomic processes.
phononic processes. A size-frequency distribution curve of *O. Texana* can provide insight into how the forams lived and how they were preserved in the rock record. However, one of the major challenges with interpreting size-frequency distributions of a fossilized species in the rock record is that there are processes that can adversely affect the quality of that record. This means that the manner in which the distribution deviates from a normal distribution, as documented in modern forams, may indicate biological stresses in the environment, or post-life (taphonomic) processes.

**Methods**

Two student teams measured the diameters of 4,245 individual forams using Chicago Brand 6” Duel Steele Calipers. Orbitolina *Texana* have relatively small fossilized tests (< 8 mm in diameter) so tweezers were used to hold the forams and ensure accurate measurement. Foram tests were assumed to be perfectly circular and were measured across the diameter of the non-fractured axis.

Samples were collected by S. Kaczmarek in 2009 and were stored in glass vials. *O. Texana* were separated from other skeletal material within the samples. A number of the forams had adhered to each other, creating a cluster of forams. Foram clusters were not measured. Fractured forams were used only when > 50% of the foram test was present and could be properly measured across the diameter of the non-fractured surface. However, the frequency of fractured forams was very low. Individual forams were measured to the nearest 0.1 mm. Measurements were recorded directly into a Microsoft Excel spreadsheet to perform data analysis.

The data were analyzed using three statistical techniques. The first binning approach used two different bin sizes in order to create a size-frequency histogram. The first histogram had bin sizes of 0.1 mm. The 0.1 mm bin histogram was created by counting the number of forams between certain sizes, in 0.1 mm increments. Plotting the frequency of a given bin size against the range of sizes created a size-frequency distribution of the recorded diameters of the forams. The second histogram used only 2 bins, which allowed grouping size data into values greater than or less than the measured median value. The number of forams that were equal to the calculated median size were not included in this histogram, only those measurements that were greater than or less than the median value. The two bin histogram, which grouped the measured values into greater than or less than the median bins indicates that the size-frequency distribution is right skewed, (not shown). However, there is only a difference of 8 forams between the forams larger and the forams smaller than the median, which corresponds to a difference of only 0.19%.

Figure 5 compares the size-frequency curves for the measured data to the idealized Gaussian distribution model. The curve based on the measured dataset has an almost identical shape to the mathematically modelled synthetic dataset. The measured data is set slightly to the left of the idealized Gaussian distribution model and the tails of the measured data are shorter than the idealized Gaussian distribution model.
Discussion

Biological, environmental and taphonomic factors may play varying roles in the size-frequency distribution of any fossilized species. The biology of an organism will determine where it can go, how it eats, whether it is mobile or sessile, its life span and its mortality rate. The environmental factors are forces and variables outside a creature’s control, such as waves, current, water quality, amount of sunshine or available food supply. Taphonomic processes may alter the preserved remains of an organism after it dies. The data obtained from the measurements of the 4,245 forams produced a near Gaussian size-frequency distribution, but in order to interpret this distribution, environmental and other taphonomic factors must be accounted for.

The O. Texana are extremely simple creatures. They are born, ingest food, grow and die. O. Texana are sessile benthic forams, meaning that never gain their own form of mobility. This means that the only way for the forams to be transported from the area where they live is by hydrodynamic forces. The portion of the Glen Rose limestone where the O. Texana is found is interpreted as a low energy platform interior (Behres, 1964). This interpretation is supported by the lack of fractured foram tests, the abundance of other marine fossils (high biological diversity) in adjacent stratigraphic layers, lack of high energy sedimentary structures, a relatively high carbonate mud content in the layer where the forams were collected and interstratified wackestone and mudstone layers (carbonate mud supported limestone) (S. Kaczmarek, personal communication).

A low energy environment also lessens the impact of taphonomic processes acting on O. Texana fossils. Low energy conditions aids in preservation of fossil material because other material does not break or fracture the forams during collisions while being transported along the sea floor; the high mud content also provides a cushion during compaction. The various forms of protection from high energy conditions surrounding the O. Texana organism and fossils allow a more complete record to be lithified and preserved in the stratigraphy.

Because the environmental and taphonomic factors that affect the O. Texana are interpreted to be minor, the primary controls on the size-frequency distribution of the O. Texana are likely to be biological. If this is the case, then the mortality rate is the main biological control on size-frequency distribution of the studied O. Texana.

Previous work completed by Peeters et al., 1998, examined the size-frequency distribution of nine species of modern forams in the Arabian Sea. The nine foram species all had a Gaussian (normal) size-frequency distribution, indicating that a healthy community of forams (ancient or modern) would share this trait of having a Gaussian (normal) size distribution. The Gaussian (normal) size distribution of the varied foram species means that they also share a type II survivorship curve, which suggests that the probability of death is independent of size/age for the forams. The population of Cretaceous O. Texana produce a normal (Gaussian) size distribution, thus indicating that this ancient species follows the same survivorship curve (type II) as other previously examined modern foram species.

Taking into account that the size-frequency distribution of the O. Texana is likely to be primarily controlled by its mortality rate, a Gaussian distribution of their size leads to the interpretation that the mortality rate of the O. Texana is uniform, regardless of age. When the size-frequency distribution for the O. Texana follow the same trends as other members of this taxon, this community of Orbitolina Texana Foraminifera is interpreted to be a healthy foram community, it is consistent with additional sedimentological and stratigraphic observations.

Conclusions

The size-frequency distribution of a single species is controlled by both biological, environmental and taphonomic factors. When environmental and taphonomic parameters are insignificant, a size distribution better reflects the biological controls on the organism. The measured diameters of 4,245 ancient Orbitolina Texana forams studied here produced a near-normal (Gaussian) size-frequency distribution. Both geologist and biologist define this as a normal size-frequency distribution curve when applied to a continually growing indeterminate growth species because it suggests that the mortality rate is uniform across all age groups within the population (Type II survivorship curve).
Because it was determined, based on sedimentological evidence, that hydrodynamic and taphonomic parameters do not exert a significant effect on the distribution of the forams before being preserved in the rock record, biological parameters can be viewed as the dominant control on the size-frequency distribution of O. Texana foraminifera from the Glen Rose Fm. As the near-normal size distribution result presented here for ancient forams is consistent with similar modern taxon, it is concluded that this Orbitolina Texana population was a healthy biologic community.

References


Edward Rochester: A New Byronic Hero

Marybeth Forina

In her novel Jane Eyre, Charlotte Brontë established several elements that are still components of many modern novels, including a working, plain female hero, a depiction of the hero’s childhood, and a new awareness of sexuality. Alongside these new elements, Brontë also engineered a new type of male hero in Edward Rochester. As Jane is written as a plain female hero with average looks, Rochester is her plain male hero counterpart. Although Brontë depicts Rochester as a severe, yet appealing hero, embodying the characteristics associated with Byron’s heroes, she nevertheless slightly alters those characteristics. Brontë characterizes Rochester as a Byronic hero, but alters his characterization through repentance to create a new type of character: the repentant Byronic hero.

The Byronic Hero, a character type based on Lord Byron’s own characters, is typically identified by unflattering albeit alluring features and an arrogant although intelligent personality. This character is usually an anti-hero who has committed a great crime for which he may feel guilt, but for which he has not repented since he feels he is above societal or spiritual law. Famous Byronic heroes in literature include Heathcliff from Wuthering Heights and Edmond Dantes from The Count of Monte Cristo. In his book, The Byronic Hero: Types and Prototypes, Peter Thorslev summarizes some general characteristics of a Byronic hero:

The Byronic Hero . . . is invariably courteous toward women, often loves music or poetry, has a strong sense of honor, and carries about with him like the brand of Cain a deep sense of guilt. He is almost invariably sympathetic in spite of his ‘crimes,’ none of which involve unnecessary cruelty. (8)

A Byronic hero is a man who is honorable and intelligent, but one who has made a mistake in the past and still carries that burden. As Thorslev points out, these past sins do not make a Byronic hero any less sympathetic; rather the mistakes can serve as a humanizing factor.

Brontë uses this template of Byron’s to create the character of Mr. Rochester. Jane’s first description of Rochester occurs when she meets him on his horse. She does not realize that this man is her employer, however, and honestly tells the reader of his unflattering appearance, noting his “dark face, with stern features and a heavy brow” (Brontë 120). Later, in fact, when Rochester asks her
himself if she finds him handsome, Jane bluntly answers that she does not (137), therefore proving that Rochester fulfills the appearance of the Byronic hero. Rochester continues to uphold the stereotype of the Byronic hero through his characteristics of arrogance and independence. As Nancy Pell points out, Rochester “continues to play the role of master not only with his household servants but toward all men and women” (82), as is evidenced by the authoritative role he takes in his relationships with Adele, his young ward, and Mr. Mason, his brother-in-law, neither servants of his, although both treated as though he is their master. He thinks himself above other and depends on no one else for anything. As he explains to Jane:

I flatter myself I am hard and tough as an Indian-rubber ball; pervious, though, through a chink or two still, and with one sentient point in the middle of the lump. Yes: does that leave hope for me? . . . Of my final re-transformation from Indian-rubber ball back to flesh? (138)

Rochester uses the example of the Indian-rubber ball to explain that he is not a soft, lovable, warm person. He has a rough exterior and is not “flesh” anymore. But as he makes note of “one sentient point in the middle,” he alludes to the fact that he has the potential to transform back into a person again, while also indicating that he was once a compassionate person. This self-awareness conveys Rochester as a man aware of his guilt and one who is beginning to look for a means of repentance.

Brontë further depicts Rochester as a Byronic hero by portraying him as a man burdened with a great sin of his past for which he has not yet repented. This great sin with which Rochester is burdened is rejecting his wife due to her insanity and falsely maintaining his status as a wealthy bachelor. Rather than accepting his mistake and repenting for it, Rochester, instead, buries his past mistake by locking his mad wife within his house: “Far from desiring to publish the connection, I became anxious to conceal it . . . and saw her safely lodged in that third story room of whose secret inner cabinet she has now for ten years made a wild beast’s den” (305). Rochester represses Bertha into an innermost room in his manor in order to hide his crime. In this passage, he compares his wife to a wild beast, implying that she is not a wife, but more of an animal, and thus, he cannot be held responsible for his crime, as he does not consider himself to be married. But as Rochester committed the sin against Bertha in locking her up and ignoring her as his wife, he also commits a sin against Jane by attempting to marry her while legally married to another. This marriage between Jane and Rochester would have never been legal, and Jane would have essentially become another one of Rochester’s mistresses. Again, Rochester has tried to place himself beyond the constraints of conventional laws. When confronted in the church, he admits his arrogance and his defeat: “Bigamy is an ugly word! —I meant, however, to be a bigamist: but fate has outmaneuvered me; or Providence has checked me” (288). He acknowledges he would have been a bigamist, and he would have willingly been leading Jane into a false marriage. Rochester commits crimes against both Bertha and Jane, although he does not see himself as at fault in Bertha’s case. As Gail Griffin writes, “Rochester spends a great deal of energy blaming his fate, his family, his women for his predicament, rather than accepting it, painful and unjust though it is” (123). His movement from the typical Byronic hero to Brontë’s modified Byronic hero is a result of his repentance, as the typical Byronic hero does not atone for his sin.

Brontë begins Rochester’s transformation to his new repentant self by first altering his appearance and his moral characteristics. When Jane was with her relatives, the Rivers, Rochester suffered injuries attempting to save Bertha and the other residents of Thornfield when it was burning down: “He was taken out from under the ruins, alive, but badly hurt: one hand so crushed that the surgeon had to amputate it directly. The other eye inflamed: he lost the sight of that also. He is now helpless, indeed—blind and a cripple” (418). Rochester’s injury is not only interpreted differently by various critics, but also by those who have adapted the book to film. In Franco Zeffirelli’s 1996 film adaptation, as well as in Cary Fukunaga’s more recent 2011 adaptation, Rochester is blinded, but does not lose his hand. This detail is a crucial one to some critics as dismemberment of a man’s hand may symbolize a loss of masculinity. Critics Richard Chase and Martin Day suggest the blinding and the maiming symbolize Rochester’s castration. Chase argues, “the faculty of vision…is often identified in the unconscious with the energy of sex. When Rochester had tried to make love to Jane, she had felt a ‘fiery hand grasp at her vitals;’ the hand then must be cut off” (58). When Jane returns and finds Rochester blind and crippled, she realizes that he has become dependent and needs help from her. Prior to his injury, Jane depended on him, but now Rochester is in a position of weakness and therefore, his arrogance has disappeared, as is evidenced when he admits he has now learned to accept help from others: “Hitherto I have hated to be helped—to be led: henceforth, I feel, I shall hate it no more.” (434) Before Jane left, Rochester would call her demeaning pet names, such as “my little darling” (297) and would belittle her intelligence; here, he abandons his superiority and arrogance and sees them as equals, thus becoming a new type of Byronic hero that evolves and learns from his past.

Rochester finally becomes a new type of Byronic hero when he repents for his sins against both Bertha and Jane. In order to fully atone for his sins, Rochester must not only make peace
with the two women, but with God as well, so he begins to pray for forgiveness: “Of late, Jane—only—only of late—I began to see and acknowledge the hand of God in my doom. I began to experience remorse, repentance; the wish for reconciliation to my Maker. I began sometimes to pray: very brief prayers they were, but very sincere” (435). Thus, by acknowledging the higher power above himself, Rochester concedes that he is not above any sort of law and repents for his previous inflated sense of self. Rochester then repents for his sins towards Bertha during the fire at Thornfield. He risked his own life to save her, not a beast he held in his house, but his wife whose life he valued. Although he failed in his attempt, he nevertheless sacrificed his own life and suffered injuries from it. Concerning Rochester’s relationship with Bertha, Nancy Pell suggests,

There is indeed a grim justice in the fact that Rochester’s only instance of open, public involvement with Bertha comes at the moment of his physical crippling…Bertha is the psychological symbol of Edward Rochester’s repressed awareness of his true social situation. (82)

The moment Rochester accepts Bertha as his wife and learns to accept his past is the moment that Rochester is freed from the burden and the restrictions of the typical Byronic hero. Bertha represents his true social standing as a second son forced to marry to maintain his situation, rather than his present façade of a wealthy bachelor. Now that he no longer carries guilt of the past, however, he can become the repentant hero that belongs with Jane. For as Day notes, “Only when he had suffered for his sins by maiming and disfigurement, only when his sins had been burnt away and his nature had achieved a transforming wholesomeness, only then could he be united with his true love” (499). Jane hears Rochester call out to her on a night when he needs her, after he has made peace with God, and after he has been relieved of the burden of his past. It is only when all these conditions have been met and Rochester has become the repentant Byronic hero that the two lovers are able to reunite at last.

When Jane and Rochester are reunited, however, there must be some change in the dynamic of their relationship before they can be married. During their first engagement, the two were not equal in their relationship, Rochester being the superior, and Jane the inferior. Rochester had money and land, while Jane was a young girl with nothing and no connections. When she finds Rochester at Ferndean, however, their positions have changed; Jane now has money and family, while Rochester has lost Thornfield as well as his sight and his hand. Mark Schorer suggests that Rochester’s injuries subdued his sexuality and therefore have removed the last barrier between Jane and Rochester (63). Jane and Rochester are now equals in their relationship. When Jane says to Rochester, “I love you better now, when I can really be useful to you, than I did in your state of proud independence, when you disdained every part but that of the giver and protector” (434), it becomes apparent that she felt inferior before, but now feels as though he needs her as much as she needs him. Now that Jane has been elevated in monetary status, and Rochester “has risen so far towards Jane’s moral rank that he has even begun to pray,” (Craig 62), they are now perfectly suitable for each other and will have a happy, albeit flawed, marriage.

To suit her changing female hero, Charlotte Brontë needed to create a new type of male hero. Brontë used the character archetype of Byron’s hero as a basis to construct the character of Edward Rochester. Brontë’s redesign of the Byronic hero as repentant allows for the social balance to shift between the hero and heroine. Jane loves Rochester, but in order to have equality between them, he must repent and admit some inferiority. Rochester is a Byronic hero; he exemplifies the characteristic traits of an unflattering albeit alluring appearance, intelligence, arrogance, and an unwillingness to adhere to social and spiritual laws. Rochester then evolves as a character and repents for his past sins, altering from the stereotypical traits of Byronic heroes. This act of repentance, however, and the change in Rochester, is what allows Rochester and Jane to become compatible. Prior to his seeking forgiveness, the two lovers were incompatible and could not be wed. Only once Rochester sought forgiveness for his sins, dismissed his sense of superiority over others, and became a new, repentant Byronic hero, could Jane feel equal in the relationship and finally succeed in marrying Rochester. Rochester has succeeded in his re-translation from Indian-rubber ball back to flesh, and thus, Charlotte Brontë has succeeded in her transformation of the Byronic hero.

**Works Cited**


Intuitive Impressions: Comparing Law Enforcement and the General Population’s Perception of Stress in Others

Lukas Klapatch

Although much research has addressed the physiological and behavioral differences between challenged and threatened stress levels (Blascovich, 2008; Frings, et al., 2012; McEwen, 2000; Vine, et al., 2013), limited attention has been paid to the ability of an observer to read behavioral cues in others and correctly identify the type of stress the target might be feeling. The purpose of the current work was to help address this gap in the literature and to compare the accuracy of participants from two groups, the general population and those with law enforcement training, who classified targets in silent video clips as challenged or threatened. What follows is a review of several areas of research related to stress classification. Research in these areas informed the hypothesis that law enforcement training would lead to improved accuracy of stress classification in comparison to civilians.

Stress Responses

Research on challenged and threatened stress responses is informed by, and closely linked to, research on approach and avoidance motivation. As early as 1889, Richard Dienstbier proposed a theory of physiological toughness to suggest that patterns of cardiovascular responses differ during potentially threatening situations. Dienstbier identified two different patterns of reaction to threatening situations, a “functional” cardiovascular response that predicted superior performance, and a “dysfunctional” cardiovascular response that predicted failure to thrive. Tomaka, Blascovich, Kibler and Ernst (1997) found support for Dienstbier’s theory in their research on cardiovascular responses during goal-relevant performance. More recently, Blascovich (2008) proposed his more complex biopsychosocial model (BPSM) of challenge and threat, which describes the physiological response, such as cardiovascular reaction, as well as the cognitive response, including appraisals of environmental stimuli in relationship to goal state and perceived competence, that prepare the body and brain for the challenge of goal attainment (approach) or potential threat (avoidance). While the BPSM classifies these states as motivational states along a continuum that can change depending on new information, the physiological difference between these states can be differentiated through the vascular contractions and change in heart rate of the target (Blascovich & Tomaka, 1996; Tomaka & Blascovich, 1994).

According to Lazarus and Folkman (1984), those who believe they have the resources to meet demands exhibit responses indicative of challenge, while...
those who feel incapable of meeting demands show signs of threat. In a challenged state, people show increased cardiac efficiency and decreased vascular resistance, which facilitates blood flow to muscle and brain. Threat is characterized by less cardiac efficiency and increased vascular resistance, causing less blood to reach the periphery and the brain, which may lead to freezing or preparation for damage or defeat (Mendes, et al., 2007). The changes in the cardiovascular system, the cognitive and affective evaluation processes, as well as the integration of intraindividual, interindividual, and environmental forces help to predict how individuals may behave and cope in response to the variety of ordinary (and extraordinary) opportunities and difficulties that require mental and physical resources (Blascovich, 2008).

According to the BPSM, a challenged state generally leads to better performance in a situation than a threatened state (Mendes, et al., 2007, among others), yet in certain situations, such as vigilance tasks, a threatened state has been associated with better performance (Hunter, 2001). Under conditions of extreme duress, the limbic system is capable of overwhelming the cerebral cortex, wherein more reason based interpretations, judgments, and restraint are formulated (LeDoux, 1995). Richard Restak (1995) referred to this as “episodic dyscontrol syndrome,” which has been linked to an inability to inhibit automatic or well-learned responses during times of severe stress that is threatening. LeDoux links this type of automatic or instinctive response to appraisals regarding the immediate and concrete risks and rewards associated with survival. A challenged person who feels they have the resources to handle the situation before them may respond more mindfully, in part because long-term goals are still accessible, yet both threat and challenge responses have obvious advantages and disadvantages. The impulsive reactivity associated with threat increases short term survival, but can interfere with the more abstract social and physical goals associated with long term success. The slower and more thoughtful responses to a challenged state may improve social relations and long term goal attainment, but may be costly in the short term.

### Stress Response Judgments

Measures of task performance generally indicate that physiological and self-reported stress evaluations are strongly correlated (Tomaka, Blascovich, Kelsey & Leitten, 1993), however, researchers have not yet examined the ability of observers to accurately label another person’s stress. The interpretation of other’s physiological states by way of external cues is a valuable skill in that intuitive judgments about how another individual may react to a situation could be valuable for optimizing interpersonal interactions. The skill may enable a person to head off a conflict, prevent escalation, or, in the context of challenge and threat, sense whether another individual feels prepared to handle a situation. Darwin (1965) argued that emotional displays have adaptive value because they communicate inner states of mind to observers whose survival is enhanced by learning to discern friend from foe without verbal information. Darwin’s claims have been supported by neuropsychological evidence that expressive displays appear to elicit a response in the observer’s mirror neurons (Wicker et al. 2003). Such empathic neurological responses may give an “experiential insight” into others’ minds (Gallese et al., 2004, p. 401).

“Thin slicing” is a term commonly used to refer to the ability of an observer to infer something about a person’ personality, character, or other traits based on only brief exposure to the stimulus. Research suggests that most of us are pretty good at making these quick assessments of people when the automatic, well learned appraisal is a good fit. For example, Ambady and Rosenthal (1993) found that participant evaluations of teachers shown in very short video clips (2, 5, and 10 seconds) were significantly correlated with the evaluations given by students after a full semester with the professor. The authors and others (Allport, 1937; Gottman, 1979) suggest that, in situations we are very familiar with, thin slices of behavior provide a great deal of information and permit reasonably accurate predictions. Although these quick judgments are not always correct, an abundance of evidence indicates that they are important and meaningful judgments that influence everyday behavior and should not be ignored.

Neuropsychological evidence indicates that judgments from thin slicing may rely on a brain network that includes the fusiform gyrus and the amygdala (Ambady, N., & Rosenthal, R., 1993). The fusiform gyrus, implicated in the perception of faces, and the amygdala, central to judgments of stimuli according to their threat or usefulness for survival (Ambady, 2010; LeDoux, 1995), appear to have specialized to give humans an edge in predicting interpersonal outcomes (LeDoux, 1995). Research also suggests that, while this brain network has specialized for automatically detecting other’s emotional states, the accuracy of such intuitive judgments may suffer when attention is focused too narrowly on the task or when intuition is disregarded in favor of retrospective explanation (Vallacher & Wegner, 1987). For example, Dunning and Stern (1994) found that eye witness accounts were more accurate when participants indicated that they relied on judgments that came from impressions or automatic process of recognition compared to self-reports of deliberative thought.

Some research indicates that women, who are generally credited with more empathy (Gault & Sabini, 2003), may be better at reading the emotions of others. For one commonly used mea-
sure (Reading the Mind in the Eyes (RMET); Cohen, et al., 2001), researchers have consistently found that women tend to perform better at discerning emotion from still pictures of the eye area. Women also tend to perform more accurately when the face is presented quickly (Hall & Matsumoto, 2004), an ability that might also be particularly relevant in reading stress responses from thin slices. Surprisingly, thin slice research has been more ambiguous. Rosenthal, Hall, DiMatteo, Rogers and Archer (1979) found women performed only marginally better in thin slicing face and/or body stimuli. The judgments women made were not statistically significantly better than those made by their male counterparts, and such equivocal findings seem to be consistent across all ages, from childhood to adulthood (Rossip & Hall, 2004).

Suggestions that women may be slightly better at such tasks lends support to Darwin's argument and neuropsychological evidence that the ability to read emotional displays may be a heritable trait, but social learning, training and experience likely enhances the ability. The ability to accurately read others would be especially important for those often faced with decisions regarding potentially dangerous individuals. Those in both challenged and threatened states could be dangerous for a police officer, for example. A challenged person may be better able to strategically use their resources to constructively cope, but might also allow for effective use of resources for attack or escape. A threatened person's sympathetic nervous system may go into overdrive, effectively shutting down higher order cognition. While threat may lead to freezing or compliance (the equivalent of "playing dead"), it could also lead to irrational or unpredictable behaviors (the equivalent of the erratic pattern of flight to evade a predator). Law enforcement officials go through hours of training designed to heighten their perception in situations where they must evaluate individuals or unpredictable behaviors (the equivalent of the erratic pattern of flight to evade a predator). Law enforcement officials go through hours of training designed to heighten their perception in situations where they must evaluate individuals quickly. Correll, Judd, Wittenbrink, Sadler and Keesee's (2007) research suggests that police officers do become better at thin slicing when it comes to shoot/don't shoot tasks. The authors compared the shoot/don't shoot responses of police officials to those of civilians for armed and unarmed African American and Caucasian targets. The performance of the officers exceeded that of civilians in both reaction time and in differentiation of armed targets from unarmed targets. Other researchers have found similar results (e.g., MacLeod, 1998; MacLeod & Dundar, 1988; Plant & Peruche, 2005).

The Current Study
The focus of the current study was on the accuracy with which observers could identify challenged or threatened states from thin slices of behavior. Participants viewed videotapes of targets who gave an impromptu speech while heart rate, blood pressure, and galvanic skin response were monitored using Biopac.

Targets were categorized as threatened or challenged according to criteria defined by previous research (Blascovich, 2008; Kasam, Koslov, and Mendes, 2009). A law enforcement cadets sample was used for comparison against the general population. Based on previous research it was hypothesized that women and those with law enforcement training would perform the task with more accuracy than the general population.

METHOD

Participants
The general population sample was comprised of 29 male and 68 female introductory psychology students aged 18 to 52 ($M = 20.4$). The law enforcement sample consisted of 73 male and 4 female cadets from Plymouth Police Academy aged 23 to 47 ($M = 27.7$). The majority of the cadets (93.7%) had no military or police experience and all were in their tenth week of police training courses. The study was approved by the Bridgewater State University Institutional Review Board.

Target Classification
Targets were participants in a previous experiment who were chosen based on their challenged/threatened physiological responses to an impromptu speech task, a common stress manipulation (Karst & Most, 1973). They were classified as either challenged or threatened based on left ventricular contractility (VC), cardiac output (CO), and total peripheral resistance (TPR). VC was calculated from the pre-ejection (the period before the blood moves out of the left ventricle and around the aorta) by measuring the time between the Q and S points of the QRS wave on an ECG. CO was computed by multiplying heart rate by stroke volume. Since we did not have a true measure of stroke volume, we assumed a constant volume based on gender. Thus, for our purposes, heart rate measurement was equal to cardiac output. To measure TPR we divided mean arterial pressure (diastolic blood pressure plus one-third of the difference between the systolic and diastolic pressures), by cardiac output (heart rate). Participants with a VC and CO reactivity greater than zero and TPR reactivity less than zero were categorized as challenged. Participants with a VC greater than zero, CO greater than or below zero, and a TPR reactivity greater than zero were categorized as threatened (M. Akinola, personal communication, November 26, 2011).

Procedure and stimulus materials
General population participants were either seated in separate cubicles in front of a PC, or were in a classroom with a video display. Police cadets were tested in a classroom setting. All participants reviewed consent materials before receiving survey packets and instructions. They viewed eight 20s video clips of 5 threatened and 3 challenged (4 female and 4 male) targets in...
RESULTS

Accuracy Results
Gender. There was no overall difference in accuracy by gender ($F(1,170) = 3.03, p = .08$), however females were significantly more accurate at classifying challenged individuals ($F(1,170) = 15.05, p = .00$). The same did not hold true when classifying threatened individuals ($F(1,170) = .04, p = .84$).

Police. Contrary to the hypothesis, police cadets did not perform significantly better than the general population. There was no difference between the groups in accuracy across all targets ($F(1,170) = 1.29, p = .26$), but the general population was significantly more accurate at classifying challenged individuals ($F(1,170) = 15.05, p = .00$). Chi-Square results show that the general population performed significantly better than chance on five of the eight targets while law enforcement performed significantly better on four of the targets. One threatened target was significantly misclassified by both police and general population participants. See Table 1 for detailed accuracy results by group.

Police by Gender. Because there were so few women in the police sample, we excluded females from both groups and repeated the analyses. Male police cadets did not perform significantly better than males from the general population; there was no difference between the groups in overall accuracy, regardless of target stress classification. However, Chi-Square results indicated that male police cadets correctly classified five targets (three challenged and two threatened), while males from the general population correctly classified only two (one challenged and one threatened). See Table 3 for detailed accuracy results by group.

PANAS Results
Overall, participants attributed challenged targets with significantly more positive emotions ($F(2, 171) = 12.57, p = .001$), and more negative emotions to threatened targets ($F(2, 170) = 11.01, p = .001$).

Positive Emotions. Cadets and general population participants attributed significantly more positive emotions to challenged targets accurately classified compared to those who were incorrectly classified (e.g., challenged targets incorrectly labeled as threatened received lower ratings on positive emotion). Correctly identified threatened targets were attributed significantly less positive emotions than those who were incorrectly classified (all $p < .00$; see Table 2).

Negative Emotions. Participants from both populations attributed targets they accurately identified as challenged with less negative emotion than targets who were incorrectly classified. More negative emotions were attributed to correctly labeled threatened targets than threatened targets who were incorrectly classified as challenged (all $p < .00$; see Table 2).

Discussion
The hypothesis that females would be more accurate than males in classifying targets was partially supported in the results showed significantly higher accuracy in their classification of challenged targets. Past research has shown that women perform better at related tasks, such as the RMET, and classifying emotions in quickly viewed stimuli (Hall & Matsumoto, 2004), but not particularly better at thin slicing when compared to men (Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979). The current results add to the equivocal findings and suggest that a more careful and pointed study of why some stimuli yield gender differences is warranted.

The results failed to support the prediction that police cadets would be more accurate than the general population when classifying challenged/threatened targets. Indeed, the general population accurately classified one challenged target more accurately than cadets. However, the sample of cadets was overwhelmingly male (73 of the 77), and males performed significantly worse in classifying challenged targets, suggesting that the effect may have been driven by gender, not group. In fact, when male cadets were compared to male general population participants, male cadets non-significantly outperformed the general population males, suggesting support for the original hypothesis. Since there were only 29 males in the general population sample the comparison is difficult to interpret. It may be that if gender participation in both samples had been more balanced the effects of police training and gender would have been more clear.

One target, a threatened male, was significantly misclassified by cadets and general population participants. This may be due to the body language or overt characteristics the target expressed. Past research has shown that threatened individuals may generate confident expressions (Ekman & Friesen, 1969) to hide their state. This would make sense as threatened individuals would have the most to gain by showing characteristics of a challenged individual. The misclassified target in this study may have been demonstrating characteristics of an opposite state to fool onlookers.
Accuracy may have also been influenced by study design. A number of studies have demonstrated the counterproductive effects of articulating and deliberating on such judgments when using thin slicing (Melcher & Schooler, 1996; Wilson & Schooler, 1991). Because participants in the current study viewed 20s clips and were given time for reflection, they may not have relied on their intuitive impressions. Deliberation may have hindered participant accuracy. Because officers do become better at thin slicing during shoot/don’t shoot tasks (Correll, Judd, Wittenbrink, Sadler & Keesee’s, 2007), it may be that a flaw in the current study obstructed all participants’ intuitive judgments, thus preventing us from detecting an effect for police training and experience. Judgments during the current thin slicing task permitted more deliberation than is allowed during shoot/don’t shoot tasks, perhaps reducing the accuracy of judgments. The results suggest support for Ambady (2010) and others who have found that thin slice judgments may suffer when information is processed more deliberately. Future research should look at the classification accuracy without deliberation.

The general population and cadets consistently judged those to whom they attributed more positive emotions as challenged, and classified those to whom they attributed more negative emotions as threatened, even when their categorization was inaccurate. It appears that both the general population and law enforcement similarly (and correctly) conceptualized challenge as a more positive state and threat as a more negative one. Because we did not ask the target participants to report their emotional state at the time they made their speech, it is unclear whether the emotional attributions were accurate. Target classification was based solely on physiological data collected at the time. However, the results do support prior research that challenged individuals, believing they have the resources to handle the situation, likely display more positive emotions. The opposite would be true for threatened individuals who believe they do not have the resources for the situation (Lazarus & Folkman, 1984). Participants who incorrectly classified a target still revealed their understanding of stress states in that perceived positive emotions were predictive of a label of challenged, and negative emotions with threatened.

Overall further research is warranted on accurate classifications of challenged/threatened individuals, particularly in those whose thin slice judgments have important social consequences. Understanding how onlookers read stress in others could provide information to improve the safety of officers and civilians alike. Because threatened and challenged individuals likely behave differently when confronted by police, accurate classification may prevent excessive use of force. Because our sample containing mostly unexperienced cadets, future research should examine the accuracy of stress classification with experienced officers. Yet, the study has bridged a small gap in the literature on stress classification, and despite certain limitations still remains a unique and innovative first step.

Acknowledgement
The authors would like to thank Modupe Akinola for her advice and input on the development of the project. The research was supported by an Adrian Tinsley Summer Grant.

References


### Table 1. Chi-Square Classification of Targets

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### Table 2. Panas Means

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* Results significantly different from chance, p < .05
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* Results significantly different from chance, p<.05
Decay and Perversion in Jacksonian America: George Lippard’s *The Quaker City*

**KEITH LYDON**

In the United States, the period between the termination of the 18th century and the commencement of the 19th century is characterized by the struggle to forge a national identity that was uniquely American in its independence from European influence. American writers of this period understood that the creation of an American literature distinct from the influence of Europe and shaped by the social, political, and natural environment of the United States would provide the country with the first vestiges of the autonomous cultural identity it so desperately desired. However, this work proved to be problematic, as with little financial or even cultural incentive to develop this American literature, many of these writers, once so enthusiastic in assisting in the development of this fledgling nation, had resorted to writing in a style imitative of European literary models. Though largely unknown to or ignored by contemporary scholarship, American author George Lippard dutifully remained at the vanguard of the struggle known as the Subversive movement, convinced of his belief that literature is integral to the development of a national identity. Permeated with the scandalous, the sensational, and the gothic, Lippard’s Subversive style is as wild, savage, and unrefined as the fledgling nation that served as its inspiration. Ultimately, though it may seem as though George Lippard and his Subversive utilization of the gothic and the sensational seem to be on the periphery of American literature, they actually had a powerful influence over the evolution of American literature as well as American cultural identity as a whole.

Lippard was deeply influenced by his alliance with the radical democrats, an extremist political group of the early 19th century committed to the eradication of what they perceived as the pervasive corruption within the American party system as well as the American government as a whole. He was also possessed of a religious fervor bordering on fanaticism, and considered literature an instrument with which it was possible to stimulate the social and political interest of society and subsequently advance societal reform (*Renaissance* 198, *City* xi). Through the intensely political novel *The Quaker City* (1845), Lippard seeks to expose the vast network of organized corruption that pervades American society, the institutionalization and subsequent perversion of religion, and the potential danger associated with the American proliferation of the ideals of the European Enlightenment.

The corruption and subsequent degradation of institutions over time and at the hands of the strong willed and powerful is a reoccurring theme in George
Lippard's personal and professional life. According to David Reynolds, one of the few scholars to study Lippard extensively, contempt for institutional corruption is a characteristic that can be traced to Lippard's ancestors, German Palatines who fled to America in an effort to escape religious persecution at the hands of the institutionally corrupt Roman Catholic Church (City ix). These tormented German pilgrims were granted asylum in a new land that promised unfathomable freedom and opportunity. The fierce appreciation and protectiveness of American ideals that this promise engendered within them was passed down through subsequent generations and became the driving creative force behind Lippard's work.

Lippard spent his formative years on an ancestral farm in Germantown, Pennsylvania under the care of his grandfather and two aunts where his frail form, strong mind, and intense nature made him stand out among his peers as “a queer fellow of no account” and brought to his attention at an unusually early age the arbitrary nature of social hierarchy and society's undervaluation of unique and critical thought. Haunted by his status as an outcast and a preoccupation with mortality, Lippard used religion as a means of comfort, painstakingly studying the bible and interpreting the word of God with his characteristic intense idealism that would be the foundation of his future unforgiving criticism of what he perceived to be misuse or exploitation of institutionalized religion in The Quaker City (City x).

In an effort to escape poverty, Lippard's aunts sold the family farm and the land it occupied, robbing Lippard of his youthful home and prompting him to brood over why “this old house, this bit of land could not have been spared from the land sharper and mortgage hunter” (City x). This experience embittered Lippard towards those “destroyers of the homestead” who participated in the American capitalist economic system, which in his view encouraged the utilization of the darkest aspects of human nature and placed greater value in profit, expansion, and urbanization than in morality, ethics, and even religion. In fact, in his mind the capitalist American economic system had become a formidable institution in its own right, and was responsible for the rapid replacement of the virtuous worship of God in small and rural communities with the blasphemous worship of the dollar in sprawling and dangerous cities (Lippard 67). If at this point in his life Lippard placed any genuine trust in institutionalized religion, his enrollment at Catherine Livingstone Garretson's Classical School in Rhinebeck, New York quickly extinguished it (City xi). Upon realizing that the school's clergyman director fell short of the level of devoutness and piety that Lippard believed a man in his position must possess, he deemed the school a breeding ground for future corrupt and hypocritical preachers and quickly left, his feelings for perverse religious institutions and duplicitous religious leaders now forged into the almost militant hatred that would fuel his macabre and menacing portrayal of them in The Quaker City (City xi).

After his departure from the Garretson's School and upon hearing of the impending death of his father, Lippard returned to Philadelphia but received no portion of his father's estate and was suddenly plunged into poverty (City x). Realizing his lack of options Lippard elected to remain in Philadelphia and acquired two law-assistant jobs as a means of financial support. Lippard's time in Philadelphia coincided with the great depression of 1837 to 1844 and his lack of money and homelessness allowed him firsthand experience of the social and political unrest that plagued the city in the form of bank failures, worker strikes, unemployment and starvation (City xi). It seemed to Lippard that among the indigent of Philadelphia, especially vulnerable were women, and all were fighting for survival while being attacked on all fronts by greed-crazed bankers, hypocritical preachers, a capricious and opportunistic news media and, perhaps most offensive, a lazy and self-indulgent literary community.

In Lippard's words, “a literature which does not work practically for the advancement of social reform, or which is too good or too dignified to picture all the wrongs of the great mass of humanity, is just good for nothing at all” (qtd.in City vii). Through his various life experiences Lippard had been gifted, or cursed depending on perspective, with firsthand knowledge of the many cancerous frauds that threatened the future moral function of not only the city of Philadelphia but the country as a whole. Lippard believed that the United States of America, a nation that shielded his Palatine ancestors from religious persecution and offered them freedom and opportunity, was decaying in the hands of new economic, religious, and political leaders while every day drifting farther and farther away from the intentions of the men involved in its foundation. To Lippard, religion had become a shadow of its former ethical and moral glory. The press had forsaken journalistic integrity and become at best an overly sentimental tranquilizer of the unruly masses and at worst an opportunistic scavenger. And most damning of all, the capitalist American economy had replaced the word of God and become an object of dedicated and feverish worship in its own right.

Lippard and others believed the United States was in need of literature capable of exposing the “social life, hidden sins, and inequities covered with the cloak of authority” that pervaded the country as well as a writer that would not flinch from the inevitably powerful backlash that comes with defying the authority of those in positions of power (qtd.in City viii). Lippard did not flinch but imbued such a wild and infernal energy into
The Quaker City that Reynolds’ description of him as a “literary volcano constantly erupting with hot rage against America’s ruling class” is inarguably apt (xii). Lippard was inspired by the actual criminal case of a Philadelphia man named Singleton Mercer, who in 1843 was acquitted of murdering Mahlon Herberton in retaliation for luring his sister to a secret location and seducing her with the promise of marriage. This true story of exploitation, murder and sexual deviance was used as the foundation for a novel that encapsulated all of the economic, religious, literary, legal, racist, and sexist corruption teeming just beneath the perceivable level of Philadelphia and by extension the United States, a story that eventually developed into The Quaker City.

Corruption

Among the many themes explored in The Quaker City the vast network of organized corruption pervading the seemingly pious and respectable city of Philadelphia is foremost.

The Evil of Influence

For the fiercely critical and idealistic Lippard it was not enough to complacently attribute the slow and steady degradation of the Enlightenment-inspired values upon which the United States was founded to inevitable social change. In The Quaker City, he articulates his belief that those responsible for this degradation, the powerful and influential, would ultimately reduce the country to a corrupt parody of its previous greatness. Additionally, Lippard often justifies his lack of allegiance to institutions by describing the men who control them as pious and respectable public figures worthy of emulation by day yet wild and drunken embodiments of corruption and debauchery by night. Through the social status and actions of the characters within The Quaker City Lippard asserts that those responsible for the orchestration of this corruption are not the uneducated, wretched and starving poor but rather the very men entrusted with maintaining the institutional integrity of the city of Philadelphia and by extension the United States as a whole.

The respectable Colonel Mutchins, for example, is known throughout the city for his portly stature and kind disposition; however when under the influence of alcohol and surrounded by the cloaking effect of night Mutchins casts off his burdensome civil duties and suggests that his partners in debauchery, “think how many bells are to be pulled, how many watch-boxes are to be attacked, how many – curse the thing, I believe I’m toddied – watchmen to be licked” (8). Drunken, foolish Mutchins sounds more like a mischievous schoolboy than a man of substantial public responsibility. Sylvester J. Petriken, editor and proprietor of Ladies Western Hemisphere, enjoys the public reputation of a journalist committed to producing a literature dedicated to exposing injustice and facilitating social change. In reality Petriken is a meek and dispassionate fraud who publishes only overly sentimental and ineffectual drivel (12). Gustavas Lorrimer is charming, intelligent, and possesses the strong constitution of a leader that is both so rare and so necessary in order to maintain American ideals and bring about beneficial social change. Hidden from the eye of the public by wealth and influence, however, Lorrimer is defined by his narcissism and sexual deviance, using his charm and superior leadership ability to manipulate others weaker than he into carrying out his will. Lorrimer describes his relationship with Petriken and Mutchins thus: “they hire themselves to me for the season – I use and, of course, despise them” (22). The character of Gustavas Lorrimer is particularly disturbing to Lippard because he represents the superior ability of those with wealth and influence to alter the institution of the United States over those who wish to maintain the authentic vision of the founding fathers.

By populating the pages of the fictional Quaker City with wealthy, influential and respected public figures that are revealed to be licentious, immoral and wicked monsters who commit debauched and deadly crimes throughout the dark streets and even in sight of the State House of Philadelphia, Lippard levels a sharp criticism against those charged with maintaining the original idealistic integrity of the country (7). It was Lippard’s intention that when the public read The Quaker City they would follow the example of Byrnewood Arlington after he stepped for the first time through the doorway of the infamous Monk Hall and “obtain a few fresh ideas of the nature of the secret life of this good Quaker City” (23).

Religion Threatened

Another prominent theme explored by Lippard in The Quaker City is the dangerous and corrupt nature of institutionalized religion in Philadelphia and by extension the United States as a whole. Through the description of the nefarious Reverend Doctor F.A.T. Pyne and his relentless exploitation of the misguided members of his independent religious association known as The Free Believers and True Repenters, Lippard argues that institutionalized religion is merely another means by which the wealthy and the influential profit by perverting the original vision of the founding fathers. Furthermore, Lippard believes the corruption pervading institutionalized religion directly contributes to the erosion of religious integrity. Worse still, it also causes the disintegration of the social cohesion provided by religion that was thought by the founding fathers to be an essential element of a secular nation without access to the cohering force of monarchical government. The Oyster Saloon of Samuel Chiffin, a subterranean den of gluttony, greed, and sloth populated by the lowest level of Philadelphia society, was originally built “for the accommodation of the brothers of
The Center of Perversity: Monk Hall

Through his description of the infamous Monk Hall and the abominable crimes perpetrated within its walls by the wealthy and influential members of Philadelphian society, Lippard reflects the truly perverse nature of American society as a whole, which he believed had become a safe haven where the powerful American elite could indulge in dark depravity without fear of suspicion or consequence. Monk Hall itself, where much of the novel’s action takes place, had originally been constructed by a “wealthy foreigner, sometime previous to the revolution,” and the strange gothic design of this residence combined with the fact that it descended just as deeply underground as it ascended into the air indicated that this person possessed a mind “rendered whimsical and capricious by excessive wealth” (46). This mysterious foreigner was dubbed a “libertine, a gourmand, an astrologer and a wizard” as a consequence of his habit of throwing lavish and drunken feasts late into the night, though he never left the seclusion of his forbidding residence during the day (47). The pattern of fear, mistrust, and religious corruption associated with the proprietors of Monk Hall continues when the residence is occupied by a Catholic priest and utilized as a nunnery, monastery and secluded refuge for what Lippard considers to be a corrupt version of Christianity (47). Lippard is careful to state that after the American Revolution the wild and unsettled regions of Philadelphia began to give way to neat brick buildings and tangled city streets as urbanization and expansion concealed Monk Hall and all fearful legends associated with it. Monk Hall is so buried in urban sprawl that if the original owner were to rise from the grave and attempt to visit his old home “he would have had to wind up a narrow ally, turn down a court, strike up an avenue, which it would take some knowledge of municipal geography to navigate.” The maze of city streets hiding Monk Hall repress the city’s natural fear and suspicion of the gothic style and leave its citizens vulnerable to corruption (48).

Hiding in plain sight yet erased from the memory of the ignorant and complacent citizens of Philadelphia, the corruption within Monk Hall was left to fester and rot so that by the time Byrnewood Arlington stands within its unhallowed walls it has become an awesome monument to godlessness, religious depravity and sexual perversion. Paintings of the god Bacchus, “while his hand swung aloft, a goblet filled with the purple blood of the grape” and the Goddess Venus, “with a softened radiance falling over her uncovered form,” decorate the walls of Monk Hall and suggest that the inhabitants have rejected God in favor of pagan embodiments of sex, alcohol and celebration (54). Continuing the pattern of pagan-inspired decoration, the corridors of Monk Hall are ornamented with “uncouth sculptures of fawns and satyrs, and hideous creations of classical mythology (54). Lippard soon trades thinly veiled suggestions of religious irreverence for clear and sharp accusations of blasphemy with the description of the effigy of a monk, “whose long black robes fell drooping to the floor, while his cowl hung heavily over his brow,” and from beneath this cowl “glared a fleshless skeleton head, with orbless eye-sockets,” the abandoned and desiccated corpse representative of the extant form of Christianity (54). Through vivid descriptions of mythological pagan creatures, allusions to pantheistic worship and the representation of Christianity as a long dead carcass, Lippard assesses religion in the United States and finds it withered almost to nothingness and the country as a whole teetering on the edge of ruin in the vein of the Roman Empire. All this occurs while its people, shrouded in ignorance and complacency, enjoy a uniquely American period of bread and circuses.

The Fall of Religion and the Rise of Capitalism

Like Lippard, the founding generation believed that for society to be successful and peaceful, humanity must be guided by an idea more complex than individualistic compulsion. And like many of the founders, Lippard believed that the force capable of pacifying self-centered human desire was religion, more specifically Christianity. But according to Lippard, institutionalized religion had become dominated by the wealthy and influential elite and deviated far from the original word of God. This deviation had subsequently allowed “authentic” religion to be replaced as the primary source of social control by the increasingly powerful institution of capitalism. For Lippard, the impending prospect of capitalism supplanting religion as the central binding American institutional force presented a great and terrible danger. Through the inhuman subjugation of the indigent by the wealthy described in The Quaker City Lippard asserts that allowing capitalism, which counts individualistic competition, monetary gain, and unrelenting expansion as priorities of the highest order, to surpass religion as the defining American moral influence will result in the country’s metamorphosis into an archaic empire ruled by a wealthy aristocracy
and dedicated to brutal economic Darwinism. Emblematic of this process is the fate of the Oyster Saloon of Samuel Chiffin, once a monastery occupied by pious men of extraordinary faith in God but now an unhallowed den of capitalistic greed run by a man whose feverish mutterings of “Four bottles o’ Cham at two dollars a bottle—four times two is eight” and “They’ll drink six more. Let’s call it twelve all together. Say twenty-four shiners for dinner and all” mirror Lippard’s fear and hatred of capitalism (11).

The Destructive Influence of Capitalism

Lippard theorizes that increased exposure to capitalism combined with decreased exposure to the moralizing influence of religion would inevitably turn the idealistic and enterprising people of the United States into the blasphemous, licentious and unfeeling characters featured within The Quaker City. When Gustavas Lorrimer declares to his dedicated band of followers that he plans on the seduction and subsequent destruction of an innocent girl, the first impulse of Byrnewood Arlington is not to express disgust for this evil plan but instead to announce “I will stake this hundred dollars that the girl who seeks your arms to-night, is not respectable, is not connected with one of the first families in the city, and more than all has never been any better than a common lady of the side walk” coldly disregarding the safety of an innocent person in favor of monetary gain (15). Lorrimer of course accepts the bet and recruits the faithful dogs Petriken and Mutchins to the blasphemous task of orchestrating a sham of a wedding designed to trick the young woman into thinking she is respectably linked to Lorrimer in the eyes of God. These meek and corrupted men easily agree to assist in the seduction for the meager price of fifty dollars with exclamations by Petriken of “Fifty dollars! Egad that ‘ill buy two steel engravings and three fashion plates for the next number of the Ladies Western Hemisphere,” and “Economy is wealth, and the best way to learn how to fly is to creep—creep very low, remarkably low, damned low—always creep!” displaying both his preoccupation with monetary gain and his understanding that in order to be successful in a capitalistic society one must be willing to utterly sacrifice morality and basic human compassion (16).

Lippard illustrates this tendency of capitalism to prioritize monetary gain over concern for humanity by describing the “Monks” of Monk Hall’s ability to exist immune to the curiousity of Philadelphia merely because they pay rent in full and on schedule. Monk Hall itself is rented by the name Abija K. Jones but the true identity of the renter was the murderous and mentally unstable caretaker Devil-Bug, a secret that the legal owner of the house, “a good Christian, who had a pew in --- church” would have been able to uncover easily if he hadn’t been too busy “cramming Abija’s rent money into the same pocket book that contained some tract society receipts” and remarking to himself, “Good tenant that!—pays his rent with the regularity of clockwork” (49).

The deadened sense of morality that began to pervade the United States as a result of the increased influence of capitalism is reflected by Lippard through the inability of the citizens of The Quaker City to see Monk Hall, an institution protected by the powerful and used to propagate corruption, as anything but a simple home “kept by a reputable old lady, and supported by the purses of goodly citizens, whose names you never hear without the addition of ‘respectable’, ‘celebrated’, or —ha-ha-’pious’-most ‘pious’ (22). Only those who had consciously abandoned morality and concern for humanity could comprehend Monk Hall for what it truly was, a godless altar to capitalism shielded from the arbitrary and corrupt institution of the law by the wealth and influence of its patrons, “where the very devil is played under a cloak, and sin grows fat within the shelter of quiet rooms and impenetrable walls,” and the vile and manipulative words of a man like Gustavas Lorrimer could be greeted with sacrilegious shouts of “Huzza! Bravo—The Reverend Gus Lorrimer preaches” (23). Through the description of the brutal fight between the creditors of Monk Algernon Fitz-Cowles over his large debt as “a forest of flying fists, rising up and down, a mass of angry faces all mingled together,” Lippard reflects his vision of the people of the United States under the destructive influence of capitalism. Through the description of the men “twisting and winding all about, with so much rapidity, that they all looked like the different limb of some strange monster, undergoing a violent epileptic fit” (172) Lippard describes the contorted and self-destructive institution of capitalism itself.

The Danger of the Enlightenment

Though Lippard was particularly anxious about the corruption of American identity by the expanding influence of institutionlized capitalism, there were sections of the idealistic legacy of the United States that he believed had the potential to be just as dangerous as capitalism if taken out of context, namely the values of the Enlightenment. Enlightenment thinking, with its emphasis on reason, the power of human understanding and individual freedom, had inspired the persecuted colonial subjects of the British Empire to cast off the yoke of oppression and forge a new nation. Through The Quaker City Lippard asserts that though the United States was founded on the belief that the betterment of humanity is possible by the agency of human reason and understanding, without the social cohesion provided by religion this humanistic perspective has the potential to bring about the destruction of the nation, especially if perverted to achieve the purposes of the wealthy and influential elite.
To Lippard, the United States in its original form had the potential to become as near a perfect society as was possible on earth because it proposed the use of religion as a means of governing the behavior of its fundamentally debauched citizens. Convinced of the concept that the only method by which the corruption that pervaded the United States could be overcome was the resurrection of what he perceived to be the superior values of the past, the majority of Lippard’s early writings consisted of the exaggerative reimagining of significant American historical events. The historical figures that populated Lippard’s revised American history included George Washington, Thomas Jefferson, and Thomas Paine, each figure depicted not only as a hero, but a hero inarguably aligned with Lippard’s ideology (Lippard 67). In Lippard’s view, the only aspect of the United States that did not lend itself to perfection was the country’s Enlightenment-based belief that too intense a reliance on religion would restrict the fledgling nation from testing the boundaries of human understanding through scientific, philosophical and technological progress, a concept that he believed encouraged human arrogance and challenged the status of the word of God as the universal truth. Lippard demonstrates the danger of casting aside the moral guidance of religion in his description of Albert Livingstone, a man whose mind “had only found use for the display of its tamest powers” in his experience so far, “while its dark and desperate elements, from the want of adversity, revenge or hate to rouse them into action, had lain still and dormant for some twenty years of active life” (36). Livingstone was a kind and gentle man, but he, along with the rest of humanity, had the potential to become a hateful, vindictive and murderous monster without the constraints of society and the guidance of religion. According to Lippard and reflected within The Quaker City, the majority of men are similar to Livingstone in the sense that “he never dreamed himself that he carried a living hell within his soul” (36) and in the protective confines of civilization become complacent in the misguided supposition that they are intrinsically virtuous. Convinced that this blasphemous ideology had taken root in his own nation, Lippard writes The Quaker City as a means of imploring his fellow Americans to accept Christ as their savior before the absence of the moralizing influence of religion reduces the great United States into nothing more than a pack of bloodthirsty beasts.

Women as Victims in Monk Hall
Lippard was convinced that without religious reverence it was simply not possible for human beings to lead good and virtuous lives. When describing Mary Arlington, the purest and most virtuous female character in The Quaker City, Lippard is careful to state that even in the throes of attraction she is not under the influence of “feverish sensual passion” and was not drawn to Gustavas Lorrimer because “his eyes were bright, his form magnificent, his countenance full of healthy manliness” (84). Mary was drawn to Gustavas Lorrimer because she believed he was an honorable man and she loved him in the sublime and spiritual manner that was intended by God. In Lippard’s view women are more attuned to the sublime and spiritual influence of God than they are to the sinful and depraved influence of humanity and so for them the animalist nature to which all humans are prone “is a passive thing that must be roused ere it will develop itself into action” (85). Subsequently, women who are engaged by men on a purely intellectual level will remain loyal and godly companions. However, if a man who has cast off religious influence in favor of the arrogant Enlightenment-based belief in the power of human understanding should decide to engage a woman in a less transcendent sense, and “play with her animal nature as you would with the machinery of a watch,” the purity of said woman is tainted forever and she becomes “but a mere animal” (85).

As Sylvester J. Petriken remarks before officiating over the fraudulent wedding ceremony of Mary Arlington, “when a man’s fit for nothin’ else, he can always find fools enough to build him a church, and glorify him into a saint” (94). Through this telling statement, Lippard postulates that just as capitalism has the potential to create the wealthy, influential, and depraved monster Gustavus Lorrimer, the proliferation of Enlightenment values has the potential to create a figure even more capable of eroding the idealistic legacy of the United States. This figure – in The Quaker City, it arrives in the person of the mysterious Maroni – would disguise itself as a symbol of hope while perverting such Enlightenment concepts as trust in human understanding, belief in progress, and value of individual freedom, as a means of convincing humanity of the corrupt and archaic nature of religion. This figure would have the ability to suppress any resistance to its deceptive assurances that mankind had finally stepped out of the shadow of a false god and into the light of human potential. Once humanity had divorced itself from the moralizing force of religion this figure would convert these weak willed and arrogant individuals into the followers of a new and fallacious faith while achieving god-like status in its own right.

The mysterious and seemingly omnipotent Ravoni is a man whose extensive knowledge of science, philosophy, and law surpasses that of the greatest minds in the country and inspires in his students a strong admiration that quickly develops into zealous worship. Ravoni preaches a dangerous message: “there is no God. There is no Heaven. There is no Hell.” He emphatically states of himself, “I believe in God, but my God is the Power of a Giant Will. In a Heaven, but it is that Heaven which springs forth from the refused cultivation of all the senses. In a Hell I believe – it is the Hell of Annihilation” (424).
Through these words Ravoni clearly states that the worship of a fictional celestial authority is foolish and that true meaning in life is not attained through an outside source but only through the endless pursuit of individual pleasure.

Through the excited exclamations of the godless libertine Gustavas Lorrimer – “Everything is fleeting and nothing stable” and “One word my fellow-Enjoy! Enjoy till the last nerve loses its delicacy of sense, enjoy till the last sinew is unstrung, enjoy till the eye flings out its last glance, till the voice cracks and the blood stagnates” (23) – Lippard predicts that if the demoralized Enlightenment teachings of Ravoni are allowed to flourish, human civilization will inevitably be torn asunder by the newly unleashed force of self-centered human impulse. Reservations about the morality of actions intended to augment human understanding will crumble in the absence of God, and make commonplace the atrocities committed by the corrupt students of Ravoni, who callously dissects the bodies of men, women, and children without once considering that the unquenchable thirst for knowledge had compelled them to destroy “rare relics of the Temple which yesterday enshrined a Soul, borne of the Living God” (437).

In Ravoni’s world, the appreciation of human reason, rationality and personal freedom that characterize the United States of America will be replaced by the relentless and animalistic pursuit of self-interest culminating in the reduction of a once great nation to dry bones and unhallowed dust. And in this desolate wasteland a figure much like Ravoni will rise and triumphantly enslave all those who had joined him in rejection of God, assisted him in the destruction of the institution of the United States and been foolish enough to believe his promises of ultimate freedom would amount to anything but total subjugation.

Lippard perceived literature as an instrument with which it was possible to stimulate the social and political interest of society as well as subsequently advance societal reform. Through the intensely political The Quaker City Lippard seeks to expose the vast network of organized corruption that pervades American society, the institutionalization and subsequent perversion of religion and the potential danger associated with the American proliferation of the ideals of the European Enlightenment. Though his extreme political ideology and intense utilization of such Subversive literary elements as the gothic and the sensational have characterized him as a radical outlier in the minds of many contemporary literary scholars and subsequently relegated him to the status of a footnote in the history of the development of the literary identity of his fledgling nation, the prodigious influence of Lippard’s wild, tempestuous and sometimes frightening work remains clearly discernable within American literature to this day.

**Works Cited**


Biodiesel is composed of fatty acid methyl esters derived from vegetable oils. The production of biodiesel from BSU waste vegetable oil (WVO) would provide positive impacts for the institution, including financial and educational benefits. BSU would no longer have to pay for the disposal of WVO and would not be as dependent on petroleum diesel, thus reducing the cost of fueling campus diesel vehicles. BSU would be able to use a biodiesel production facility as a learning tool for students in introductory, intermediate and advanced chemistry courses, non-major courses, undergraduate research, STREAMS and K-12 outreach. This would allow students to acquire a better understanding of biodiesel production at the lab and manufacturing scale. BSU could become a regional research, education and outreach center on biodiesel production and its use, especially for those interested in small scale production for their own business or as an educational teaching tool. With such strong benefits for BSU, its students, and the community, it is worthwhile to invest in research that will permit the actualization of this potentially lucrative renewable fuel source.

Biodiesel is produced through a base-catalyzed chemical reaction called transesterification, where the fatty acid glyceryl esters of vegetable oil exchange glycerol for methanol, producing fatty acid methyl esters (biodiesel), Figure 1.¹ The crude biodiesel is purified by washing out byproducts and residual reagents with water. This is a crucial step because any impurities in the biodiesel could lead to serious and expensive engine damage.
Research in Dr. Brush's group is focused on applying the 12 Principles of Green Chemistry to develop an efficient and cost-effective process for converting WVO into biodiesel for campus use.\(^3\) The focus of this research project has been on Green Chemistry Principle #11 which states the importance of “Real-Time Analysis for Pollution Prevention.”\(^4\) This means that it is important to analyze the chemical substances at each stage of a chemical process to determine if hazardous products are being produced, and to exert appropriate control measures. For the production of biodiesel from WVO, this can be accomplished using the advanced analytical instrumentation available in the BSU chemistry department. This instrumentation enables the precise assessment of the purity of biodiesel samples, and identity of any contaminants. Furthermore, the data from this project will be valuable in supporting the ongoing biodiesel research projects being carried out by BSU undergraduate chemistry research students.

In order to achieve our goal of developing an efficient chemical process to produce large quantities of pure biodiesel while eliminating waste, it is essential to know not only the precise purity of the biodiesel product, but also the identification and amount of byproducts. A further complication is that biodiesel is produced from many similar fatty acid glycerol esters, such that the biodiesel product is actually a blend of very similar fatty acid methyl esters. The focus of our research was limited to obtaining quantitative data on impurities and byproducts, as this information would allow us to assess the efficiency of our production method, identify where waste was being produced, and determine how the process could be improved. Furthermore, by perfecting our analysis methods BSU could serve as a regional analytical center performing quality assurance tests on biodiesel process being developed in our research group. The following instruments were evaluated as part of this research project: Gas Chromatograph/Flame Ionization detector (GC-FID), Nuclear Magnetic Resonance spectrometer (NMR), and Fourier Transform Infrared Spectrometer (FTIR).

**Description of Instrumentation**

**Gas Chromatograph/FID Detector (GC-FID).** Gas chromatography is the most widely used method for biodiesel analysis, and the most accurate for minor byproducts such as methanol, glycerol and fatty acid glyceryl esters.\(^5\) Different chemical analytes pass through a heated chromatographic column at different rates depending on their chemical and physical properties, and their interaction with the column’s stationary phase. An elution profile is produced that is compared to reference standards in order to identify the product distribution, and all byproducts. The presence of glycerol in the elution profile from a biodiesel sample may indicate problems in the water extraction step of the synthesis process, while the presence of glycerol esters will indicate an incomplete transesterification reaction. Two types of capillary chromatography columns are typically used, a fused silica 100% dimethylpolysiloxine capillary column, or a fused silica column coated with (5%-Phenyl)-methylpolysiloxine.\(^5\)

The flame ionization detector (FID) is the most sensitive gas chromatographic detector for hydrocarbons; organic compounds containing only carbon, hydrogen and oxygen (like biodiesel). The FID has a wide linear range (6-7 orders of magnitude) and limits of detection in the low picogram or femtogram range, making this gas chromatographic detector the best suited for many carbon containing compounds.

**GC-FID method development for a new type of analyte is time-intensive.** This starts with a chemical pre-treatment step to derivatize the biodiesel sample components through silylation, using methylsilyl trifluoroacetamide (MSTFA). This commonly used approach ensures that the chemical characteristics of all analytes of interest, especially glycerol compounds, are compatible with the conditions in the heated chromatog-
The oven temperature is programmed to ensure effective separation of the analytes. Typically an oven ramp program is used based upon standard ASTM methods that serve as guidelines, but trial and error are needed to improve separation.\(^6\)

**Nuclear Magnetic Resonance Spectrometry (NMR).** NMR is the most widely used method for qualitative analysis in determining the structure of organic compounds. However, NMR has also shown excellent potential for the quantitative analysis of biodiesel analytes.\(^3\) NMR spectrometry measures the frequency at which hydrogen and other nuclei resonate when put in a magnetic field, and can provide valuable information about the carbon and hydrogen backbone structure of organic molecules. In biodiesel analysis we focus on specific signals associated with unique hydrogen atoms in the analyte molecules. Overall, NMR can be used to identify and quantitate the presence of glycerol, methanol, fatty acid glycerol esters, and fatty acid methyl esters (biodiesel).

**Fourier Transform Infrared Spectrometry (FTIR).** The FTIR is another routine instrument used by organic chemists to conduct qualitative structural analysis, and typically goes hand-in-hand with NMR. FTIR provides information on the types of chemical bonds in a sample as related to specific functional groups that can indicate the presence of methanol, water, and fatty acid esters. This is the simplest of the three instrumental methods, analysis is very rapid, and no special sample preparation is required. FTIR is most valuable for the rapid screening of samples prior to detailed analysis by GC and NMR. FTIR has been used for quantitative analysis of biodiesel and related analytes, but the accuracy of these methods is questionable.

**Assessment Protocol**
The goal of this project was to assess and evaluate the effectiveness of each instrument in the qualitative and quantitative determination of biodiesel, methanol, glycerol and fatty acid glyceryl esters. This assessment was based on a six point rubric that covers the difficulty, cost, speed, accuracy, precision, and versatility of the instrumental method.

**Difficulty** considers the challenge involved with learning the instrument and procedure, analysis preparations, running the instrument, and evaluating the results. **Cost** is concerned with the expenses needed for any chemical reagents and expendable supplies, instrument maintenance, and upgrades needed for the instrument. This attribute does NOT include the cost of purchasing the instrument. **Speed** refers to the time required for sample preparation, analysis, and evaluation of the results. **Accuracy** considers the detection limitations, signal to noise ratio, and possible interference involved in the analysis, as well as any means to verify the accuracy. **Precision** looks for reproducible results and maintenance of consistency. **Versatility** is concerned with the volume of data each instrument can provide and if the instrument can be used for multiple purposes or just one.

The six point rubric was applied to each instrument by grading each attribute on a 5 point scale that considered how much and often the attribute is displayed:

5: The particular attribute is positive at all times by the instrument.
4: The particular attribute is mostly positive at all times or fully positive at most times.
3: The particular attribute is half positive at all times or fully positive half of the time.
2: The particular attribute is slightly positive at all times or fully positive few times.
1: The particular attribute is always negative at all times.

**Methods**

**Fourier Transform Infrared Spectrometer (FTIR).** Samples of biodiesel were examined using the PerkinElmer Spectrum 2 Infrared Spectrometer along with the Spectrum Touch interface software. This software includes a guided procedure based off the European biodiesel standard procedure, EN14078 meant for biodiesel blend analysis. It utilizes a calibration curve to quantify the percent by volume of biodiesel using Beer’s law. The software walks the user through the procedure and the Spectrum QUANT analysis software quickly computes calibration and experimental data.

Preparation involved making calibration standards of pure biodiesel using 1, 3, 5, 7 and 9% by volume samples in hexane solvent. Two samples of synthetic biodiesel were prepared at 4% by volume to assess the accuracy of the calibration curve. The FTIR was prepared for analysis by installing the flow cell apparatus with a 1 mm path length. The Spectrum software was used to calibrate the exact path length for highest accuracy.

Using the FTIR and TouchSoft EN14078B procedures, the calibration standards were scanned with the EN14078B calibration method, and the experimental samples were scanned with the nonstandard method. The data produced was saved and analyzed using the Spectrum QUANT program. The analysis software configured the FTIR to use the ester carbonyl absorbance band at 1720 cm\(^{-1}\), and built a calibration curve with the biodiesel reference data. Using the completed calibration curve, biodiesel experimental samples were evaluated with the
same program to determine the concentration of diluted test samples, as compared to the actual concentration.

**Nuclear Magnetic Resonance (NMR).** The biodiesel samples for NMR quantification were prepared in triplicate using maleic acid as an internal reference standard and an equal molar amount of biodiesel analyte (16.87 mmol). When making stock solutions, the mass needed for biodiesel was calculated using the methyl ester of oleic acid as a model compound with molecular weight of 296.5 g/mol. The biodiesel stock solution was diluted with deuterated acetone solvent, and the maleic acid stock solution diluted in DMSO solvent. These stock solutions were used to create the NMR samples by mixing them with deuterated acetone (and TMS if needed) into a standard 5mm NMR tube.

After collecting an H-NMR spectrum and setting the TMS reference signal to 0.0 ppm, the signal for the maleic acid vinyl protons at 6.3 ppm were integrated to a value of 2H. The biodiesel methyl ester peak was observed at 3.7 ppm, and the validation methylene peak at 2.3 ppm. The biodiesel percent yield was calculated using Equation 1, where \( x \) is the integration signal for the methyl ester group, and \( y \) is the value of the maleic acid vinyl proton integration signal.\(^5\)

\[
\text{Eq 1: } \% \text{ yield} = \left( \frac{2(x)}{3(y)} \right) \times 100
\]

The resulting value is the percent yield of biodiesel found in the formula in relation to how much was expected, represented by the maleic acid signal. To validate the results, Equation 2 was used to calculate the validation percent yield, where \( z \) is the methylene peak integration signal and \( y \) represents maleic acid.\(^5\)

\[
\text{Eq 2: } \text{validation \% yield} = \left( \frac{z}{y} \right) \times 100
\]

The percent yield validates the experiment if it is nearly identical to the previous percent yield. Major deviations from the yield may indicate poor sample preparation, a bad scan, or poor integration.

**Gas Chromatograph/FID Detector (GC-FID).** The PerkinElmer GC-FID Clarus 580 was prepared with a 15 meter fused silica capillary column with an internal diameter of 0.32 mm, and a 0.1 mm film thickness of 5% phenylpolydimethylsiloxane bonded and cross linked phase internal coating. The column also included a 2 meter guard column with 0.53 mm internal diameter.

For the preliminary assessment, one standard was prepared using commercial stock solutions (each in pyridine solvent): 500,000 ppm glycerin (100 uL); 5,000,000 ppm monoolein (200 uL), diolein (100 uL), and triolein (100 uL); 1,000,000 ppm butanetriol (100 uL); and 8,000,000 ppm tricaprin (100 uL). The standard solution mixture was derivatized by adding 100 ml of N-Methyl-N-trimethylsilyltrifluoroacetamide (MSTFA), shaken, and left to stand at room temperature for 15-20 minutes. The sample was diluted with 8 ml of heptane and the vial shaken to mix the contents.\(^6\)

The solution was then transferred to a glass GC vial, which was sealed with a TFE-fluorocarbon-lined cap. These solutions were placed in the GC-FID auto injector tray and a chromatogram of each sample was obtained using the programmed instrumental method recommended in the ASTM procedure, displayed in Table 1.\(^6\) The only modification made to this method was to the injection technique. Without any programmable temperature setting for the injector inlet, the inlet was kept at 50°C throughout the method.

| Table 1. Detailed Procedure for the GC Instrument Settings Used During the Analysis |
|-----------------------------------------------|-----------------|
| **Injector**                                | Cool on Column  |
|                                               | 50°C            |
| **Sample Size**                              | 1uL             |
| **Column Temperature Program**                |                 |
| **Initial Temperature**                       | 50°C (hold 1 min) |
| **Rate 1**                                   | 15°C per min to 180°C |
| **Rate 2**                                   | 7°C per min to 230°C |
| **Rate 3**                                   | 30°C per min to 380°C (hold 10 min) |
| **Detector**                                 | Flame Ionization Detector |
| **Temperature**                              | 380°C           |
| **Carrier Gas**                              | Helium          |
| **Flow Rate**                                | 3 mL/min        |

**Preliminary Assessment: Results and Discussion**

The scores for this preliminary assessment are as shown in Table 2, where the FTIR displays moderate efficiency and the NMR near perfect efficiency. The GC was determined to be difficult and expensive to operate, and requires more work before any other grades can be assigned.
Fourier Transform Infrared Spectrometer (FTIR). In reviewing the performance of the FTIR during biodiesel analysis, we found success in the areas of difficulty, speed, and precision; moderate success with cost and versatility; and failure with accuracy. Looking first at difficulty, the FTIR was an easy instrument to use due to a heavily guided procedure allowing for a short learning curve. With the procedure prompt walking the user through the experiment, and a comprehensive manual, the experimenter will have no problem with setup of the instrument apparatus or mastering its proper use. The manual also acts as a concise guide for using the Spectrum QUANT software, which makes the construction of a calibration curve and quantification of the experimental data an easy process. Considering all of these findings this instrument scores a 5 for difficulty.

Considering speed, the analysis is fairly quick, ranging between 20 minutes and 2 hours. The procedure time runs longer if a calibration curve needs to be produced, where most of the time is spent preparing and analyzing each calibration standard. With a curve in place the procedure is no more than 20 minutes and 2 hours. The procedure time runs longer if a calibration curve needs to be produced, where most of the time is spent preparing and analyzing each calibration standard. For an analysis where most of the time is spent performing dilutions, the FTIR scores a 5 for procedure speed.

The cost for this procedure is both positive and negative for this instrument. Apart from the actual cost of the analysis kit and software, maintaining the instrument with analytical reagents to build a good calibration curve, glass syringes for injections, and analytical solvents all can add up to become expensive. But if the calibration curve is already in place and there are syringes available, all that is needed are the solvents to dilute the biodiesel and rinse the flow cell between injections. However, if the flow cell is damaged its replacement cost would be very expensive. As a result the FTIR scores a 3 for cost, since most of the cost is usually spent replacing solvents, but this cost can climb if calibration reagents or kit maintenance is needed.

When considering accuracy, the FTIR was unreliable at assessing the purity of synthesized biodiesel samples due to contaminants interfering with the results. The biodiesel methyl esters and bound glycerin contaminates all have a carbonyl functional group that adds to the signal produced at the analysis frequency of 1720 cm⁻¹. This interference makes obtaining an accurate concentration of biodiesel difficult. This is not surprising because this FTIR method was designed to measure the concentration of pure biodiesel blended with petroleum diesel. As a result, the FTIR scores a 1 for analyzing lab-synthesized biodiesel samples, making this instrument very unreliable for quantification of biodiesel purity under these conditions.

The FTIR maintains a moderate amount of versatility for biodiesel analysis. The kit was designed for analyzing biodiesel blended with petroleum diesel, using the 1720 cm⁻¹ ester carbonyl absorbance band. This will come in handy for quality control analysis if there is ever a need to blend our biodiesel with petroleum diesel. Since this procedure is very simple, it may be useful as an educational tool to teach about basic quantitative analysis. The FTIR can also be used for qualitative analysis in the determination of unique functional groups from contaminating species that may exist in the sample. However, there is an issue concerning contaminant interference at the analysis frequency of 1720 cm⁻¹, making the instrument unreliable for quantitative analysis of biodiesel for % yield determination. Furthermore, the analysis procedure cannot focus on any absorbance band other than 1720 cm⁻¹, making quantification of any contaminant impossible. With all of this under consideration, the FTIR receives a 3 for versatility.

| Table 2. Assessment of Each Instrument with Respect to the Six Attributes Graded on a 5 Point Scale (5 = Positive...1 = Negative) |
|---|---|---|
| Difficulty | IR | NMR | GC |
| Speed | 4 | 5 | - |
| Cost | 3 | 5 | 1 |
| Accuracy | 1 | 5 | - |
| Precision | 5 | 5 | - |
| Versatility | 3 | 5 | - |

Nuclear Magnetic Resonance Spectrometer (NMR). The NMR seems to display high success with the areas of difficulty, speed, cost, accuracy, precision, and versatility. The learning curve to use the NMR to assess biodiesel purity is minimal. Essentially, the user needs to only understand how to prep the sample, load it into the instrument, set up and run the analysis, and know which signals need to be integrated on the spectrum.
for calculation. With such a high level of simplicity, the NMR scores a 5.

In terms of speed, NMR analysis is rapid. Preparing the sample might take 5 to 10 minutes, each H-NMR scan takes about 10 minutes to complete, and interpreting the results might take 5 minutes. Without the need to run standards for a calibration curve, the experimental time is cut down drastically. Running one sample took about 25 minutes, but this time increases with more scans and samples. As a result, the NMR receives a 5 for speed.

Assuming that an NMR is already available, the cost of using this instrument is very minimal. Purchasing solvents, an internal reference standard, and NMR tubes is the only upkeep needed for this instrument, landing a solid 5 for cost.

Considering accuracy and precision, this instrument is able to very accurately determine the amount of biodiesel in a sample, and precisely reproduce the results. The procedure utilizes an internal quantitative reference standard, which allows the user to determine the amount of biodiesel in a sample with high accuracy. Multiple samples gave near identical results, vouching for the precision of the instrument. The only possible negative aspect is that the limit of detection may not allow the NMR to be accurate enough for quantifying low concentrations of contaminating species in a sample. Both of these aspects receive a 5 as a result of excellent performance.

The NMR shows a high amount of versatility in analyzing biodiesel. This method can very accurately quantify the amount of biodiesel in a sample using an internal reference standard. The NMR can also be used for qualitative analysis, providing information related to the structure of the biodiesel molecule, and about contaminating species as well. It is possible that NMR might be sensitive enough to quantify contaminating species, but more work is needed to assess this. With the ability to detect and identify a number of analytes, the NMR receives a 5 for versatility.

**Gas Chromatograph/FID Detector (GC-FID).** While there is enough preliminary information to provide an evaluation of the cost aspect of the assessment for this instrument, there is not enough data to evaluate any of the other attributes. Beginning with difficulty, the GC-FID has a steep learning curve due to the complex nature of this instrument. Furthermore, in order to follow the certified biodiesel analysis procedure the experimenter must become very adept with the numerous facets involved with the instrument. It takes a while to learn the variety of software tools related to the instrument, and even longer to know how to maintain the hardware. Once the complexities involved with the instrument are grasped, the difficulties faced with instrument use and maintenance become easier to handle. Troubleshooting issues with the experiment operation are complicated, and could range from temperature programming to issues with the hardware, where the only means to address these issues is through trial and error. In some cases, a specialist may be needed to solve certain problems that are too complicated to fix alone. There is still much more that needs to be done with this instrument for biodiesel analysis before a final assessment can be given.

The operating cost of the GC is high compared to other instruments for biodiesel analysis. The column specific for the procedure costs $380, chemical reagents cost about $300, and the parts needed to install the column to the GC costs another $100. This instrument needs a lot of cost investment for biodiesel analysis that require specific parts and reagents. Since it is so expensive to prepare the GC for the procedure, and to purchase reagents, a score of 1 was assigned to the cost.

Regarding the accuracy and precision, much more data is needed before any grade or assessment can be made. Nonetheless, these aspects are projected to score high, and make all the difficulty and cost worth the trouble, as the GC is typically an accurate and precise instrument in normal circumstances.

**Conclusions**

*Fourier Transform Infrared Spectrometer (FTIR).* Due to its poor accuracy with biodiesel analysis, the FTIR is not useful for analyzing experimental samples of biodiesel for purity from contamination. However, it can play an effective role with qualitative analysis for contamination without using the kit, by looking for functional groups unique to contaminants found in biodiesel samples. It also will play an effective role with the quality assurance of biodiesel blended with petroleum diesel when that stage of research is reached. This method can also be used for educational purposes in BSU chemistry classes, where students can learn about the FTIR by using the kit to analyze samples of blended biodiesel fuel purchased from local gas stations.

**Nuclear Magnetic Resonance Spectrometer (NMR).** The NMR plays a vital role in biodiesel analysis, by providing very effective and efficient qualitative and quantitative analysis. This instrument is simple, cost effective, rapid, accurate, precise, and versatile, providing a large amount of sample information.

**Gas Chromatograph (GC).** This evaluation is still ongoing, but it is clear that this instrument is difficult to learn and operate.
Future Work
In moving forward with this project we need to continue our evaluation of the GC-FID by optimizing the method, including minimizing oven temperature to limit degradation of the GC column. More work will be done with the FTIR and NMR to quantify accuracy and precision. If time permits, I will also conduct research evaluating the use of atomic absorbance spectrometry and high performance liquid chromatography in biodiesel analysis.

Acknowledgements
I would like to extend my gratitude to Dr. Edward Brush for mentoring me through this project, and to Dr. Stephen Waratuke and Jeff Monroe for teaching me everything I needed to know to get started with the gas chromatograph. I would also like to thank the BSU Chemistry Department for providing me with resources and assistance. I also thank the BSU Adrian Tinsley Program and Center for Sustainability for funding my research and making this opportunity possible.

References Cited
Applying Green Chemistry Principles in the Electrophilic Bromination of Indole-3-Acetic Acid

Kyle Murphy

The goals of green chemistry are to reduce or eliminate the use of hazardous reagents, prevent the synthesis of toxic products and byproducts, and improve the overall efficiency of chemical reactions. Green chemistry is incredibly important today as chemical products are produced and used around the world, resulting in the use and generation of hazardous chemicals, and unintended consequences to human health and the environment. Figure 1 shows the 12 Principles of Green Chemistry, developed by Paul Anastas and John Warner, which provide the framework for a sustainable future in the design of more efficient technologies to produce consumer products that are better, safer and cheaper. As the research in our group is focused on improving the efficiency of chemical reactions, Principles 1, 2, 3, 5 and 8 were applied to this project.

3-Bromooxindole-3-acetic acid (BOAA) is an important intermediate in our group’s work on the design and synthesis of small-molecule mechanism-based enzyme inhibitors. Also referred to as “suicide substrates,” this unique class of inhibitors that initially unreactive molecules are disguised to “trick” enzymes into acting on them as normal substrates. Once chemically activated the inhibitor molecule then rapidly, specifically and irreversibly attacks and shuts down the target enzyme. As shown in Figure 2, BOAA is readily transformed into a variety of oxindole derivatives that have the ability to inhibit anticancer therapeutic target enzymes such as glyoxalases I&II and the cysteine proteases.

The traditional method to synthesize BOAA from indole-3-acetic acid (IAA) is illustrated in Figure 3 where N-bromosuccinimide (NBS) serves as brominating agent and tert-butanol acts as both solvent and reactant, providing the C-2 oxindole oxygen. We have found major complications with this synthesis, including the use and generation of hazardous chemicals, poor atom economy (30%), and low percent yield (25%). NBS is a major source of the waste byproducts that include succinimide, and hydrobromic acid (HBr), which is a strong acid (see box in Figure 3). Note that of the 24 atoms in two mole equivalents of NBS, only one bromine atom is incorporated in the final BOAA product, contributing to the low atom economy. Based on previous studies, we suspected that the low percent yield was primarily due to poor regioselectivity in the bromination of IAA, resulting in the formation of isomeric brominated products. It has been reported that the selectivity...
of NBS-mediated brominations can be controlled with amides and amidines that act as Lewis base catalysts by either facilitating the regioselective transfer of bromine from NBS to the acceptor, or stabilizing the bromonium ion intermediate.5-8

The goal of this research project was to obtain a better understanding of the overall BOAA synthetic process and apply the Principles of Green Chemistry to improve reaction efficiency. Utilizing 1H NMR we have identified four major products from IAA bromination, determined that the reaction process occurs in two discrete steps, and obtained key mechanistic insight that will help us improve on the overall efficiency of this reaction.

Figure 1. The Twelve Principles of Green Chemistry

1. **Prevention**
   It is better to prevent waste than to treat or clean up waste after it has been created.

2. **Atom Economy**
   Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.

3. **Less Hazardous Chemical Syntheses**
   Wherever practicable, synthetic methods should be designed to use and generate substances that process little or no toxicity to human health and the environment.

4. **Designing Safer Chemicals**
   Chemical products should be designed to affect their desired function while minimizing their toxicity.

5. **Safer Solvents and Auxiliaries**
   The use of auxiliary substances (e.g., solvents, separation agents, etc.) should be made unnecessary wherever possible and innocuous when used.

6. **Design for Energy Efficiency**
   Energy requirements of chemical processes should be recognized for their environmental and economic impacts and should be minimized. If possible, synthetic methods should be conducted at ambient temperature and pressure.

7. **Use of Renewable Feedstocks**
   A raw material of feedstock should be renewable rather than depleting whenever technically and economically practicable.

8. **Reduce Derivates**
   Unnecessary derivatization (use of blocking groups, protection/deprotection, temporary modification of physical/chemical processes) should be minimized or avoided if possible, because such steps require additional reagents and can generate waste.

9. **Catalysis**
   Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.

10. **Design for Degradation**
    Chemical products should be designed so that at the end of their function they break down into innocuous degradation products and do not persist in the environment.

11. **Real-time Analysis for Pollution Prevention**
    Analytical methodologies need to be further developed to allow for real-time, inprocess monitoring and control prior to the formation of hazardous substances.

12. **Inherently Safer Chemistry for Accident Prevention**
    Substances and the form of a substance used in a chemical process should be chosen to minimize the potential for chemical accidents, including releases, explosions, and fires.
**Experimental**

All reagents were purchased from Sigma-Aldrich or Fisher Scientific and used without further purification. Tert-butanol was stored over 3Å molecular sieves. Nuclear Magnetic Resonance (NMR) spectra were obtained on a JEOL ECX-400 MHz instrument.

Evaluating different reaction parameters for the synthesis of BOAA would require substantial amounts of solvent and reagents, produce liters of hazardous waste, and an entire day would be needed to run and analyze a single reaction. To optimize our “green chemistry” approach, we developed a quick, reproducible and efficient reaction screening method that required milliliters of solvent, milligrams of reagents, and minimized waste. The screening method used quantitative NMR (qNMR) to determine % yield and recovery. In qNMR the quantity of a particular analyte could be determined by comparing the integrated value of an analyte signal of known number of H’s to the integrated value of the vinyl protons (2H, 6.33 ppm) of the maleic acid internal NMR reference standard.

The standard screening reaction used 200 µL of a 0.174 M solution of IAA in tert-butanol (6.11 mg, 34.9 µmole) added to a 10 mL reaction vial with an additional 800 µL of tert-butanol. The solution was stirred at room temperature and the reaction was initiated by the addition of two mole equivalents (12.4 mg, 69.8 µmole) of NBS. After stirring for an additional 10 minutes, the reaction mixture was concentrated by evaporation of tert-butanol solvent on a high-vac followed by suspension of the residue in diethyl ether. The succinimide precipitate was removed by filtration into a 10 mL round bottom flask and the diethyl ether evaporated under reduced pressure. Acetone-d$_6$ containing 0.05% TMS (1.0 mL) was added to dissolve the residue, then 2.00 mg (0.0172 mol) of maleic acid dissolved in 25 µL of dimethylsulfoxide-d$_6$ was added as the internal qNMR reference standard. This screening method allowed us to run and analyze up to five reactions per day. We employed this screening method to survey a variety of Lewis base and acid catalysts for improving the overall efficiency of BOAA synthesis.

**Results and Discussion**

The $^1$H-NMR spectrum of the residue obtained from the traditional reaction mixture with two equivalents of NBS, is shown in Figure 4. By focusing exclusively on signals in the aromatic region between 6.5 and 8 ppm, we were able to identify four major IAA bromination products as shown in Figure 5.

We propose that the bromination of IAA with two equivalents of NBS occurs in two reaction steps as shown in Figure 6. In Reaction #1 the initial mole equivalent of electrophilic bromine (NBS) adds rapidly (within seconds) to the C-2,3 double bond (possibly with assistance from N-1 of IAA), followed by addition of tert-butanol to C-2. Subsequent elimination steps (mechanism not shown) produce oxindole-3-acetic acid (OAA). We also observe 5-bromo-OAA most likely from the addition of a second equivalent of bromine to C-5 of OAA (consistent with literature precedent). Reaction #2 is slow addition of the second mole equivalent of NBS to C-3, producing BOAA and 5-bromo-BOAA. Our proposal is consistent
with the observation of C-3 and C-5 brominated products from indoles.\textsuperscript{3,4,11} The C-3 position of indoles is known to undergo bromination very rapidly, while C-5 bromination was based on the known activating effects of the N-1 nitrogen (C-7 brominated product was not observed). These original studies employed indirect methods for product analysis based on chemical transformation to known compounds, followed by melting point determination. Our work is the first to conclusively identify the IAA bromination products using $^1$H NMR analysis.

To test the two-step reaction scheme proposed in Figure 6, we ran the traditional BOAA synthesis from IAA by adding NBS in two separate steps. The results of these reactions (data not shown) clearly show that addition of one mole equivalent of NBS produces OAA and 5-bromo-OAA. Subsequent addition of a second NBS mole equivalent gives the typical product distribution shown in Figure 5.

Our preliminary data suggested that addition of the first equivalent of electrophilic bromine to IAA was critical for the efficient production of brominated product. As shown in Step 1 in Figure 6, multiple oxindole byproducts are produced and that this poor regioselectivity was ultimately responsible for the poor overall efficiency of this reaction. Our ability to successfully run the BOAA synthesis as two separate reactions (Figure 6) allowed us to examine the effect of changing reaction parameters on the overall reaction efficiency. We conducted preliminary experiments to examine the effect of amides and amidines as Lewis base catalysts in controlling the selectivity of NBS-mediated IAA bromination. Furthermore, we suspected that the HBr generated during the course of Reaction #1 (Figure 6) catalyzes C-3 halogenation of OAA through an enol intermediate. The effect of using various Lewis base and acid catalysts on the overall synthesis is shown in Table 1.

### Table 1. \% Composition of Oxindole Products as a Function of Reaction Conditions

<table>
<thead>
<tr>
<th>Compound</th>
<th>NMR Signal (ppm)/#Protons</th>
<th>% Composition of oxindole products as a function of reaction conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maleic Acid</td>
<td>6.33(2)</td>
<td>-</td>
</tr>
<tr>
<td>BOAA</td>
<td>7.52(1)</td>
<td>47.5% 46.8% 42.9% trace</td>
</tr>
<tr>
<td>OAA</td>
<td>7.18(1)</td>
<td>27.8% 34.4% 45.8% 71.8%</td>
</tr>
<tr>
<td>5-Br-OAA</td>
<td>7.48(1)</td>
<td>6.1% 2.8% 3.1% trace</td>
</tr>
<tr>
<td>5-Br-BOAA</td>
<td>7.77(1)</td>
<td>18.1% 15.8% 7.8% trace</td>
</tr>
</tbody>
</table>

When dimethylformamide (DMF) was added to Reaction #1 there was modest improvement in the regioselectivity by promoting BOAA production as compared to the oxindole by-products. Similar results were obtained when acetic acid was added to Reaction #2, consistent with acid catalyzed halogenation. Furthermore, addition of triethylamine inhibited production of BOAA and other oxindole byproducts, possibly by neutralizing any HBr produced in Reaction #1.

### Conclusions and Future Work

We have applied Green Chemistry principles and NMR analysis to better understand the synthetic reactions in the preparation of BOAA from IAA. We have identified four oxindole products from this reaction and determined that IAA bromination occurs in two discrete steps. These preliminary results have provided key mechanistic insight that will help us improve the low yield and overall efficiency of this reaction. We are currently evaluating additional Lewis base catalysts to improve the regioselectivity in Reaction #1, and the effect of acid catalysts for Reaction #2. We are also very interested in developing an efficient gram-scale synthesis of oxindole-3-acetic acid (OAA) in Reaction #1, as this compound has recently been identified in the regulation of auxin homeostasis and response mechanisms in plants\textsuperscript{12}, suggesting that OAA may play a role in controlling plant growth and regulation.

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References


Melissa Oquendo is a senior majoring in Sociology. Her research on the languages of Cape Verde began during the winter of her junior year when she traveled to Cape Verde as a part of the Language Study Tour with Dr. Fernanda Ferreira (Foreign Languages) and six other students. Melissa researched the sociolinguistic situation of Cape Verde to gain perspective on Cape Verdean cultural identity. Melissa’s passion for both language and identity is what drives her journey in learning languages and exploring, cultivating, and understanding her own cultural identity. Thus far, Melissa has learned to speak Spanish, and read Portuguese; and she has a fair understanding of Cape Verdean Creole.

Cape Verde is a West African country located in the Atlantic Ocean, off the coast of Senegal. The archipelago is composed of 10 islands, 9 of which are populated (Santo Antão, São Vicente, São Nicolau, Sal, Boa Vista, Maio, Santiago, Fogo, and Brava). Santa Luzia is the only uninhabited island. Cape Verde was colonized by the Portuguese and therefore includes a rich mix of Portuguese and African cultures. Because today’s Cape Verdians are descendants of both the Portuguese and West Africans, there are elements of both in their languages, traditions, history, and development as a nation. These Portuguese and West African influences are seen on a daily basis in Cape Verdians’ choice of languages. This paper focuses on the linguistic situation of Cape Verde, where two closely related languages or dialects are used by the same linguistic community. This particular linguistic situation is called diglossia, a term coined by Ferguson in 1959. Later, Bright (1964), Fishman (1967) and Gigloli (1972) elaborated on what sociolinguists mean by the term, explaining that a diglossic situation occurs where there are strong differences in form and function between the formal and informal styles of a language. In the case of Cape Verde, the diglossic situation includes Portuguese, the official language, and Cape Verdean Creole (or Kriolu, as expressed by its speakers), which is the “national language,” also known to Cape Verdians as “the language of the heart” or the “mother tongue.” These languages exist side by side in the community, each playing a linguistic role in the way Cape Verdian society functions and reflecting Cape Verdians’ cultural identity. The official language of Portuguese is used by the government and taught in schools. The national language of Cape Verdean Creole is the language used informally by the community (Ardilo & Ramos, 2007).

Like many other diglossic and bilingual communities, Cape Verde has a language that unifies them (Kriolu) as well a language that connects them to people in other parts of the world (Portuguese). Kriolu does not have the same high regard as Portuguese. “The superposed variety [in this case, Portuguese] is referred to as ‘High’ or simply H, and the other variety or varieties [Kriolu] as Low, or L. The most important stamp of diglossia is the functional specialization of H and L. In one set of situations, only H is appropriate, while in another, only L is” (Romaine 1989, p. 31).
As in other language contact situations, the colonial language is referred to as the “lexifier.” In the case of Cape Verde, Portuguese is the colonial language which gives the vocabulary or lexical items to the restructured creole. To be sure, Kriolu is a Portuguese-based creole. According to the article “The Creole Language” (2010), “Cape Verdean Creole consists of 90 percent from the old Portuguese. The rest is borrowed from the African, French, English, and other European languages—all of those languages whose people influenced the island’s history and past.” The Portuguese word for “creole” is crioulo, which derives from the verb criar (“to raise or to bring up”), and Cape Verdeans make that word their own as Kriolu.

Kriolu is used among family, friends, and in informal situations, such as at the market, connecting people as a community and helping them establish their collective identity of Portuguese colonization and African roots. Kriolu is the language of choice in Cape Verde, but everyone comprehends Portuguese. In addition to legal and government situations, Portuguese is used in schools, hotels, banks, and many other workplaces, as well as on television. It is also the language of navigation and development. According to the CIA World Factbook, 84.3 percent of the population can read and write in Portuguese as well as speak Kriolu. The only people in Cape Verde who do not comprehend Portuguese are those who did not attend school or who stopped going to school. Today, most Cape Verdeans can fully comprehend Portuguese; it is the older generation that lacks some literacy. Cape Verdeans have to use both languages on a daily basis; they speak in Kriolu but read signs in Portuguese. They must consistently select the language according to the context.

Today, there is some resistance towards Portuguese as the only official language of Cape Verde because both Portuguese and Kriolu are consistently used. Some Cape Verdeans living there and abroad believe that Kriolu should be recognized officially. Kriolu has historically been viewed as an inferior language, especially during the colonial era. In the article “Cape Verdean Creole in the United States,” it is stated that “after the slave trade ended, Portuguese remained the language of empire, the official language of the state institutions of justice, education, taxation, and defense. In colonial culture, using Kriolu was a mark of ‘social inferiority’” (Gonçalves, n.d.). Gonçalves explains that among workers and intellectuals, especially, there was an element of resistance towards Portuguese colonialism. Although Cape Verdeans accept the Portuguese language as a major part of their culture, many feel that Kriolu needs to be accepted on the same level as Portuguese. They believe that Kriolu retains the culture of the community and creates a unified bond among Cape Verdeans—something that needs to be preserved.

The Kriolu language is one of the elements that keep Cape Verdeans connected to each other throughout the world. There are about 500,000 Cape Verdeans living in Cape Verde and over a million outside of Cape Verde. Most traditional Cape Verdean music has Kriolu lyrics, often focusing on missing the motherland and being away from those they love. There are many generations of Cape Verdeans abroad who have learned how to speak Kriolu because their parents wanted to pass down their native language. This is observed here in the United States where there are several Cape Verdean Student Associations created by second-generation Cape Verdean Americans who keep the culture alive, especially through traditional music and dance. Even though Portuguese is the language of education, Kriolu is what is used to keep the culture alive anywhere there are Cape Verdeans. Cape Verdeans clearly take pride in speaking Kriolu; they make it known to the world that speaking their Kriolu is not inferior to Portuguese. For most Cape Verdeans with whom I have interacted, Kriolu is the language that best represents them; it is closer to their cultural essence.

While Kriolu remains alive in the Cape Verdean culture, no one can deny the benefits of having Portuguese as an official language in Cape Verde. For instance, Portuguese has a unifying effect for Cape Verdeans among all nine islands. That is because some dialects of Kriolu are not mutually intelligible. When communicating with people on another island, Cape Verdeans use Portuguese. Furthermore, Cape Verde is able to maintain a partnership with seven other countries whose official language is Portuguese: Angola, Brazil, Guinea-Bissau, Mozambique, São Tomé e Príncipe, and East Timor, as well as Portugal. Together, these countries form the Community of Portuguese Speaking Countries, known by its Portuguese acronym CPLP. According to UNESCO, the objective of CPLP is “cooperation in all matters, including education, health, science and technology, defense, agriculture, public administration, communication, justice, public security, culture sports and social communication.” Cape Verde is part of this community supported by UNESCO not just because Portuguese is Cape Verde’s official language, but also because Cape Verdeans identify with other Africans who are descendants of Portuguese colonizers.

If Kriolu were the official language of Cape Verde, the population would not benefit from the advantages of being part of the world-wide CPLP. Being in the CPLP community allows Cape Verde to develop in many different areas as a country, and allows the people of Cape Verde to maintain productive relationships with countries worldwide and getting help when needed in many different projects related to social development. For example, many Cape Verdean high school graduates receive scholarships to go to college in Brazil and Portugal, due to
the excellent relationship between these countries. By already speaking Portuguese, Cape Verdeans are able to easily adapt and excel overseas. Because Cape Verde lacks natural resources, its major resource is its people who, by succeeding abroad, are able to contribute to the overall development of Cape Verde.

Portuguese is also important because the education system implemented in Cape Verde was based on the Portuguese educational system which allows Cape Verdeans to be at the same literacy level as students in many developed countries around the world. Cape Verdean culture is founded on such linguistic and cultural flexibility that, while Kriolu maintains their national identity, Portuguese is their gateway to global opportunity.

Most people of Cape Verdean descent become not just bilingual, but multilingual. This is greatly due to the fact that most Cape Verdeans immigrate to Europe, the Americas, or Asia. Not only do they speak Kriolu and Portuguese, but they also learn a third language. This is less challenging to do, just for the mere fact that they are brought up already speaking two languages (Poplack, 1980). They are constantly switching between languages, a practice that provides them with neurological benefits. It is contended that both young and old will have benefits in brain health and attention. In the article “Being Bilingual: Beneficial Workout for the Brain,” Wheeler explains, “for aging subjects, learning more than one language builds their ‘cognitive reserves,’ the capacity that helps adults maintain their mental skills as the brain deteriorates. And babies exposed to multiple languages do not get confused, but quickly learn to distinguish between languages and build a stronger ‘perceptual vigilance’.” (Wheeler, 2011, Benefits of Linguistic Conflict, para.3). This suggests that there are benefits to using more than one language on a regular basis which Cape Verdeans have to do. In other words, Cape Verdeans have significant benefits from being multilingual, not just because of the global connections, but also because of physical reasons.

Recently there has been a lot of discussion about standardizing Kriolu and even making it the official language of Cape Verde. Standardizing Kriolu poses several potential problems. Even though Kriolu is considered one language, there are different dialects on each island. There are common words that enable Cape Verdeans on different islands to speak with each other; however, there are also many differences. Each island has its individual pride and would not necessarily agree to another Kriolu dialect designated the official language for the country. Some dialects have more African influence while others have more Portuguese structures. The type of influence from island to island is in direct correlation to geographic location. The *barlavento* islands tend to identify more with Portuguese colonizers. *Barlavento* is a Portuguese word meaning “windward.”

The *sotavento* islands are closer in cultural affinity to Africa. *Sotavento* is the Portuguese word for “leeward.”

Standardizing one dialect of Kriolu as an official language of Cape Verde would cause cultural identity conflicts among people who speak other dialects. In my conversations with Cape Verdeans from the islands of Brava, Santiago, Fogo and São Vicente, they relate a sense of defeat when imagining one single dialect across the islands. According to “The Creole Language” (2010), a lot of English is heard in the Kriolu of São Vicente, and the Kriolu of Santo Antão sounds more like French. These two islands are right next to one another, yet their dialects of Kriolu differ a lot. Differences increase between islands that are further apart. The diversity of dialects among islands is so vast that Cape Verdeans traveling between islands often resort to Portuguese in order to communicate with other inhabitants. In that sense, Portuguese as the official language contributes to the unity of the country, while the different dialects of Kriolu contribute to pride in national identity.

Cape Verdeans also express linguistic pride in speaking Portuguese because it is a European language with similarities to other Romance languages such as French and Spanish. With that strong foundation in Portuguese, Cape Verdeans are able to grasp other world languages which are beneficial to them. The current diglossic situation allows Cape Verdeans to flourish and does not create confusion about cultural identity. That is, they are both proud of speaking their dialect of Kriolu and of speaking a Romance language. Being Cape Verdean means coexisting with all these variations of language and culture.

The diversity of dialects of Kriolu and its coexistence with Portuguese fortifies Cape Verde’s layers of identity. Although each island has its own version of what it means to be Cape Verdean, the people of each island embrace the others knowing there would not be a Cape Verde without one or the other. The country is also racially mixed. Ask a Cape Verdean if he is African or Portuguese and the answer will vary, but it will always come down to “I am Cape Verdean” (Costa, 2012). Almost any Cape Verdean family has African descendants as well as Portuguese descendants in their family tree. According to the CIA World Factbook, the population of Cape Verde is 71% Creole—or native-born Cape Verdean—and 28% African immigrants from continental Africa; about 1% of the population is made up of European immigrants. Cape Verde has a strong commitment to education, spending about 6% of its annual gross domestic product on education, which places Cape Verde at number 32 worldwide in the education expenditure category (CIA World Factbook).
Cape Verdean cultural identity is complex in its nature because of the African and Portuguese roots of Cape Verde. Its current diglossic system has enabled Cape Verde to further develop as a country. It has not only embraced all the different dialects of Kriolu but has also reaped benefits in having Portuguese as the official language. As individuals and a nation, Cape Verdeans are succeeding. They are globally integrated at the same time that they pride themselves in being Cape Verdean. Most people of Cape Verdean descent are also multilingual, speaking more than just Kriolu and Portuguese. They are often fluent in English, French, or even Chinese. The benefits of such a rich cultural identity are apparent in the layers of language, music, history, education, and development of Cape Verde.

References


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I grew up in New England. Mansfield, more specifically: a suburb of the Boston Metro area. My only sense of regionalism while I was growing up came from the knowledge that the leaves change with the seasons, and that the Pilgrims anchored themselves here four centuries ago. I don't know much about my genealogy except that my paternal grandfather came up from Illinois to marry Pattie Shea, so my name, at least, has traveled. But the other seventy-five percent of me, for all I do know, has been here forever. I am a New Englander. I've never been anything else.

According to Howard Odum and Harry Estill Moore, a region is “an area within which the combination of environmental and demographic factors have created homogeneity of economic and social structure” (Odum and Estill 2). In this vast American landscape, many people come to understand and sometimes define themselves within the context of their regional borders. Perhaps still reeling from Ellis Island shakeups or feeling insufficiently established within the “New World,” Americans seem particularly concerned with placing themselves, in proving that they belong somewhere.

In her essay, “Regional Studies in Folklore Scholarship,” Barbara Allen suggests that American cultural regionalism was determined by and formed around ethnic communities. In the early days of American settlement, when populations were still sparse, citizens were not so much concerned with regionalizing—until the Civil War, when they became, as Allen puts it, “keenly aware of sectional divisions between North and South” (Allen 4). Most of the folklore data collected soon after that period, though, indicates that regional boundaries began to form along the same lines as ethnic settlement. Allen concludes that, “much of the ostensibly regional folklore gathered during this period (1880s - 1940s) was actually collected from ethnic groups within particular regions, such as Pennsylvania Germans, southern blacks, and Hispanics in New Mexico...For all intents and purposes, regional culture in these works was ethnic in nature” (Allen 6). Modern inhabitants have maintained these early cultural perimeters, which have evolved into the regions they are today.

This is especially apparent in a region like New England, which retains the very name of its ethnic progenitor. In part, New England’s identity has always been rooted in the complicated history of the place. Nowadays,
town Plymouth is a peculiar cross-section of historical land-mark society and beachside tourist town. Some visitors recline outside the ice cream cafés that mark every block along Water Street on their way to and from gift shops displaying miniature Mayflower paperweights and Plymouth baby bibs. Others walk steadily between placards, headphones on, listening to ancient cassette tapes on the Pilgrim Path audio tour, which winds cautiously along the shore so as not to obstruct the deep blue ocean view. Or they hang, shoulders slumped, on the Plymouth Rock railings, staring absently out to sea. I wonder if anybody ever stands before that rock and considers what the shore was like before it became New England. In his writings, William Bradford describes the pilgrimage to the Americas as an opportunity to start anew in an uninhabited land. He and other settlers often referred to the indigenous people who were, by every right, inhabiting the land, as “barbarians”—more akin in their regard to animals than serious stakeholders of the land. If anything, the Pilgrims reasoned that it was their duty to tame and Christianize these people, as if religious freedom were an exclusive right of the white man.

For my part, as I stood upon the Plymouth Rock precipice, grateful for the intermittent sea-breeze that tempered the high noon sun, and though decrying these odious crimes, I had to acknowledge that my skin is white, my language is English, and I live on Massasoit’s land (in Mansfield, no less, and if that doesn’t scream “White Patriarchy,” then I don’t know what does). And I had to admit that I am entirely comfortable in this modern Western society, founded by the very ships that breached the shore and desecrated Native culture. So part of being a New Englander, I think, is owning that culpability, and recognizing that I have benefitted directly and exceptionally well from some less palatable truths of my heritage. True, this is part of the general history of anglicized America, and aren’t all privileged Americans equally liable? Maybe it’s something about being so close to the epicenter of it all, of being a part of the umpteenth wave of New England settlers. Other regions have their own baggage.

Still, there is something undeniable about feeling placed that provokes an individual to ally him- or herself loyally with a homeland. In his essay, “The Work the Landscape Calls Us To,” Michael Sowder writes about his itinerant childhood, during which he moved between twenty-one homes across the country. He writes, “I’ve been harried, like many, by a sense of never having had any home ground, a place to stay” (Sowder 43). Sometimes it is merely the desire to feel like we have a home, a point of reference by which we can measure what we know and who we know against everything we don’t. Our region, our landscape, is the somewhat narrow and very distinct spyglass through which all of our worldly perceptions are formed. It’s like a safety blanket, the way it incubates and isolates us, but it’s a necessary and profound one, inasmuch as we need a home, unless, like Sowder, we can rise above it, becoming: “cosmo-politan, not of any provincial locale” (Sowder 43). Those of use still tied to this provincial life have, in the most meaningful sense, our motherland, and like it or not we grow into it.

Our landscapes make us unique. No two people interact with their landscape in the same way, and not everybody is aware of how their landscape shapes them, but each person is incomplete without it. In The Pine Island Paradox, Kathleen Dean Moore crafts a metaphor from the tide, writing, “it is impossible to know where land ends and water begins...it is the same as the line that separates the human from the natural” (Moore, 10). Thus, on the cusp of a paralyzing disconnect between the people and their land, Place Writers endeavor to memorialize and revive their kindred landscape: to make us aware of the forces surrounding and influencing us.

Emily Dickinson—arguably the quintessential New England poet and notorious shut-in—was, by the very nature of her reclusion, bound to write only from her New England perspective. Her relationship with the New England landscape is evident in her “Poem 285.” Written from the point of view of a speaker reflecting on her habitat, and the role that it has played in forming her inherent biases, it reads:

_The Robin’s my Criterion for Tune—_
_Because I grow—where Robins do—_
_But were I Cuckoo born—_
_I’d swear by him—_ (1-4)

The robin, representative of all things indigenous to New England for Dickinson, serves as the standard against which she measures all else, because that is the only standard she understands. Had she been born anywhere else—like in the Cuckoo’s climate—her perspective would have been formed to abide rather by those norms. She lives by the seasons, as all of us must, writing:

_The Seasons flit—I’m taught—_
_Without the Snow’s Tableau_
_Winter, were lie—to me—_
_Because I see—New Englandly—_ (12-15)

She can only see “New Englandly.” Place necessarily shapes perspective. Of poem and place, Roger Sedarat, in his study of New England Landscape History in American Poetry, writes that, “the speaker’s perception of her environment, her ability to ‘see New Englandly,’ determines the nature of her voice” (Sedarat 2). By virtue of her homeland, she is limited to a distinctly New England perspective.
The leaves change with the seasons. That’s one thing that always defined New England for me. Lush summer ferns. Spring apple blooms. Bare and tantalizingly sinister winter branches. My favorite is the autumnal crunch underfoot, when chill mornings smell like engine fuel on the way to back-to-school, which for me—more than any budding spring—has been the season of fresh starts.

This whole provincial world changes with the seasons. In her “Poem 130,” Dickinson writes:

These are the days when Birds come back—
A very few, a Bird or two—
To take a backward look. (1-3)

It’s the winter’s end, when birds return from migration and those who love their song can rejoice at the onslaught of spring. While she relishes the return of summer, she cannot forget that winter, invariably, will come again—so she writes:

Oh fraud that cannot cheat the Bee—
Almost thy plausibility
Induces my belief (7-9)

It’s the same aching many New Englanders feel, knowing all too well the rhythms of the seasons, knowing the lovely weather and the birds will give way to the onslaught of bitter cold. It’s the natural order of things and one to which we have become accustomed.

The geese in my town have stopped migrating. Fulton Pond, just off of Main Street, has become stagnant and too polluted with goose shit and sewage for fishing anymore. Mosquitos come at dusk and picnicking families flee, tossing bread as they go to the fleets of waterfowl that wait along the shore. To geese that can hardly fly anymore because the locals have conditioned them out of instinct, so they grow big on yeast and never try to leave their pond, because isn’t this the life? Then winter comes and freezes them in place.

I know in my heart that this is home, but sometimes I wonder if man was meant to stay stuck in one place for so long. Isn’t the modern man descended from nomads? I think we rue the birds’ migration because we envy them. We’re stuck. I am a New Englander. I’ve never been anything else. That seems, at times, so banal.

East Mansfield, where I grew up, is a part of Bristol County cut out of the woods halfway between Boston and Providence. It’s the 8th stop on the Stoughton Line. Residents learn to take a detour around Chauncy Street after six if they want to dodge station traffic. Main Street has potential, but the Main Street businesses always fail. Pizza place income is steady, and the Town News Smoke Shop stays busy with old men’s tobacco habits and young men’s contraband pipes—but new enterprises are working against high turnover rates. Some short-winded upstarts are just bad ideas. The Family Dog was a 50s-style restaurant that served nothing but specialty hot dogs and bad fries. The Family Dog deserved to die. But the honest places die too. The Green Earth Grocer went out of business years ago. The sign still hangs like a reprimand telling us that this is why we can’t have nice things. All the bookstores and cafés have gone under—taken over by tanning beds and overpriced flower shops—so there’s nowhere to go anymore and the young people don’t know what to do with themselves or anyone else unless they’re getting high in the back of someone’s car.

East Mansfield is built on uneven terrain, so the roads dip and turn without warning, and the rain water pools and bleeds into the concrete and warps the roads when it freezes so that they’re perpetually riddled with potholes. Those of us who live here grow into a certain East Side Pride.

“Are you an Eastie or a Westie?” we ask. If people answer, they answer with such a relish, and often a snort, like there’s only one proper reply.

“I’m an Eastie, of course!” Westies get confused and try to hedge.

“Uhm, I’m in the middle I think?”

Westies think they’re the center of everything. No, I’d say. You’re not “in the middle.” You’re a Westie. Spoiled by your straight roads and wide lanes. You’ve probably never popped a tire twenty feet from home, and you should feel bad about that. I’ve never popped a tire twenty feet from home, but I’ve come close.

Westies couldn’t make it over here. They turn off the beaten path of 106 and see the woods encroaching over our property lines. They double check their maps and wonder where the hell they are. Am I even in Mansfield anymore?

I know a guy from out-of-state who says New Englanders have a maddening underdog complex. Westies don’t know they’re called Westies. I don’t think they even know there’s a designated East and a West side of town. No outsider could tell the difference. And anyway, all any of us want is to get out.

We all wound up here in the same way: we’re sprung from the urban exodus. We’re children of the non-rhotic tongue, but most of us have been schooled out of it. We’re almost all Irish,
Catholic, and middle-class, and we live well enough that we shouldn’t be so bored. But when everyone in a place is so woe-
fully similar, it seems only natural to want to get out, to distin-
guish ourselves elsewhere.

Mansfield looks like any other New England town I know. Trees spring up around the houses, thick enough to offer privacy that borders on reclusive. And yet, I remember. In the uncritical bliss of childhood, it was the charmiest place in the world. Old pines bend and cast shadows like ghost stories, and when we were young and our ears untuned to the forest sounds, my brothers and sisters and I could barely sleep. The mating calls of crickets and frogs at first astonished and terrified us.

To occupy myself, I would take to the woods, to the dozens of acres of oak trees and white pines that flesh out the no-man’s-land between Mansfield and Easton. A well-worn path extends from the end of our lawn to the forest precipice, right before it takes a sharp dip down into a blanket of fern leaves and fallen trees that lead to the soggy marsh at the base of the woods. It was our unofficial boundary as children. To the top of the hill and not a step more. Every summer my arms and legs were cov-
ered in mosquito bites from afternoons climbing trees through sap-sweet leaves. I’d scratch them until they bled. By the time the scabs had faded, I’d be covered in a thick rash of poison ivy.

“Should have bought stock in Cortisone,” my parents would say. But I was Henry David Thoreau in those days! All, “rapt in a reverie, amidst the pines and hickories and sumachs” and full of quiet desperation. And the back woods were my Walden, and I went there to live deliberately. “From the desperate city you go,” says Thoreau, “into the desperate country, and have to console yourself with the bravery of minks and muskrats” (Thoreau 12). I understood him better then than I did once I was old enough to know him, for we spoke the language of New England woods.

Thoreau writes about this shedding of the numbing routine of the material world, but not as a means to the material end, rather to escape those distractions that keep us from truly con-
necting to our landscape and thus ourselves—what he calls “the very tedium and ennui which presume to have exhausted the variety and the joys of life” (Thoreau 13).

It’s not necessary to get away—away from our provincial life to discover our own uncharted land, to bury our head in the sands that bank Walden Pond. Even if we wanted to, Walden today is nothing like Thoreau’s idyllic retreat. Not the one he wrote of when he said:

My house was on the side of a hill, immediately on the edge of the larger wood, in the midst of a young forest of pitch pines and hickories, and half a dozen rods from the pond, to which a narrow footpath lead down the hill. In my front yard grew the strawberry, black-
berry, and life-everlasting, johnswort and goldenrod, shrub-oaks and sand-cherry, blueberry and ground-
nut. Near the end of May, the sand-cherry, (cerasus pumila,) adorned the sides of the path with its delicate flowers arranged in umbels cylindrically about its short stems, which last, in the fall, weighed down with good sized and handsome cherries, fell over in wreaths like rays on every side. I tasted them out of compliment to Nature, though they were scarcely palatable. The sumach, (rhus glabra,) grew luxuriantly about the house, pushing up through the embankment which I had made, and growing five or six feet the first season. Its broad pinnate tropical leaf was pleasant though strange to look on. The large buds, suddenly push-
ing out late in the spring from dry sticks which had seemed to be dead, developed themselves as by magic into graceful green and tender boughs, an inch in diameter; and sometimes, as I sat at my window, so heedlessly did they grow and tax their weak joints, I heard a fresh and tender bough suddenly fall like a fan to the ground, when there was not a breath of air stirring, broken off by its own weight. In August, the large masses of berries, which, when in flower, had attracted many wild bees, gradually assumed their bright velvety crimson hue, and by their weight again bent down and broke the tender limbs. (Thoreau 73-74)

Now the two-thousand-or-so acres of forest surrounding the pond make up a protected landmark reservation. It’s wild to think that one man could ever have occupied that land alone. Some of that forest used to be fields tended by neighboring plantations, but still with enough wilderness surrounding to buffer his solitude, and the whole massive pond before him. With all the space outside, the replica hut doesn’t seem so small—though there is hardly room enough for a bed and a writing desk. And so much for solitude, the park today caps visitor access at 1,000 people at a time. If they were to spread out, they’d have nearly two acres apiece. In the summer heat, though, most crowd the shore for swimming, or hike on designated trails. A road has been paved between that space where the hut once stood and the pond, which seems to me like blas-
phemy. And the hillside of his account has been demolished for parking. There’s not much marrow of life there anymore.

In the grand scheme of things, that’s all beside the point. The landscape is constantly changing. Emily Dickinson’s quiet Am-
herst landscape is now overcome by thousands of this region’s most boisterous college students. Thoreau’s retreat has become a museum, and my parents cut down all our trees. As much as we rely on our landscapes, as much as they transform us, we too transform them, until the relationship between the two becomes so complicated and convoluted that we wonder, what is the point? It is a symbiosis. It is the blood-brother finger prick. It is a collaboration of fates. Not to escape the land, but to become a proud and active part of it. We cannot expect to preserve the land tangibly forever as we have known it in our lifetimes. To preserve the land—to save the land, we need only acknowledge the tremendous impact it has had on us in our lifetime.

I think I saw nothing remarkable about my own landscape until I left it. I went to Israel for three weeks to write, thinking: At last! Something to write about! Everything was remarkable to me in a way that I thought nothing was at home.

The seawater in Israel is perpetually warm. You can walk in any time at will and without caution. It is so unlike the Atlantic Ocean, which is cold all year. You have to be wary of the tide. It’s an exercise in patience. One is always fighting the waves.

My father taught me how to skip stones off Hough’s Neck Beach a block away from his childhood home. He sifted through the sand to find long flat rocks that were best for skipping. He told me to look closest to the shoreline, where the tide beat them smooth.

“Hold it between your thumb and your first finger,” he said, pulling one arm back sideways as far as he could reach, keeping it steady and parallel to the ground before launching it forward like a slingshot.

“Keep it straight. Aim for Raccoon Island.”

Raccoon Island wasn’t far but it was impossible to reach at high tide, when the waves would span the shore and slap violently against the concrete breakwaters. By low tide the waves would recede far enough to clear the sand and create a damp walking path to the island, directly between the shores.

We weren’t allowed to walk to Raccoon Island. My father told us not to tempt the tides. So when low tide came and the waters receded, my siblings and I only looked out to sea and satified our curiosity by inventing stories of the legendary raccoons inhabiting the island, and how spectacular they must be to have named it. And we threw stones and tried to reach the island, or at least to out-throw each other.

On our last visit to Quincy—a summer day spent packing up boxes for my grandmother’s move to a retirement community in Halifax—my brother, my sister, and I escaped to Hough’s Neck Beach to say goodbye to the shore. By some chance of fate the tide was low and the shore stretched out to Raccoon Island as if they were one bank—and we wondered if we’d ever have another chance to walk upon the island we’d been casting stones to for years.

Without any deliberation, Jimmy took off and walked full-force toward the island. Amanda and I followed. The sand in between was saturated and sucked on our shoes and I thought perhaps it meant to keep us back. The island was closer than it looked and we were there in only a minute. It was smaller than it looked, too. We could spread along the length of it and barely had to shout across. Weeds grew thick and high over our heads. Was there poison ivy here? I hadn’t had an outbreak in years. I’d learned to keep out of the woods. So I explored from a safe distance, scanning the island from its small sand perimeter. Jimmy rushed straight into the thicket, and straight out again, swarmed by mosquitos.

“The water, guys...” Amanda said, as we slapped at the bugs now swarming us too. We weren’t there five minutes before the tide was advancing. “We have to go.”

We looked once more on Raccoon Island, wishing we could boomerang our glances around to see all the land left unexplored. We’d never get another chance.

We ran back to Hough’s Neck beach, our sneakers sinking, the sand up to our ankles this time. Jimmy screamed. He’d been afraid of dying in quicksand ever since he’d seen it in a movie. The way back, racing the tide, seemed a lot longer than the way there. We didn’t breathe until we hit dry coast, and then we collapsed on the sand. We wrung out our socks on the concrete stairs that led back up to the street, and we collected shells for an alibi, breathing heavy and satisfied as we tried to hide our smiles, and we never spoke of Raccoon Island again.

“Some - keep the Sabbath - going to church,” as Emily Dickinson poeticized, but she kept hers at home. If anybody knows anything about beauty from afar, it’s Emily Dickinson, who quartered herself in her room and was content to appreciate a world apart from her own without needing to interject herself into it. There’s something about New England spirituality that hedges on finding some “otherness,” never satisfied with home. I went to my Other, to my own Promised Land on Raccoon Island. There were no raccoons, and it wasn’t very big. The Quincy shore was better.
In *Mapping the Invisible Landscape: Folklore, Writing, and the Sense of Place*, Kent Ryden writes: “Places do not exist until they are verbalized” (Ryden 241). It’s bringing the land to life, simply by paying attention to it, and how it connects to us. According to author Jennifer Sinor, “writing about a place can equate to saving it” (Sinor 9). What she is referring to is the menacing schism drawn between people and their place ever since ego took over and pride gave way to introspection, and we all but forgot the whole world around us. The trouble with this is that our place is so central to who we are that in forgetting it we lose the ability to orient ourselves spiritually and intellectually as much as physically. Hence the imperative of this work: to understand and communicate the relationship between the individual and his place in an effort to recover that bond. To recover that bond myself.

This place and I, we’re fickle. New England has a little bit of every extreme: the winter, the summer, the ocean, the hills. It is the sun’s heat at noon always tempered by the breeze. I am never wholly satisfied, but always quite content. I am the Canada goose, instinctively migrant with a backward look, for I couldn’t love the robin if I’d never seen a cuckoo replace it, and I didn’t love New England before I left it. And so, at last, I’m caught somewhere between the Pilgrim’s Progress of exploration and the simple resignation of a home. No longer stuck in a place, but at last rooted.

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**Works Cited**


Anterior and Posterior Types of Neuropsychological Deficits in Parkinson’s Disease: A Subgroup Classification of Cognitive Outcome

Megan Risi

Parkinson’s Disease

Parkinson’s disease (PD) is a pervasive neurodegenerative disorder with a prevalence rate of approximately 150 out of 100,000 individuals in the United States and Western Europe (Checkoway & Nelson, 1999). The most widely recognized motor symptoms associated with PD include a resting tremor, rigidity, slowness of movement (i.e., bradykinesia), freezing, and gait abnormalities. Non-motor symptoms typically consist of depression, hallucinations, sleep disturbances, fatigue, autonomic nervous system impairment, and cognitive deficits (see e.g., Stacy, 2011). The frequency and severity of these non-motor impairments typically increase with disease duration, and they are not exclusively linked to the motor symptoms (see e.g., Yu et al., 2012).

Cognitive impairment is an understudied aspect of PD, which is often present in the early stages of the disease. It has been estimated that approximately 30-90% of patients who suffer from cognitive impairment will eventually develop a form of dementia that is specifically associated with PD, known as Parkinson’s Disease Dementia or PD-D (Williams-Gray, Foltynie, Brayne, Robbins, & Baker, 2007). The wide variation in incidence is primarily due to the lack of criteria in diagnosing dementia in PD and the heterogeneity of the neuropsychological measures used by researchers. While age and disease duration are strong predictive markers of PD-D, cognitive impairment in posterior domains is also considered to be a major risk factor (Dalrymple-Alford et al., 2011; Williams-Gray et al., 2009).

It is believed that changes in cognition occur between the development of PD and the progression to PD-D. Termed mild cognitive impairment (MCI), these changes can be measured through neuropsychological tests that focus on anterior (frontal lobes; executive function) and posterior (temporal and parietal lobes; language, memory, and visuospatial abilities) regions of the brain, which can provide great insight into the progression of PD to PD-D (Miller, Neargader, Risi, & Cronin-Golomb, 2013).

Research suggests that the presence of MCI within the first few years of PD diagnosis can aid in predicting cognitive outcome in patients. In longitudinal studies by Williams-Gray, et al. (2007, 2009) non-demented PD participants completed a battery of neuropsychological tests that included the National Adult Reading Test to estimate premorbid intelligence, anterior-based tests
(Tower of London, FAS, Switching), posterior-based tests (Pentagon Copy, semantic fluency, pattern recognition memory, spatial recognition memory), the Beck depression index and the Mini Mental State Exam (MMSE) to measure the presence of dementia. The results showed that anterior deficits of executive function, shown on performance on the Tower of London test and the FAS task, were the most common types of cognitive impairment in non-demented PD. In the 2.5 year and 5 year follow up, deficits in performance on semantic fluency and Pentagon Copy, both tests of posterior regions of the brain, were the most significant neuropsychological test predictors of dementia within the cohort, whereas the more common anterior deficits were not. Dementia was defined as performing one standard deviation (SD) below published normative data. Based on the results of this longitudinal research, the authors concluded that posterior cognitive impairment was a significant risk factor in the development of PD-D.

Although previous research clearly demonstrates that MCI in PD patients does in fact exist (Williams-Gray et al, 2007, 2009), it remains unclear how best to characterize it. Specifically, should MCI be defined based on performance that falls 1 SD below the normative mean, 1.5 SDs, or 2 SDs? Should data be compared to published normative data or to an age- and education matched control group wherein assessments are administered in the same environment by the same researcher? If anterior- and posterior-based tests are good predictors of MCI, does an individual have to perform poorly on all tests given within a specific domain (e.g., four out of four anterior tests), or should some other type of criterion be established?

The present project aims to further examine these questions by administering a series of anterior- and posterior-based tests to a group of non-demented PD patients and their age and education matched controls. Previous research has primarily compared PD and HC participants’ performance against published normative data, with no direct comparisons made with an age and education matched control group. It was hypothesized that PD would perform significantly more poorly across all anterior and posterior tests than age and education matched HC participants. A second goal was to examine cognitive performance variation within individuals with PD in an effort to develop subtypes based on patterns of anterior and posterior deficits. Based on previous literature, it was hypothesized that PD participants would fall into one of four cognitive groups (anterior deficit only, posterior deficit only, both deficit, and neither deficit) and that more patients would exhibit anterior-type compared to posterior-type deficits. Further, to determine MCI in PD, various criteria were used such as two deficits in a single domain with cut offs of 1.5 SD, and 2 SD below control participants. Based on previous research (Dalrymple-Alford et al., 2011), it was hypothesized that two deficits of 1.5 SD below the mean in a single domain would provide categorization that is sensitive enough to detect cognitive impairment, yet conservative enough to avoid false positives. The purpose of this research is to further our understanding of the criteria involved in diagnosing MCI in PD.

**METHOD**

Participants

The study consisted of 61 participants: 34 non-demented PD participants and 27 healthy control (HC) participants who were matched on age \[t(60)=.57, p=.96\] and education \[t(60)=.39, p=.67\]. Participants were referred from the Parkinson’s Disease Center of Boston University's Medical Center and local support groups, and included individuals who met the clinical criteria for mild to moderate PD as diagnosed by the patients’ neurologists. HC participants were recruited from the community.

Measures and Procedures

Participants were given a battery of tests as part of a larger study on PD and cognition. These tests measured anterior- and posterior-type abilities. Anterior tests measured frontal lobe abilities including executive functioning, attention, and decision-making skills. Posterior-type tests measured abilities associated with the parietal and temporal lobes and included visuospatial, visuomotor, visual dependence, spatial reasoning, and memory skills. PD patients were categorized into subgroups based on their performance across the various tests relative to healthy control participants.

Anterior-Type Tests.

*The Stroop Color-Word Task.* The Stroop Color-Word Task (Stroop, 1935) is a test of executive functioning and measures selective attention, cognitive flexibility, and processing speed. First, participants were presented with a series of “XXXXs” in five columns of 20 words. Each series was presented in one of three colors: green, blue, or red. Participants named the color of each series of “XXXXs” as quickly as possible. If the participant was able to complete the list of words, they went back to the beginning to continue reading. The number correct after 45 seconds was recorded. Next, they were presented repeatedly with the words “green,” “blue,” and “red,” that appeared in black (the Stroop word portion). Their task was to read the words as quickly as possible within a 45-second time frame. Finally, they were repeatedly presented with the words “green,” “blue,” and “red,” except now the words were colored such that the color of the word was incongruent with what the word said (e.g., the word blue appeared in red; the Stroop color-word portion). Participants were asked to name the color
in which the words appeared (the response to the above example would be red). Participants were timed and the resulting score was equal to the number correct within a 45-second time frame (dependent variable). Lower scores indicate poorer performance.

**The Delis-Kaplan Executive Functioning System (D-KEFS) Verbal Fluency task.** The D-KEFS (Delis, Kaplan, & Kramer, 2001) measures verbal fluency. Participants were asked to generate as many words as possible that started with the letter F within a period of one minute. The number of words that were said in each 15-second interval was recorded along with set loss errors and repetitions. This procedure was repeated for the letters A and S. The results from each portion (F, A, and S) were summed to generate a total score (dependent variable). For the category switching portion of the D-KEFS, participants were asked to name as many pieces of fruit and furniture as possible while alternating between categories (e.g., apple, table, banana, chair, etc.) for a period of 60 seconds.

**The Trail Making Test.** The Trail Making Test (Tombaugh, 2004) measures executive function, specifically attention (Trails A) and set-shifting (Trails B). The Trail Making Test consists of two parts. Trails A has 25 circles with numbers (1-25) in them. Trails B has 25 circles with letters or numbers (A-L, 1-13). The circles are scattered throughout the page in no discernable pattern. Participants were asked to connect the dots in order. For Trails A, the amount of time it took to connect all of the dots was recorded as the dependent variable. For Trails B, each circle had either a number or a letter in it. Participants were asked to connect the dots in order alternating between letters and numbers (1, A, 2, B, etc.). The amount of time it took to connect all the dots was recorded as the dependent variable with lower time indicating better performance.

**Posterior-type tests.**

**The Cube and Pentagon Copying tests from the modified Mini Mental State Exam (mMMSE).** The Cube and Pentagon Copying tests (Stern, Sano, Paulson, & Mayeux, 1987) measure motor abilities related to vision (visuomotor) and abilities related to the perception of spatial relations involving vision (visuospatial). For these tests, participants copied a 3-D cube and two overlapping pentagons without a time limit. The accuracy of the drawings was the dependent variable with higher scores indicating better performance.

**The D-KEFS Verbal Fluency task.** The D-KEFS (Delis et al., 2001) measures semantic fluency. Participants named as many animals as possible in one minute. The number of words stated in 15-second intervals was recorded as well as set loss errors and repetitions. Individual words that met the criteria (dependent variable) were counted resulting in a total score with lower scores indicating poorer performance.

**The Landmark Line Bisection task.** The Line Bisection task (Davidsdottir, Wagenaar, Young, & Cronin-Golomb, 2008; Lee, Harris, Atkinson, & Fowler, 2001) measures spatial perception without motor demands. On a computer screen, participants viewed a horizontal line crossed by a vertical mark that began on either the left or right side of the horizontal line. As the experimenter moved the vertical mark toward the opposite side of the line, participants indicated when the mark reached the perceived center of the line. Each trial started at different sides of center and at different distances resulting in five trials that started to the right of center and five trials that started to the left of center. The distance between the perceived center and the actual center was the dependent variable. The average absolute value of distance from the actual center was taken for the 10 trials with lower numbers indicating less variation and better performance.

**The Visual Dependence task.** In the Visual Dependence task (Azulay, Mesure, Amblard, & Pouget, 2002; Danta & Hilton, 1975; Davidsdottir et al., 2008), participants viewed a computerized rotating white rod on a black screen presented at an angle (five tilted upward to the right and five tilted upward to the left). The researcher manually rotated the rod from a separate station. The participant was asked to indicate when the rod reached a horizontal position. Scoring was based on how close to horizontal each trial was (dependent variable). The average of 10 trials was used for analysis with lower numbers indicating better performance.

**The Delayed condition for the Rey Auditory Verbal Learning Test (RAVLT).** The RAVLT-delay (Rey, 1964) measures delayed memory. Participants were given a list of 15 words read in a monotone voice with even spacing. Participants were asked to repeat as many words as they remember from the list in any order. This was repeated 5 times. Then, there was an interference recall wherein the participants were read a new list of words in a monotone voice with even spacing. Participants were asked to repeat as many words as they remember from the list in any order. After approximately 20 minutes of neuropsychological testing, the participants were asked to recall the original list (with no additional prompting). The score was the total number of correctly recalled words in the delay portion only with lower scores indicating poorer performance.

**RESULTS**

Independent groups t-tests with a Bonferroni correction of .008 (.05/6) was used to examine group (i.e. HC and PD) dif-
ferences on the six anterior- and six posterior-type assessments. As illustrated in Table 1, the HC group significantly outperformed the PD group on most tasks including anterior-based tasks of Stroop word and color-word, FAS, switching, Trails A, and Trails B. Similarly, the PD group performed significantly worse on the posterior-based tasks of Line Bisection and RAVLT-delay. See Table 1 for the t-test results, means, and SDs of each group.

Individual PD performance was evaluated to examine within group variability and sensitivity of tests to PD performance. To examine individual performance, means and SDs were calculated for HC participants for each test. PD scores were then converted to z-scores by using the means and SDs of the HC group for each test. For purposes of this project, a deficit was identified as a score that fell at least 1.5 SD below the HC mean for a particular test. The number and percentage of PD participants who exhibited a deficit for the anterior and posterior-type tests according to the 1.5 SD and 2 SD criteria is shown in Table 2. As illustrated, PD participants showed the largest percentage of deficits on Trails A (55.88% and 50% respectively) and the least on semantic fluency (12.50% and 0% respectively). Table 3 shows individual PD performance for each test. Noted deficits and their severity (1.5 SD or 2.0 SD below the HC mean) are provided. Number of deficits on tests ranged from four (switching, cube copy, and semantic fluency) to 19 (Trails A) deficits. Individual performance ranged from zero deficits (five participants) to 10 deficits (one participant).

As explained above, we examined PD participants whose z-score fell at least 1.5 SD below the HC group mean as well as a stricter cut-off of at least 2 SD below the HC mean on any given task. For both sets of criteria, participants who had two or more deficits in a single domain (anterior, posterior) were categorized as being deficient in that domain. This subtyping resulted in the establishment of four groups: anterior deficit only, posterior deficit only, anterior and posterior deficit (both), and no deficit in either domain (neither). This categorization for 1.5 SD below showed nine individuals with anterior deficit only, one individual with posterior deficit only, 10 individuals with anterior and posterior deficits (both), and 14 participants with neither deficit. When the cut-off was increased to the stricter 2 SD below the mean, four participants categorized as both moved to the frontal only category, four from the frontal only and one from the both categories moved to neither. This change in categorization maintained the 9 in-

### Table 1. Comparison of HC and PD Cognitive Performance. Mean (SD) total score unless indicated otherwise

<table>
<thead>
<tr>
<th>Test Name</th>
<th>PD (n)</th>
<th>HC (n)</th>
<th>PD Mean (SD)</th>
<th>HC Mean (SD)</th>
<th>95% Confidence Interval</th>
<th>PD-HC Effect Size η2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anterior-type tests</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroop Word score</td>
<td>34</td>
<td>27</td>
<td>32.09 (9.30)</td>
<td>42.11 (8.97)</td>
<td>[12.11, 27.02]</td>
<td>.001* 0.22</td>
</tr>
<tr>
<td>Stroop Color-Word score</td>
<td>34</td>
<td>27</td>
<td>85.88 (12.59)</td>
<td>105.44 (16.52)</td>
<td>[5.30, 14.75]</td>
<td>.001* 0.11</td>
</tr>
<tr>
<td>D-KEFS FAS</td>
<td>34</td>
<td>27</td>
<td>39.79 (7.55)</td>
<td>54.85 (12.00)</td>
<td>[9.71, 20.40]</td>
<td>.001* 0.20</td>
</tr>
<tr>
<td>D-KEFS Switching</td>
<td>17</td>
<td>22</td>
<td>12.94 (3.11)</td>
<td>14.77 (2.83)</td>
<td>[ -.10, 3.76]</td>
<td>.03* 0.02</td>
</tr>
<tr>
<td>Trails A completion time</td>
<td>34</td>
<td>27</td>
<td>35.11 (10.33)</td>
<td>24.48 (5.17)</td>
<td>[-14.72, -6.56]</td>
<td>.001* 0.23</td>
</tr>
<tr>
<td>Trails B completion time</td>
<td>34</td>
<td>27</td>
<td>90.71 (42.98)</td>
<td>54.09 (15.16)</td>
<td>[-52.62, -20.64]</td>
<td>.001* 0.33</td>
</tr>
<tr>
<td><strong>Posterior-type tests</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mMMSSE Cube Copy</td>
<td>34</td>
<td>27</td>
<td>5.85 (1.40)</td>
<td>6.41 (0.97)</td>
<td>[-.05, 1.16]</td>
<td>0.37 0.05</td>
</tr>
<tr>
<td>mMMSSE Pentagon Copy</td>
<td>29</td>
<td>25</td>
<td>6.90 (.90)</td>
<td>7.04 (0.68)</td>
<td>[-.30, .58]</td>
<td>0.26 0.12</td>
</tr>
<tr>
<td>D-KEFS Semantic Fluency</td>
<td>32</td>
<td>27</td>
<td>22.03 (5.55)</td>
<td>23.85 (5.80)</td>
<td>[-1.14, 4.79]</td>
<td>0.11 0.01</td>
</tr>
<tr>
<td>Visual Dependence</td>
<td>34</td>
<td>27</td>
<td>0.51 (0.52)</td>
<td>0.35 (0.26)</td>
<td>[-.37, .04]</td>
<td>0.06 0.001</td>
</tr>
<tr>
<td>Line Bisection</td>
<td>34</td>
<td>27</td>
<td>-0.10 (0.77)</td>
<td>0.55 (0.70)</td>
<td>[-.51, .03]</td>
<td>.001* 0.01</td>
</tr>
<tr>
<td>RAVLT Delayed recall</td>
<td>17</td>
<td>22</td>
<td>7.24 (3.73)</td>
<td>10.41 (3.53)</td>
<td>[.81, 5.54]</td>
<td>.005* 0.08</td>
</tr>
</tbody>
</table>

* Indicates significant difference at α = .05 between HC and PD
individuals with anterior deficit only and one individual with posterior deficit only; however, individuals categorized as being deficient in both fell to five, and neither deficit increased to 19.

Discussion

The first hypothesis stated that PD participants would show more cognitive deficits than HC participants. As predicted, the non-demented PD participants in this study performed significantly worse than the HC participants on several measures of cognition, including all anterior-based tests (Stroop word, Stroop color-word, FAS, switching, Trails A, and Trails B) and two posterior-based tests (Line Bisection and RAVLT delayed recall). These results are in line with previous studies, which have found that anterior deficits as opposed to posterior deficits are more commonly observed in PD (Miller et al., 2013; Williams-Gray et al., 2007, 2009). Contrary to research by Williams-Gray et al. (2009), semantic fluency did not appear to be a strong indicator of posterior cognitive deficits in this PD population, as no significant difference in performance was observed on this measure between PD and HC participants. This may be due to the fact that these PD participants were extremely high functioning whereas Williams-Gray et al. included participants who were more heterogeneous in terms of cognitive functioning.

The second hypothesis stated that PD participants would fall into one of four cognitive groups: anterior deficit only, posterior deficit only, both deficit, and neither deficit. As demonstrated by the data, the numbers of PD participants that were categorized in the groups changed as a function of the criteria adopted for inclusion. As predicted, PD participants exhibited more cognitive deficits on anterior-based tasks when compared to posterior-based tasks. These results were consistent with the literature on cognitive performance in PD participants (see e.g., Williams-Gray et al. 2009).

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Total PD</th>
<th>Total Deficits -1.5 SD</th>
<th>Percentage</th>
<th>Total Deficits -2 SD</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior-type tests</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroop Word</td>
<td>34</td>
<td>14</td>
<td>41.18</td>
<td>4</td>
<td>11.76</td>
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<tr>
<td>Stroop Color-Word</td>
<td>34</td>
<td>12</td>
<td>35.29</td>
<td>6</td>
<td>17.65</td>
</tr>
<tr>
<td>FAS</td>
<td>34</td>
<td>11</td>
<td>32.35</td>
<td>3</td>
<td>8.82</td>
</tr>
<tr>
<td>Switching</td>
<td>17</td>
<td>4</td>
<td>23.53</td>
<td>3</td>
<td>17.65</td>
</tr>
<tr>
<td>Trails A</td>
<td>34</td>
<td>19</td>
<td>55.88</td>
<td>17</td>
<td>50.00</td>
</tr>
<tr>
<td>Trails B</td>
<td>34</td>
<td>16</td>
<td>47.06</td>
<td>14</td>
<td>41.18</td>
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<tr>
<td>Posterior-type tests</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cube Copy</td>
<td>34</td>
<td>4</td>
<td>11.76</td>
<td>4</td>
<td>11.76</td>
</tr>
<tr>
<td>Pentagon Copy</td>
<td>29</td>
<td>9</td>
<td>31.03</td>
<td>2</td>
<td>6.90</td>
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<tr>
<td>Semantic Fluency</td>
<td>32</td>
<td>4</td>
<td>12.05</td>
<td>0</td>
<td>0.00</td>
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<tr>
<td>Visual Dependence</td>
<td>34</td>
<td>7</td>
<td>20.59</td>
<td>7</td>
<td>20.59</td>
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<tr>
<td>Line Bisection</td>
<td>34</td>
<td>10</td>
<td>29.41</td>
<td>8</td>
<td>23.53</td>
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<tr>
<td>RAVLY-delay</td>
<td>17</td>
<td>5</td>
<td>29.41</td>
<td>3</td>
<td>17.65</td>
</tr>
</tbody>
</table>
There are no set diagnostic criteria for MCI in PD. The Movement Disorder Society recently assembled a task force to clarify MCI in PD, but used various ways to establish a diagnosis. These guidelines suggested that multiple domains be assessed with many neuropsychological measures, but did not come to a consensus as to which measures to use and urged additional research to determine these measures. To diagnose MCI, they suggested that a deficit should be found on at least two tests within a single domain. Determining a cognitive deficit on a test had various options. A deficit could be determined if the patient scored between 1 and 2 SD below matched normative data. If available, a significant decline on serial cognitive testing or estimated premorbid abilities could be considered a cognitive deficit in the corresponding domain (e.g. executive function, visuospatial abilities). Finally, if a patient had undergone neuropsychological testing previously, reported a change in cognition, and fell at least 1 SD below previously tested abilities, a score of less than 1 SD below published norms was sufficient to determine a deficit on that task (Litvan et al., 2012). Determining a deficit within a domain varies among researchers. Some studies have emphasized the need to show a deficit on two tests within a single domain (see e.g., Williams-Gray et al., 2007, 2009). Dalrymple-Alford et al. (2011) proposed that one deficit across two domains (e.g. one anterior test and one posterior test) was sufficient for the categorization of MCI in PD. Researchers in Taiwan (Yu et al., 2012) considered a domain impaired if the participant scored 1.5 SD below normative data on a minimum of one test within that domain. With so many variations, it is clear that more research is needed to establish reliable and valid guidelines.

MCI was evaluated using cut-off values of 1.5 SD below the HC participants’ mean and 2 SD below the HC participants’ mean with two deficits in a single domain (anterior or posterior) constituting a deficit in that domain. When 1.5 SD below the HC participants’ mean was used, nine PD participants were categorized as having anterior deficits, one PD participant was categorized as having posterior deficits, 10 PD participants were categorized as having both deficits, and 14 PD participants were categorized as having neither deficit. When the more strict cut-off of 2 SDs was used, anterior and posterior grouping remained the same (nine and one respectively), but the PD participants classified as both deficits was decreased to five and neither deficit increased to 19.

The type and number of neuropsychological tests used to determine this subtyping is needed in future research. Many of the investigations into PD-MCI have used various neuropsychological tests. Other research into PD-MCI has used unbalanced numbers of tests between domains. For example, Dalrymple-Alford et al. (2011) used 12 anterior-based cognitive tests and eight posterior-based tasks. The more tests you have for a single domain, the more opportunity there is to find deficits within that domain. When the number of tests is unbalanced, the testing can appeared skewed to uncovering deficits within the domain with more tasks.

Overall, research into PD-D is highly varied and subject to limitations such as a participant’s inability to continue with research for reasons of motor impairment, dementia resulting in the inability to complete a neuropsychological battery, and high morbidity and mortality rates, making longitudinal research difficult. Because of these factors, a large pool of participants is needed. It is important to test newly diagnosed PD participants to obtain a baseline score on neuropsychological tests to better understand the course of the disease. Finally, by continuing the research for 10 or more years, the progression to dementia in PDs may be better understood, resulting in more precise risk factors being identified. Through continued research, better understanding of PD and its progression to dementia will aid in the care of the patients.

References


### Table 3. Individual PD Performance

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* Test showed significant difference between PD and HC
The Experiences of Transgender Students in Massachusetts’ Colleges and Universities

KAYLA SPAGNA

This research examines the experiences of transgender students attending four-year colleges or universities in Massachusetts. I pursued a series of qualitative interviews to gain a deeper understanding of the resources available to transgender students and to identify potential barriers to full integration on college campuses. Ten transgender students were interviewed; all were between the ages of 18 and 24 years. Data were coded using grounded theory and a constant comparative approach. Themes include: awareness, safety, college and university policies, and support by trans-inclusion through programs and policies. These findings highlight the importance of transgender-specific information and broader education for both students and faculty, an improved climate regarding safety concerns, the impact of barriers experienced by transgender students, and ways in which transgender students can be supported by colleges and universities. One significant finding of this study is that many transgender students in this study rely on their college or university and its programs for support due to a lack of understanding available in their home environment. While most studies on transgender youth focus on adolescence, this study focuses on emerging adults and provides new avenues for supporting transgender students attending colleges and universities.

“My life was kind of like mixed and matched little pieces at the time and then after starting everything, with my transition, it kind of all came together and I was able to piece together my life and be fully comfortable with myself and start succeeding and making my own paths.”

–Travis

Introduction

Transgender is an umbrella term that encompasses people who transition from one gender to another and/or people who defy the gender binary. The gender binary is the traditional classification of sex as male and female. Also contained in this group are those whose gender identity or gender expression differs from the social norms concerning masculinity and femininity. These traditional gender stereotypes are determined culturally and place specific expectations upon individuals to conform to their assigned biological sex category of male or female. A person’s gender identity is how a person identifies and expresses their own gender, which may or may not be consistent with their biological sex.
Some transgender individuals choose to make a physical transition to their chosen gender identity; others do not. The most commonly understood experience of transitioning is through the use of hormone therapy and gender reassignment surgery. Hormone therapy is the use of testosterone, testosterone blockers, or estrogen prescriptions to diminish or enhance biological secondary sexual characteristics. In gender reassignment surgery, biological reproductive organs are surgically reconstructed or altered. Although these are the two most common ways of transitioning, they are not what exclusively defines one transgender. Male-to-female (MTF), female-to-male (FTM), intersex, cross dressers, drag kings and queens, transsexual individuals, gender queer, gender benders, and androgynies, among others, are also included under the transgender umbrella (Davidson, 2007). Being transgender could also mean identifying as neither gender or as parts of both (Holmes, 2003; Massachusetts Transgender Political Coalition 2012).

**LITERATURE REVIEW**

While definitive statistics are not available, the transgender population lies somewhere around 1% in the United States (Miller, 2011). Due to both the limited available research on the transgender youth community, as well as the frequent combination with the gay, lesbian, and bisexual youth in research, this literature review also considers the experiences of GLB youth.

**GLBT Experiences of Oppression**

Transgender individuals, like most minority groups, face significant oppressions. These include a lack of trans-positive support, both medically and socially, a lack of culturally-competent services for those with substance abuse and mental health issues, and a lack of shelter (Mallon, 2009). Most significantly, transgender youth experience sexual assault and violence in rates far greater than the general population. In 2011 approximately 221 transgender persons were murdered worldwide (Balzer, 2011; Broverman, 2011). The 2011 Hate Violence Report recorded 87% of the reported victims were people of color, and 40% were transgender women (GLAAD, 2012).

Due to discrimination in housing, employment, and health care, transgender individuals are far more likely to become homeless; it is estimated that between 20 and 40 percent of homeless youth identify as gay, lesbian, bisexual, or transgender (Cochran, 2001; Ray, 2006; Miller, 2011). Transgender youth face significantly more mental health difficulties, such as depression, anxiety, and self-harming behaviors, than their gender conforming peers (Heck, 2011). Due to these mental health challenges, transgender students often feel marginalized and segregated from their peers and experience high rates of discrimination (McKinney, 2005). Individuals who reject the gender assigned to them, known as gender-nonconforming, often encounter hostility for not conforming to socially acceptable gender behavior (Bornstein, 1994; Feinberg, 1996; Bildeau, 2005). Compared to their GLB peers, transgender youth are often far more marginalized and disenfranchised, often finding themselves unwelcome even at GLBT youth-serving agencies (Kosciw, 2001; Miller, 2011).

**GLBT Students: Educational Experiences**

The school context is one of the primary settings where social interactions occur during adolescence (Morrow, 2004). Effects of at-school victimization, such as negative responses from peer groups, may impact a person’s life beyond high school years and can permanently affect psychosocial adjustment (Ellis, 2002; Bontempo, 2002). At-school victimization of GLBT youth is also perpetuated by faculty and staff. Experiences from non-accepting staff and faculty members negatively influence GLBT youth’s access to education as they lead to feelings of being unsafe in school, increased discipline problems, and lower levels of school engagement and academic achievement (Kosciw, 2012).

The 2011 National School Climate (NSC) Survey consisted of 8,584 student respondents ages 13 to 20 from all 50 states in America and the District of Columbia (Kosciw 2012; Mara, 2012). An incredible 57% of students reported hearing these negative remarks from their teachers and other school staff members. Unfortunately, over 60% of students in the NSC Survey who were targets of assault or harassment did not report the incident to school staff, due to the belief that no action would be taken. The 36.7% of students who did report an incident stated that school staff did nothing in response (Kosciw 2012). The 2011 NSC Survey concluded that many GLBT students avoid school due to feelings of being unsafe. Students who experienced victimization due to their sexual orientation or gender expression were twice as likely to not pursue any post-secondary education (Kosciw 2012).

**Transgender College Students.**

There is no accurate measure of the number of transgender college students currently attending U.S. colleges and universities (Beemyn, 2003). However, the last decade has seen an increasing number of students identifying as transgender or openly addressing gender identity issues (Lee, 1998; Carter, 2000; Beemyn, 2003). One study found that campuses produce a hostile climate for transgender students and that they are further marginalized due to a lack of resources and education (McKinney, 2005).
As it relates to the specific experiences and lives of transgender students, GLB student leaders and center directors still have a limited understanding of the experiences of transpeople and many continue to engage in trans-exclusive practices (Beemyn, 2003). Issues such as inadequate housing, health support, and social support groups can hinder a transgender person's academic career. Without proper support, transgender students are sometimes unable to receive the best education possible (Kosciw, 2009). Of the 4,850 colleges and universities in the United States, 414 have non-discrimination policies that include gender identity/expression; 81 provide gender-inclusive housing; 30 provide a formalized process for a name change without legal change; and 15 provide health coverage for hormone therapy (Miller, 2011).

**METHODOLOGY**

In order to gain a more comprehensive understanding about the challenges that Massachusetts transgender college and university students face, the primary focus of the study was to determine the available campus resources and to identify potential barriers to full integration on campuses. I gathered information from participants who identify as transgender and attend a four-year college or university in the state of Massachusetts. Four-year colleges or universities were selected as the focus of the study in order to explore resources, housing, and campus environment specifically related to these institutions.

Participants were recruited through flyers, e-mails, and by word of mouth. Of the ten participants in this study, four identified as transmen, one as a transwoman, three as transgender, one as female assigned at birth gender queer, and one as gender fluid. All participants were between the ages of 18 and 24. Of the four-year colleges or universities attended by the participants two were women's colleges. Six participants attended schools located in Plymouth County, two in Western Massachusetts, specifically in the Pioneer Valley/Springfield Metropolitan area, one in Bristol County, and one in the North Shore. In this paper, participants are identified by selected code names; no actual names are used.

Interviews generally lasted between thirty minutes and an hour and were conducted in an environment chosen by each participant. One interview was conducted over email at the participant's request. The interviews included questions pertaining to general personal background, resources, housing, health services, campus policies, and safety of the participants. The interview questions also explored participants' personal experiences of the college or university they attend. The full list of interview questions appears in Appendix 1.

After completing the interviews, the data were transcribed using the denaturalized, or loose verbatim, method, which focuses on the content of what participants are saying while disregarding natural pauses and stutters in speech (Mero-Jaffe, 2011). Once data were transcribed, I coded the data using grounded theory, which is created through the collection and analysis of data (Backman, 1999; Jones, 2011). This theory is used to develop thematic categories, and over time, to understand the data by identifying relationships between and among transcriptions. The major themes that develop through this process then allow the researcher to discover hypotheses and theories rather than creating them beforehand (Charmaz 2011).

**FINDINGS**

The primary themes are as follows: awareness, safety, college and university policies, and support by trans-inclusion through programs and policies. These findings highlight the importance of transgender-specific information and broader education for both students and faculty, an improved campus-climate regarding safety concerns, barriers experienced by transgender students, and ways in which transgender students can be more fully supported by colleges and universities.

**Awareness**

A majority of participants indicated that the first step any school should take, whether primary, secondary, or college level, is to inform and educate faculty, staff, and students about the transgender community. Knowing more about the existence and experiences of the transgender community is necessary for the implementation of trans-inclusive policies and for full integration of transgender students. A majority of participants signified their understanding of being fully integrated on campus as participating in and out of the classroom, the ease of communication with both faculty and peers, and comfort with seeking assistance.

Six of the ten participants indicated that they had no prior knowledge of the transgender community until reaching their college or university. Ashley stated:

The first time that I really understood that I wanted to be female and that I was transgendered was during my senior year of high school. I didn't know that much about it until later when I did more research in college. Joining my college's GSA helped me get to know other transgender folk as well as talking to others online. So I didn't really discover the community until my first or second year of college.
Half of the participants confirmed that awareness and education about the transgender community could provide greater understanding and acceptance from the broader campus community.

**Safety**

Safety is an important factor in the life of students who identify within the transgender umbrella, as transgender individuals experience disproportionate rates of violence. All but one participant asserted feeling safe at their college or university. This is an important finding, as feeling safe and protected supports full integration into the community. Despite the comfort felt by the participants, all participants indicated risks involved with being “out” on campus. These safety concerns include: a lack of or difficult accessibility of gender-neutral bathrooms and legal issues outside of the college or university’s control.

According to the 2009 D.C. Trans Coalition Survey, 70 percent of transgender people interviewed reported being either harassed or assaulted while using a gender-specific bathroom (Our Survey Results, 2009). Gender-specific bathrooms are a significant concern to transgender individuals. Nine of the ten participants indicated that while their school has gender-neutral bathrooms, they were few in quantity and were located in places that were not easy to get to.

There are larger legal issues that impact the need for and use of gender-neutral bathrooms. As Alex stated:

> I usually go into the men’s bathroom, but we just recently found out that if anyone was to have an issue or kind of knew that you weren’t actually biologically a male and got uncomfortable they could call the police and I could be arrested. If the charges go far enough you would have to register as a level one sex offender.

Here, Alex is alluding to a 2011 the Massachusetts An Act Relative to Gender Identity Law, which defines gender identity as an individual’s gender preference, appearance or behavior, regardless if the gender identity coincides with the individual’s assigned sex (O’Flaherty, 2011; GLADD, 2012). While this law prohibits discrimination based on gender identity in the multiple arenas, it does not prohibit discrimination based on gender identity in public accommodations (GLADD, 2012). Due to the gaps within this law, and depending on each town and state, transgender individuals who use a bathroom that does not match their biological sex face penalties or fines, jail time, or having to register as a sex offender.

One particularly significant finding is that nine of the ten participants confirmed feeling safe at the college or university they attend, especially when compared to home. One participant stated that while he is unable to express his preferred gender identity while at home, on campus he does not experience that same fear or harassment. This participant, currently a first year student, moved from Texas to Massachusetts and specifically chose his university due to its trans-inclusive policies. When asked where he lives as a student and his experiences living on campus, another participant, Travis, indicated:

> I didn't actually have a room right away. I was sleeping on all my friend's couches because... my mom wasn't letting me live in the house... I just couldn't keep up with my classes while staying in everyone's rooms so I went to the housing department and I just talked with them about my situation and... they were able to get me a room.

Being kicked out of his home and unable to live on campus initially not only affected him emotionally, but it also reflected poorly on his academics. For a majority of the participants, campus offers protection and allows them the ability to be comfortable in expressing their gender identity; this is a luxury not often found in the home environment.

**College and University Policies**

College and university policies can serve as barriers to full inclusion on campus or can be a positive support for the transgender students. In discussing potential barriers, participants identified gender-neutral bathrooms, as previously discussed. Other concerns included housing options and preferred name policies. Barriers hinder transgender integration into communities and foster negative stereotypes and stigmas.

All participants who resided on campus faced revealing their gender identity in order to acquire proper housing. Many transgender students are offered rooms typically provided to students with medical or mental health diagnoses. Travis, stated:

> It knocks you down when you have to go into a medical room to figure out your rooming situations... until then you are taking a room from a blind student or someone who is disabled and I feel like you shouldn't be taking that space away from someone for something that should easily be situated with.

Offering a transgender student medical housing suggests that being transgender is a disability rather than a gender identity. It also takes away necessary housing to a student who has a disability and may require it.
One step of transitioning is through changing one's birth name to fit the desired gender. A transperson may change his or her names several times until they find the desired fit and then take steps for a legal name change. A preferred name policy allows any student to change their names on college or university records where the legal name is not required. Transgender students who attend colleges and universities that do not have a preferred name policy face the fear of having to “out” themselves in many different campus contexts, such as in classroom settings. Half of the participants confirmed that their colleges or universities did have a preferred name policy and indicated this as a positive experience, both emotionally and academically. Half of the participants did not have a preferred name policy at their college or university, but desired one greatly.

One participant, addressing the lack of a preferred name policy, stated, “It’s extremely triggering for a transgender student, transgender persons in general, really, to see their birth name and assigned sex.” Although preferred name policies are extremely helpful for transgender students who wish to not reveal their gender identity, this policy can only help so much if other trans-inclusive policies are not put in place. According to one university’s preferred name policy, records such as transcripts, degree audits, commencement brochures, degree certificates, and financial records, will still show the individual's legal name. To change these records, an individual must make a legal name change and then inform the university.

Support: Trans-Inclusion through Programs and Policies
Social and institutional support is important and necessary for transgender students to feel connected and motivated during their college career. A majority of the participants indicated the need for programmatic supports, including both student-assisted and faculty-assisted programs, and trans-inclusive and trans-specific policies.

Programmatic Supports.
Programs and groups on campuses are designed to incorporate more of the student body in the campus community. A majority of the participants indicated that the primary source of trans-related information and guidance they received came from GLBT organizations in their colleges or universities. A majority of participants stated that colleges and universities have more student-run GLBT organizations than staff-run organizations. Four of the participants attend colleges that do not offer any staff-run GLBT supportive organizations. According to participants, student-run organizations offer secure and safe environments where GLBT students can connect, talk, and meet others of the community. These organizations, in some cases, also attempt to implement or change policies. One participant desired more transgender-specific organizations, stating: “There are some things I would like to bring up in a group of people who could share my point of view… I would love to see a group that is specifically transgender.”

The four participants who attended a college or university that do not offer staff-run GLBT organizations stated the desire to have staff-run organizations supporting the GLBT community and advocating for trans-inclusive policies. Ashley stated that “[Student run groups are] good, but [they don’t] really teach anything new and [they’re] not really active in the community.” Staff-run GLBT organizations not only allow students to work side-by-side with faculty and produce positive opportunities, but they also demonstrate support, interest, and commitment on the part of the college or university administration. Other advantages of staff-run groups are the sub-groups or programs that extend from them.

Trans-Inclusive Campus-Based Policies.
One interesting finding concerned the two participants attending women’s colleges. Bradley indicated that his college implemented a policy to support members of the college community who identify as transgender. Incoming students to this college must have a female gender marker, whether biologically female or as a transwoman. Current students who undergo transitioning and identify as male, whether or not the student’s gender marker changes, are allowed to both continue attending the all-women’s college as well as to continue living on campus. However, due to Title IX, transwomen who still have a male gender marker are not allowed to attend these women’s colleges.

While Title IX of the Education Amendments states that no person in the United States can be excluded from any education program based on sex, it does not prohibit private undergraduate colleges and universities from discriminating based upon sex in the admissions processes. Most female-only institutions do not have a formal policy regarding transgender students who come out, are outed, or begin transitioning after the time of admission. The most important implication of Title IX permits institutions offering single-sex education to receive federal funding. Therefore, if a women’s college admitted students who identify as male (or not identifying as female), the institution’s funding could be in danger (Kraschel, 2012).

The two participants who attend women’s colleges discussed how attending an all-women’s college helped them to discover what they consider to be their true identity as a transgender male. According to Bradley, not all students at his women’s college identified as female, which surprised many students, including himself. Bradley stated that in his experience, single-sex institution students have a lot of freedom to explore their identities. The second participant stated: “I go to school where
I do because it was the best education I had offered to me.” To these participants it mattered less whether the college they attend catered towards a specific sex, as long as their needs, emotional and academic, were met.

Discussion
Participants were forthcoming in discussing their experiences and opinions concerning attending Massachusetts colleges and universities. A number of trans-inclusive policy recommendations emerged from these student findings. Trans-inclusive policies remove significant and exclusionary barriers, which do not allow transgender students the opportunity for full integration, whether through in-class participation, communication with faculty and peers, or in other aspects of campus life.

McKinney (2005) noted that undergraduate students felt that faculty and staff were not educated about transgender issues, resulting in a lack of programming and a lack of resources for transgender students. This study is consistent with McKinney (2005), as participants discussed how a prevailing lack of information and resources negatively impacts educational outcomes. More transgender-related education for all members of the campus, can increase transgender student safety and support full inclusion in all aspects of campus life. A lack of basic information, even by well-meaning staff or faculty members, can further marginalize transgender students (Beemyn, 2003).

This study also highlights that education about the transgender community prior to college years is important. As previously noted, education about the community to children at a younger age could encourage understanding and acceptance of persons who identify as transgender. Earlier education can also provide those children who identify as transgender the opportunity to begin transitioning earlier, to develop positive feelings towards themselves, and to have a confident sense of the future (Ryan, 2009). However, due to the lack of early education of the transgender community, college is often the first opportunity gender variant students have to question their ascribed gender. Therefore, college administrators and faculty members need to improve the campus climate for gender variant students and foster an environment in which people of all genders can more readily be themselves. This would be made possible through supporting openly transgender students and providing accurate information about gender diversity (Beemyn, 2003).

Implementing easily-accessible gender-neutral bathrooms, rather than only offering gender binary bathrooms or handicapped restrooms, is one such change more colleges and universities can begin to make. Consistent with Carter’s (2000) and Beemyn’s (2003) studies, this research indicates that policies such as restroom designations and residence hall assignments can penalize students who do not fit the gender binary, further segregating them. Gender-neutral housing can be implemented to more fully address the needs of transgender students. Trans-friendly housing options offers safety, as well as social and emotional support. One participant, unable to acquire trans-friendly on-campus housing, found difficulty in making friends and becoming involved in the campus community due to commuting rather than living on campus.

Other trans-inclusive policies, such as the preferred name policy or the trans-inclusive policies implemented by the all-women’s college, are advances colleges and universities can making to become more responsive to the specific needs of their transgender students. This study also demonstrates that a combination of student-run and staff-run GLBT organizations provide the most advantages for the transgender student population. This study demonstrates that while student-run organizations cater more towards the individual’s needs, the staff-run organizations can have a greater community outreach and opportunities. Combining education, and trans-inclusive policies and resources is important for transgender students to feel welcomed on campus (Johnson, 2011).

Due to its small sample size and a requirement for participants to attend a four-year college or university in Massachusetts, the conclusions in this study may differ from other states and countries. However, these findings do represent experiences of transgender Massachusetts students over a broad area and reveal important trends. Future studies can be taken to broaden the scope of the research.

Conclusion
College and university administrators should consider the importance of trans-inclusion on campuses, especially where transgender students are considered a minority group. Transgender students, like most students, offer new insights, experiences, and opportunities to their colleges and universities; however, feelings of segregation can lead to a decline in participation and motivation, resulting in students who pass through college on the outskirts.

Colleges and universities should provide education about the transgender community to its faculty and staff so that these individuals can be better suited to understanding, advocating, and helping the students on campus. As demonstrated through this study, trans-inclusive policies and programs are what allow transgender students to fully participate on campus, receive a more inclusive education, and foster feelings of safety. It is my hope that this study contributes to the improved campus climate for transgender students.
Acknowledgements
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References


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Appendix 1

PERSONAL BACKGROUND
What does “transgender” mean to you?
How or when did you decide to come out as transgender (whether to others or yourself)?
How did this revelation make you feel?
How have other people reacted?
How has your life changed?

RESOURCES
What resources does your school have for GLBT students?
Follow up questions (as needed)
Does your school have a pride center or some other GLBT friendly group?
Are there support groups or other programs for GLBT students?
Are there any resources or programs specifically for transgender students?
What kind of support do you receive or observe from these resources?
What kind of resources would you like to see on campus?

HOUSING
Where do you live as a student? As a transperson, what is it like for you to live there?
Follow up questions (as needed)
What are the housing options at your school?
Does your school offer medical housing or gender-neutral housing?
If you live on campus, how easy or difficult is it to get proper housing?
Tell me more about your experiences in on-campus housing.
If you have friends who identify as trans, what have some of their experiences been?

HEALTH SERVICES
Does your school's health services meet your needs as a transgender person?
Follow up questions (as needed)
How easy or difficult is it for you to be taken care of medically?
What challenges or obstacles do you face?
What improvements would you like to see?
Does your school provide gender-neutral or guest bathrooms?

POLICIES
Are there policies in place to aid, protect, or support transgender student?
How do you think your school could improve to meet your needs?
What specific policies have affected you the most?
What policies do you want your school to implement?

SAFETY
How comfortable do you feel about being “out” on campus?
Do you fear discrimination on campus? In the classroom? Additional places?
Have you experienced hate crimes on campus? In the classroom? Additional places?
Do you feel safe at your school?
Is there anything else you would like to tell me?
Len Sprague is a junior pursuing a B.S. in Chemistry with an Environmental concentration. This research began as an idea, buried among many others, that thrust itself to the forefront with its seemingly endless torrent of questions. Ten weeks of long days and nights were spent consumed by these questions, with conjectures forming from the numerous avenues of exploration. Such work was made possible with the guidance of his mentor, Dr. Ward Heilman (Mathematics), and with funding from an Adrian Tinsley Summer Research Grant. All results of this research are meant to open a new branch of mathematical inquiry, with the intention of revealing ever more useful patterns and solutions to those unending questions. This work was presented at the fall 2013 Mathematical Association of America (MAA) Northeastern Sectional Meeting.

For centuries, scholars have analyzed a collection of problems that, nowadays, has been defined as NP-complete. Currently, NP-complete problems have no known efficient solutions. The Clay Mathematics Institute has offered a reward of one million dollars for a solution. The problem of finding Hamilton paths and cycles has been shown to be in this category. Knight’s tours, where the knight must visit every square of a chessboard exactly once, are examples of Hamilton paths and cycles.

This research revolves around the creation of a new branch of the tour problems, through a new piece: the Archbishop. Chess Grandmaster José Capablanca created this piece, giving it the ability to move as either a Knight or a Bishop, to increase the complexity of Chess. Some of the questions investigated are: does the Archbishop have Hamilton cycles and paths on various size boards (not only 8x8 but 3x3, 4x4, ...)?, and, how many edges are there in the movement graphs of these boards?

One result used different counting arguments. The Archbishop, unlike the Knight, is not forced to “switch colors” on the checkered chess board, as it has the ability to move diagonally to a square of the same color. Therefore, it has the ability to tour a board with an odd number of squares. A second result was the equation for the number of edges the Archbishop movement graph has in relation to the size of the board: \(6n^2 - 16n + 10\). With this finding also came the equation of a Bishop’s number of edges: \(2n^2 - 4n + 2\). Third, using graph theory, it was found that an Archbishop cannot complete a cycle on a 4x4 chess board. And fourth, using a cyclic solution of a 3x3 board, a solution for all 3nx3n boards was found by connecting the smaller solutions together. These findings suggest many new problems and present new opportunities for people to investigate.

Introduction, Context, and Significance
Since the creation of the chess board in 9 A.D., its many pieces have given birth to new ideas and puzzles in mathematics. These puzzles were expansive enough to have sparked the creation of books specifically covering the topic of mathematics in chess and games similar to it (shogi, Go, checkers, etc...). One highly popular puzzle is the attempt at touring a chess board with a chess piece. This puzzle is described in Graph Theory as searching for a Hamilton path or cycle. Graph Theory is the study of graphs. A graph is defined by
mathematicians as a set of objects, called vertices, and their connections, called edges, illustrated by lines linking them together. On a chess board, each square is a vertex, and the chosen piece's possible movements are the edges (Figure 1a & 1b, example edges; Figure 2, example vertices). Each vertex in a graph has a degree, which is the number of edges connected to it (a degree 5 vertex has 5 edges sprouting from it). Two vertices are said to be connected if there is an edge from one vertex to the other vertex. A Hamilton path is a sequence of connected vertices which contains every vertex exactly once, while a Hamilton cycle is a Hamilton path that, in addition, returns to the starting vertex. A graph with a Hamilton cycle is referred to as Hamiltonian. The Knight is the most studied of the chess pieces in this puzzle of touring, and is the most difficult one so far. The Knight became a piece of intrigue because its move differed so greatly from any of the other pieces, and became the object of greater study in the realm of Hamilton paths and cycles. In Figures 1a and 1b, examples of solved Knight's tours (a path and a cycle) are illustrated. Presently, there is no way of solving for a Knight's tour in an efficient amount of time, although strategies and theorems are known for determining the existence of a solution on a given board.

Puzzles such as the Knight's tour problem have gained enough interest to warrant a million dollar reward for a complete solution. These tour-problems fall into a category of problems called NP complete, which is specifically designated for problems lacking an efficient solution (defined as finding a solution in polynomial time). Problems such as route efficiency (which are either Hamiltonian or Eulerian questions) make up a portion of these NP complete problems, and if a pattern or calculation were known for one it can be transformed into a solution for other NP complete problems. The Clay Mathematics Institute has defined a set of seven problems, known as “The Millennium Prize Problems,” each of which holds a million dollar reward for a fully fleshed out solution. Determining if NP complete problems have an efficient solution is one of these.

Despite all the interest in the Knight's tour problem and problems similar to it, there were some chess pieces left out of the math world's gaze that deserve attention as well. In the 1920's,
José Capablanca, a chess grandmaster and, at the time, the World Chess Champion, extended the 8x8 chessboard (the standard chess board size) and created two new pieces, the Archbishop and the Chancellor, in order to increase the difficulty of the game of chess and prevent what he thought would soon be constant stalemates between Grandmasters. The Archbishop increased the complexity of the Knight's abilities since it could move as a Knight or a Bishop (Figure 2 illustrates this combination). When Capablanca lost the World Championship title the next year, his new pieces were almost forgotten. Yet these new abilities endowed to the Archbishop piece created a new puzzle filled with many new questions which should be explored.

George Polya’s book *How to Solve it* was a very helpful tool and key factor in researching this rather complex problem. He focuses on the concept of breaking down larger problems into smaller questions and attempting to solve the smaller problems first. Research, therefore, began with a chess board of 3x3 squares instead of the traditional 8x8, to search for the Archbishop’s Hamilton cycle.

### Findings

1. **Smaller Solutions**
   Using a trial and error method, the following solutions of some Hamilton paths and cycles on boards of size 3x3, 4x4, 5x5, and 2x3 were found (Figures 3a and 3b). Larger solutions were found using a modified Warnsdorff’s rule. Due to the exponential growth of the number of solutions a board will have, brute force methods become unfeasible, and abhorrent.

![Figure 2](image)

**Figure 2.** Bishop, Knight, and Archbishop Movement Patterns (Left to Right, respectively)

2. **Larger solutions using smaller ones**
   With the above smaller solutions, larger ones can be solved using a sectioning method of a given board size, i.e., a 6x6 board is equivalent to connecting four 3x3 solutions together. In order to solve larger boards of 3x3n size, the smaller solution can be used by breaking an edge of the cycle to make it a path, therein covering all the squares while allowing two squares to have a connection to other 3x3 sections of the 3x3n. Each grid block in Figure 4a and 4b represents a 3x3 segment. Using all cycles (turned into the necessary path to continue movement to the next 3x3 segment), one can follow the directions shown in Figure 4a and 4b to complete a 3x3n board, n being odd or even respectively.

![Figure 4a & 4b](image)

**(Above) Fig 4a and 4b-Odd/Even solution pattern**

*S = starting position*

Starting from the corner 3x3 segment of a 3x3n sized board, travelling the full length of segments in one direction, and then the full length 90 degrees from the first direction, weaving back and forth until returning to the original segment will complete the cycle. This pattern was discovered by following a modified Warnsdorff strategy, traveling around the edges of the board and working closest to the solved 3x3 grids to avoid missing a vertex.

![Figure 3a & 3b](image)

**Figure 3a & 3b.** 2x3, 3x3, 4x4, and 5x5 Archbishop Paths
3. Use of the counting argument in determining what size boards can be solved
Among the first and simplest methods of determining a chess-board’s possibility of having a Hamilton cycle is through the aforementioned strategy of counting. To summarize, the idea is: when a Knight moves on the chess board with squares colored alternately black and white, it must switch to a different colored square every time (the Knight’s only option is a black square when it moves from the white). Therefore, in order to visit every square only once and return to the start (creating a cycle), there must be an even number of black and white squares so that it can finish in a square that allows it to return to the starting square. Thus, there can be no Knight tours of \((2n+1) \times (2n+1)\) boards.

However, since the Archbishop has the ability to move as a Knight or a Bishop, it does not have to switch colors every move (a Bishop movement keeps it on the same color). The Archbishop can, therefore, take up as many white or black squares in a row as the board will allow, meaning that the number of white and black squares overall does not have to be the same. So, the Archbishop has the ability to establish a Hamilton path or cycle on boards with an odd number of squares, as well as the possibility of one even if the numbers differ significantly. Figure 3b illustrates this with a cyclic route on a 5x5 board done with an Archbishop, whereas the Knight is unable to complete a cycle on a 5x5.

4. A 4x4 Has No Cycle (drawing graphs)
Graphs are useful in finding Hamilton paths and cycles in largely two ways. One, if the graph can be drawn such that the vertices and some edges create a circle (see Figure 6, with an Archbishop’s graph on a 2x3 board), then it has a Hamilton cycle (exactly one, if no other edges exist that lie on the circle). The original graph may look like Figure 5, but the vertices upon shifting around can be manipulated into a circular shape if the cycle exists. On a 2x3 and a 3x3 grid, this circle is easily visible (Figure 6). And two, The Rubber Band Theorem uses graphs to quickly test for the lack of a Hamilton cycle.

Figure 7a shows the four vertices and their connected edges that were removed for the Rubber Band Test (circled). Figure 7b shows the five components of the graph that remain; one more component than the number of vertices removed. Therefore, the 4x4 Archbishop graph does not pass this Rubber Band Test, and therefore the Archbishop is unable to complete a Hamilton cycle on a 4x4 grid. However, as seen above in the 5x5 case, a Hamilton path is still possible. The Knight, however, also cannot complete a cycle on a 4x4 grid, and in turn the Archbishop may not be able to cycle every board size, but has the ability to cycle more than the Knight alone.

Figure 6. Manipulated forms of an Archbishop’s graph: Left, 2x3; Right, 3x3.

Figure 7a. Graph of 4x4 with vertices being deleted (Circled)
Archbishop Edge Equation

Apart from the above findings which focused on determining and solving for cyclic solutions of boards, a more Eulerian approach was applied, dealing with the number of edges a graph of size $n \times n$ would have. In Ian Parberry’s article, *An efficient algorithm for the Knight’s tour problem*, he gives the equation for a Knight’s number of edges on an $n \times n$ board: \( 4n^2 - 12n + 8 \). This led to the question: is there an equation for finding the number of edges an Archbishop’s graph will have on a square board?

The top table in Figure 8 shows the results of hand counting the number of edges an Archbishop has on each $n$ sized board for $n = 1$ to $9$, producing evidence that there was indeed a trend. The Archbishop’s board was then broken down in an attempt to discover its edge equation. Three segments were formed, nicknamed: the outer rim, mid lane, and core (the squares at the edges and corners of the board, those that are only one step in, and then the rest of the board, respectively).

However, knowing the equation of a Knight’s edges and that the Archbishop is simply the combination of the two, this segmentation was applied to the Bishop’s board, and each segment was generalized to a simple equation (with the Bishop’s segments, the mid lane was a part of the core due to the range of the Bishop). It turned out that this breakdown was simpler to work with than the twelve possible movements of the Archbishop. With the outer rim (the vertices or squares along the very edge of the board), there are limits as to how many movements the Bishop has due not only to its own abilities but to its position on the board. For example, the corners of a board allow movement only towards the inside of the board since there are no vertices farther out than those, leaving only one possible movement (edge) for a Bishop (4 corners * 1 edge/corner = 4 edges). As for the points between the corners (still in the outer rim), these vertices are limited to two movements each, and the number of them can be calculated as: \( 4(\text{number of board sides}) \times 2(\text{possible moves}) \times (n-2) \). These two facts give the equation \( 4+(4*2(n-2)) \), or, \( 8n-12 \). Through similar breakdowns the second equation, for the core, was found: \( 4(\text{possible moves per point}) \times [n-2]^2 \times \text{(the number of points on the board without the outer rim)} \), or, \( 4n^2-16n+16 \). This equation was added to the outer rim’s to account for the whole board, and divided by two to account for edges counted twice, producing the equation \( 2n^2-4n+2 \) for the Bishop’s number of edges per $n$ board.

By adding the Bishop and Knight equation together, the equation \( 6n^2 - 16n + 10 \) was formed: the Archbishop’s edge equation. The lower table of Figure 7 shows where the Excel spreadsheet plugged in the size, $n$, and used the equation to get the
exact same answers as done by hand, therein validating these earlier calculations.

**Partially Explored Conjectures**

While working with the creation of the Bishop Edge equation, two approaches were created: the Bishop's diagonal movements are considered one square at a time, and are considered bound only by the board size diagonal moves (more than one square at a time). While the earlier equation was created using the first approach (what was originally nicknamed the Limpin' Bishop), the latter was also attempted for a short amount of time (nicknamed the Unlimited Bishop). Similar steps were taken to break down the Unlimited Bishop's movements into manageable equations, such as hand counting up to an 11x11 sized board and separating the board into sections, yet gave only a rough ability to estimate larger boards. By using excel's ability to form an equation from a set of graphed data points (the values calculated by hand for the number of edges up to an \( n = 11 \) board), this equation was estimated:

\[
\frac{2}{3} n^3 - n^2 + \frac{1}{3} n
\]

By rounding up to the nearest whole number, the value this equation puts out matches the actual number of edges per \( n \) sized board. However, the catch, of course, is having to round up each output from the equation, which at some point will cause the values to skew, albeit at very high values of \( n \). By having excel estimate using a fourth degree polynomial, this equation is formed:

\[
\left( (-3 \times 10^{-14}) n^4 \right) + \frac{2}{3} n^3 - n^2 + \frac{1}{3} n - (3 \times 10^{-9})
\]

This fourth degree equation gives a much closer value output, but is slightly overestimating the number of edges by about .002 edges per increase of \( n \) by 1.

Recall that the Archbishop is unable to complete a cycle on a 4x4 board. This is true as long as the board is not linked from one side to the other in what is known as a wrap-around. A wrap-around allows for a connection to be made between all the side squares. Each square on one side is connected to a square on the other side. For example, if we were using a Bishop, and he was positioned on the lower left corner of a 4x4 board, not only could we move to the square up one and right one, we could move from there to: the top right square, the one above the bottom right corner square, and the one to the right of the top left square, in only one movement. If the Archbishop is placed on this wrap-around version of a 4x4 board, it turns out that it can, in fact, complete a cycle.

**Conclusion**

Two things embody the purpose behind research such as this: one, it is a new branch of study that holds many unanswered questions, which opens up a whole new set of possibilities; and two, good, pure, mathematical research inevitably leads to important applications. As a new branch of study, it opens up interesting lines of research on a whole new set of problems, involving questions such as: is there a limit to the number of diagonal (Bishop type) movements that can be made to complete a tour; and, is there a minimum number of Bishop movements needed to complete a cycle where Knight’s moves alone cannot; or, is there a maximum? What is it? Do even or odd, square or rectangular boards have a higher maximum, or are they the same? These questions arose during only ten weeks of study on the Archbishop, allowing the creation of conjectures and side quests from the main problem. For example, after only a small amount of time exploring how many Bishop moves are needed and if there is a maximum allowed when completing an Archbishop cycle, the following conjectures were made: (i) it seemed that the number of movements must be odd in order for a cycle to be formed; (ii) it seemed that the minimum was three bishop movements in order to create a cycle; and (iii) it appears the movement of a Bishop will approach 50% traversal of the board, though never reach it as it cannot escape from a corner, and therefore less than half of the movements in a cycle must be a Bishop's. Many more of these questions and conjectures exist, opening many other fascinating and challenging lines of inquiry.

**Works Referenced**


A Mathematical Analysis of a Game of Craps

Yaqin Sun

The game of craps is an extremely popular game offered by casino operators. There are some 40 different types of bets that one can place each time the game is played. One of the best bets from a player’s point of view is the Pass Line bet. The probability of winning a Pass Line bet is almost the same as the probability of losing (\( \frac{244}{495} \) versus \( \frac{251}{495} \)) as we will derive rigorously in this article. Since the “house” has such a small advantage over the players, many players possess the illusion that they have pretty good chance of making a profit or even making a living by playing this game. This article will show that this really is not the case. We will show that the probability of making a profit is almost zero if one plays the game regularly for a relatively long period of time.

I. Introduction

Craps is a dice based game where multiple players make bets against the “house” by placing chips on the appropriate part of the layout of a special table before each roll. The layout is a table cloth made of felt that displays the various betting possibilities. According to Botermans & Fankbonner (2008), “Craps is derived from an English dice game Hazard. In North America, Hazard began to spread, starting in 1800 among the black residents of New Orleans” (p. 541-42). People who play craps often believe that they have opportunities to win large amounts of money and pull down the house -- as long as they do not bet too much money all at once, and keep playing. In this article, we will show mathematically that this is not the case. There are about 40 different types of bets that can be made on a craps layout, but most of them, like the Proposition and the Hardway Bets, have terrible odds that we should avoid (Ortiz, 1986).

According to Derousseau (2007), the game of craps, as a whole, arguably gives the best odds of winning among all casino games. As a matter of fact, as we will show in this article, among all the different bets one can place in the game of craps, the Pass Line bet regards one of the best bets due to its high winning probability. In this article, we will concentrate on deriving results for a Pass Line bet. Unlike most of the literature that uses a heuristic method, we will derive all our results, including the probability of winning by using a completely rigorous mathematical approach. Ultimately, we will show that the probability of coming out ahead (making a profit) is actually slim to none if you keep playing- as problem gamblers do, who comprise 1.1 percent of the adult population of the United States and Canada, (Shaffer, Hall & Vander, 1999).
II. Description of the Pass Line Bet

We know that the game of Craps is played by rolling two dice on the Crap table. Players take turns to be the thrower. Players should make their bets before the thrower begins his/her roll, this is known as the come out roll. A thrower will continue to be the thrower until he/she “sevens out” (explained later). When that happens, another player will become the new thrower. Based on the rules described by Morehead, Frey, and Mott-Smith (1991), one of the following three things will happen on the come out roll:

1. A sum of 7 or 11 is rolled. The game ends. The same thrower will then make another come out roll after all players placed their new bets.

2. A sum of 2, 3, or 12 is rolled. The game ends as well. All Pass Line bets are lost. The same thrower will then make another come out roll after all players placed their new bets.

3. A sum of 4, 5, 6, 8, 9, or 10 is rolled and that sum becomes “the point”. The thrower will continue to roll the dice until either the point is rolled again or a sum of 7 is rolled. If the thrower makes the point (rolled the “point” again before a sum of 7) or “sevens out” (rolled a sum of 7 before making the point), the game will end. If the thrower makes the point, all Pass Line bets win and the same thrower will remain the thrower for the next game. If the thrower sevens out, all Pass Line bets are lost and the dice will be passed on to a new thrower.

III. Winning Probability and Expected Profit of a Pass Line Bet

A. Payoff Schedule: Before analyzing the winning probability and expected profit of a Pass Line Bet, it is necessary to know the payoff schedule. Suppose that a player makes a $90 Pass Line bet, one of the following three cases will happen:

Case 1: If the come out roll yields a sum of 7 or 11, then the player makes a $90 profit.

Case 2: If the come out roll yields a sum of 2, 3 or 12, then the player loses his/her $90 bet.

Case 3: If a point (a sum of 4, 5, 6, 8, 9, or 10) is rolled on the come out roll, the thrower will continue to roll the dice until either the point is rolled again or a sum of 7 is rolled. If the point occurs first, then the player wins $90. If the sum of 7 occurs first, then the player loses and the house wins $90.

B. Winning Probability: In this section, I will compute the winning probability and net profit of a Pass Line bet. To start, I am going to explain two concepts in probability theory: mutually exclusive events and independent events.

Mutually Exclusive Event: According to Hsu (1996), events $E_1, E_2, E_3, ..., E_n$ are said to be mutually exclusive if no two events can occur at the same time. The probability that at least one of the mutually exclusive events will occur is

$$P(E_1 \cup E_2 \cup \cdots \cup E_n) = P(E_1) + P(E_2) + P(E_3) + \cdots + P(E_n)$$

Independence: According to Hsu (1996), events $E_1, E_2, E_3, ..., E_n$ are said to be mutually independent if the occurrence of one event does not affect the probability of the others. For example, when the thrower throws two dice, the probability of throwing a sum of k on any roll is not affected by previous outcomes. The probability of successive events is

$$P(E_1 \cap E_2 \cap \cdots \cap E_n) = P(E_1) \cdot P(E_2) \cdot P(E_3) \cdot \cdots \cdot P(E_n)$$

On each roll of the game, the thrower throws two six-sided standard dice at the same time. There are 36 possible outcomes (1,1), (1,2), (1,3), ..., (6,5), and (6,6), where (i,j) stands for the outcomes when the face value on die 1 is i and the face value on die 2 is j((i,j)=1,2,3,4,5,6).

The sum of the two face values can be any integers from 2 to 12. There are 6 ways to roll a sum of 7 [(1,6),(6,1),(3,4),(4,3),(2,5),(5,2)] and 2 ways to roll a sum of 11[(5,6),(6,5)]. Therefore, the probability of rolling a sum of 7 is 6 out of 36, the probability of rolling a sum of 11 is 2 out of 36. To compute the winning probability, we define the event $R_k$ as event that a sum of $k$ ($k = 2, 3, 4, ..., 12$) is rolled on a single roll of the dice. The probability of rolling a sum of $k$ is shown in Table 1 above, right:

According to the rules of the game described in section II, there are two ways to win the game; roll a sum of 7 or 11 on the come out roll or establish a point on the come out roll, then make the point afterwards. We will use $W_p$ to denote the event that the player wins on the 1st roll of the dice. According to Table 1, the probability of rolling a sum of 7 is $\frac{6}{36}$, and the probability of rolling a sum of 11 is $\frac{2}{36}$. Since the events $R_7$ and $R_{11}$ are mutually exclusive, therefore, the probability of winning on the first roll

$$P(W_p) = P(R_7) + P(R_{11}) = \frac{8}{36}.$$
We will use \( W_i (i=4, 5, 6, 8, 9, \text{ or } 10) \) to denote the event that player wins by making the point \( i \). We further define \( W_{i,j} \) as the event that the player wins on the point \( i \) on the \( j \)th \((j=2, 3, 4 \ldots)\) roll. In order to win a game on a point of \( i \), one of the following must happen:

1. The player wins on the second roll: the sum of the 2nd roll must be \( i \), therefore the probability of winning on the second roll is \( P(W_{i,2}) = P(R_2) \times P(R_2) \) by independence.

2. The player wins on the third roll: the sum of the second roll must be neither the sum of point \( i \) nor 7. Therefore, winning by making the point \( i \) on the 3rd roll is \( P(W_{i,3}) = P(R_3) \times [1-P(R_2) -P(R_7)] \times P(R_3) \), where \([1-P(R_2) -P(R_7)]\) is the probability of rolling a sum that is neither the sum of \( i \) nor 7.

To summarize, the probability of making the point \( i \) on the \( j \)th roll is:

\[
P(W_i) = P(R_i) \times [1-P(R_i) -P(R_7)]^{j-2} \times P(R_i)
\]

Since the events \( W_{i,2}, W_{i,3}, \ldots \) are mutually exclusive, therefore,

\[
W_i = \bigcup_{j=2}^{\infty} W_{i,j}
\]

and

\[
P(W_i) = \sum_{j=2}^{\infty} P(W_{i,j}) = P(W_{i,2}) + P(W_{i,3}) + \ldots = \\
P(R_4)^2 + P(R_5)^2 \times [1-P(R_2) -P(R_7)] \times P(R_5)^2 + \ldots \\
+ P(R_6)^2 \times [1-P(R_2) -P(R_7)]^2 \times P(R_6)^2 + \ldots
\]

\[
P(R_i)^2 \sum_{k=0}^{\infty} [1 - P(R_i) - P(R_7)]^k
\]

(1)

Note that formula (1) is a geometric series with a common ratio of \( r = [1-P(R_2) -P(R_7)] \) and the first term is \( a = P(R_i)^2 \). We know that the sum of a infinite geometric series with a common ratio \( r \) and the first term is a is

\[
s = \frac{a}{1-r}.
\]

Therefore,

\[
P(W_i) = \frac{P(R_i)^2}{1 - [1-P(R_i) - P(R_7)]} = \frac{P(R_i)^2}{P(R_i) + P(R_7)}.
\]

Hence, \( P(W_i) \) can be simplified to

\[
\frac{P(R_i)^2}{P(R_i) + P(R_7)}.
\]

Table 2 summarizes the values of \( P(W_i) \) for all \( i = 4, 5, 6, 8, 9, \) and 10.

We will use \( W_p \) to denote the event that the player wins on point 4, 5, 6, 8, 9, or 10. Since the events \( W_4, W_5, W_6, W_8, W_9, \) and \( W_{10} \) are mutually exclusive, the probability of winning with a point is:

\[
P(W_p) = P(W_4) + P(W_5) + P(W_6) + P(W_8) + P(W_9) + P(W_{10}) = \\
\frac{1}{36} + \frac{2}{36} + \frac{25}{36} + \frac{25}{36} + \frac{2}{36} + \frac{1}{36} = \frac{134}{495}
\]

Let \( W \) denote the event of winning on a Pass Line bet. Since the event \( W_p \) and \( W \) are mutually exclusive, thus,

\[
P(W) = P(W_p) + P(W) = \frac{8}{36} + \frac{134}{495} = \frac{244}{495}
\]

C. Expected profit: In this section, I will calculate the expected net profit from a $90 bet on the Pass Line for a total of \( n \) times, where \( n \) can be any positive integer. At the outset, I will explain some concepts in probability: expected value, variance, and standard deviation.
Expected Value: According to Grinstead and Snell (1997), suppose random variable $X$ can take the value $x_1$ with the probability of $p_1$, the value $x_2$ with the probability $p_2$, and so on, up to the value $x_k$ with the probability $p_k (k = 1, 2, 3, \ldots)$. Then the expected value of this random variable $X$ is defined as

$$E(X) = x_1p_1 + x_2p_2 + \ldots + x_kp_k.$$ 

Variance: According to Grinstead and Snell (1997), let $X$ be a numerically valued random variable with expected value $E(X)$. Then the variance of $X$, denoted by $\text{Var}(X)$, is

$$\text{Var}(X) = E(X^2) - [E(X)]^2.$$ 

Standard Deviation: According to Grinstead and Snell (1997), the standard deviation of $X$, denoted by $\sigma_X$, is

$$\sigma_X = \sqrt{\text{Var}(X)}.$$ 

We will use the random variable $X_i$ to denote the profit, in dollars, from the $i^{th}$ game. Then $X_i$ takes on either the value 90 when the player wins or the value -90 when the player loses. Therefore,

$$E(X_i) = 90 \times \frac{244}{495} + (-90) \times (1 - \frac{244}{495}) = -\frac{14}{11}$$ 

$$E(X_i^2) = 90^2 \times \frac{244}{495} + (-90)^2 \times (1 - \frac{244}{495}) = 8100$$ 

$$\text{Var}(X_i) = E(X_i^2) - [E(X_i)]^2 = 8100 - \left( -\frac{14}{11} \right)^2 = \frac{979,904}{121}$$ 

$$\sigma_{X_i} = \sqrt{\text{Var}(X_i)} = \sqrt{\frac{979,904}{121}}$$

Let $T_n$ denote the total profit from playing the game a total of $n$ times. Since $X_1, X_2, \ldots, X_n$ are independent and identically distributed random variables with the same mean $-\frac{14}{11}$ and the same standard deviation (square root of $979,904/121$), hence the mean, the variance, and the standard deviation of $T_n$ are as follows:

$$E(T_n) = \sum_{i=1}^{n} E(X_i) = nE(X_i) = -\frac{14n}{11}$$ 

$$\text{Var}(T_n) = \sum_{i=1}^{n} \text{Var}(X_i) = n\text{Var}(X_i) = \frac{979,904n}{121}$$ 

$$\sigma_{T_n} = \sqrt{\text{Var}(T_n)} = \sqrt{\frac{979,904n}{121}}$$

### Table 2. The Probability of $W_i$

<table>
<thead>
<tr>
<th>$i$</th>
<th>$P(R_i)$</th>
<th>$P(R_i) + P(R_j)$</th>
<th>$P(W)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>$\frac{3}{36}$</td>
<td>$\frac{3}{36} + \frac{6}{36} = \frac{9}{36}$</td>
<td>$\frac{1}{36}$</td>
</tr>
<tr>
<td>5</td>
<td>$\frac{4}{36}$</td>
<td>$\frac{4}{36} + \frac{6}{36} = \frac{10}{36}$</td>
<td>$\frac{2}{45}$</td>
</tr>
<tr>
<td>6</td>
<td>$\frac{5}{36}$</td>
<td>$\frac{5}{36} + \frac{6}{36} = \frac{11}{36}$</td>
<td>$\frac{25}{396}$</td>
</tr>
<tr>
<td>8</td>
<td>$\frac{5}{36}$</td>
<td>$\frac{5}{36} + \frac{6}{36} = \frac{11}{36}$</td>
<td>$\frac{25}{396}$</td>
</tr>
<tr>
<td>9</td>
<td>$\frac{4}{36}$</td>
<td>$\frac{4}{36} + \frac{6}{36} = \frac{10}{36}$</td>
<td>$\frac{2}{45}$</td>
</tr>
<tr>
<td>10</td>
<td>$\frac{3}{36}$</td>
<td>$\frac{3}{36} + \frac{6}{36} = \frac{9}{36}$</td>
<td>$\frac{1}{36}$</td>
</tr>
</tbody>
</table>
By the Central Limit Theorem, $T_n$ is approximately normally distributed with a mean of $\frac{-14n}{11}$, and a standard deviation of $\frac{\sqrt{979,904n}}{121}$ when $n$ is sufficiently large (at least 30).

Therefore, the chance of making a profit after playing the game a total of $n$ times is

$$P(T_n > 0) = P\left[Z > \frac{0 - \left(-\frac{14n}{11}\right)}{\sqrt{\frac{979,904n}{121}}}\right] \approx P(Z < -0.014\sqrt{n})$$

Using the standard normal table, we can find the value of $P(T_n > 0)$ for all values of $n$. Table 3 shows the value of $P(T_n > 0)$ for some selected values of $n$.

**Table 3. Probability of Making a Profit**

<table>
<thead>
<tr>
<th>$n$</th>
<th>$P(T_n &gt; 0)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>0.443</td>
</tr>
<tr>
<td>400</td>
<td>0.3897</td>
</tr>
<tr>
<td>900</td>
<td>0.3372</td>
</tr>
<tr>
<td>2,500</td>
<td>0.2420</td>
</tr>
<tr>
<td>6,400</td>
<td>0.1292</td>
</tr>
<tr>
<td>10,000</td>
<td>0.0808</td>
</tr>
<tr>
<td>40,000</td>
<td>0.0023</td>
</tr>
<tr>
<td>100,000</td>
<td>0*</td>
</tr>
</tbody>
</table>

* it is less than .005 of one percent

The results in Table 3 are shown in the following figure, Figure 1.

**Conclusion**

As shown in Figure 1, if a player plays the game long enough, then the chance for the player to come out ahead (making a profit, that is) is slim to none. The chance of making a living from playing the game regularly is even smaller. If each game takes an average of 1.5 minutes to play, it will take a total of 1,000 hours if a player plays the game a total of 40,000 times. Assuming the player spends an average of 20 hours a week playing this game, he or she would have played the game more than 40,000 times in one year. Therefore, if a player plays the game regularly, he or she will have a less than one fourth of one percent chance to be ahead after one year of playing the game. On the other hand, the casino operators should never worry about losing big money to certain lucky patrons. Considering the size of the sample (pooling all the thousands and millions of patrons together), the chance of meeting a profit goal for the casino is almost certain with a negligible margin of error. In summary, almost no one is going to make money playing craps over a long period of time. The results we have proved in this article are testimony to an old Chinese saying that “if you gamble long enough, you are destined to lose.”
References


Adam Smith – Providing Morality in a Free Market Economy

Kendra Tully

Kendra Tully is a graduating senior majoring in Economics and Political Science, with a minor in Philosophy. This research, part of a larger Honors Thesis, was conducted under the direction of Dr. Jordon Barkalow (Political Science) and supported with funding from a 2013 Adrian Tinsley Summer Research Grant. She will present this research at the 2014 Midwest Political Science Association conference in Chicago, IL. Kendra plans to pursue Ph.D. program in Political Science, where she hopes to continue her research and develop her teaching abilities.

Adam Smith’s Theory of Moral Sentiments (TMS) and Wealth of Nations (WN) appear to suffer from an irresolvable tension: TMS extols human sympathy whereas WN extols the consequences of self-interest. This paper takes a comprehensive approach, adding to scholarship on what has become known as the “Adam Smith Problem.” Through a textual analysis of TMS and WN that focuses on prudence, the nature of happiness and Smith’s rhetorical style, the inconsistency between his two texts disappears. The emphasis Smith places on prudence in WN can only be properly understood when one considers its foundations in sympathy found in TMS. By demonstrating the integral connection between morality and markets, Smith provides his reader with the means to critique educators, economists, and skeptics of capitalism.

When Adam Smith completed his two greatest texts, he could not have foreseen that scholars would later name the “Adam Smith problem” after an apparent inconsistency in his work. Yet the “Adam Smith problem” persists, which comes about from a tension between his moral theory based on sympathy, laid out in Theory of Moral Sentiments, and his economic theory based on self-interest, laid out in Wealth of Nations (hereafter, mentioned as TMS and WN). Sympathy and self-interest are at odds, as one is other-regarding and the other is self-regarding. Analyzing the connecting virtue of prudence dispenses with this tension and then leaves room to explore broader connections that can be made between his two texts, such as Smith’s idea of happiness (which is realized through prudence) and his style of rhetoric. Some of Smith’s technical economic reading can be tedious, but when employing historical or situational examples he encourages his audience to make moral as well as economic and political evaluations. One example in particular showcases the importance he places on morality: the characters of the agricultural versus manufacturing man. Drawing these conclusions about the relationship between these two texts shows that Smith is, in fact, very consistent and even more comprehensive in his works than previously thought. If then economics has lost its way by portraying economic actors as strictly utility maximizers, a reading of the two texts in this light brings a more robust understanding of human economic and social behavior.

In reconciling Smith’s economic, political, and moral thought more generally, scholars use four different approaches: the political, economic, “prin-
Prudence

In critical analysis of a text, one cannot deny fact, and the fact is that self-interest is the basis for individual economic behavior in *WN*. However, self-interest is framed as prudence, which is a virtue only rightly understood by also examining *TMS*. Without moral context, there is no way to connect prudence with sympathy, which is the basis for all morality in *TMS*. First, it will be helpful to explore self-interest in *WN* to understand why Smith believes it to be the driver of progress, and then to ground his understanding of prudence in his moral theory.

Smith believes that self-interest is an inherent quality in man, which realizes itself in economic behavior by man’s tendency to “truck, barter, and exchange” for their mutual advantage (WN I.ii.1). A man could produce all the means of his own subsistence; he could cut his own timber to build his own house, he could grow all his crops, butcher his own meat, and sew his own clothes, but men realize the ease that can be obtained by relying on others for the production of these things (WN IV.ii.11). Smith recognizes that it is easier for one man to buy or trade for all the conveniences of life than attempt to create and provide them all himself, thus, he employs himself in some other way, which is not only more advantageous to himself, but to society as well (WN III.1). Improvements and increases in productivity are caused by the division of labor and the increase of specialization (WN I.i.1, 6). Some of these improvements are the introduction of money as a means of exchange (WN I.iv), as well as the introduction of the manufacturing sector. Manufacturing is what moves society from the agrarian stage to the commercial stage, “when by the improvement and cultivation of land the labour of one family can provide food for two, the labour of half the society become sufficient to provide food for the whole. The other half, therefore... can be employed in providing... the other wants and fancies of mankind” (WN I.xi.c.7). The division of labor is not a chosen outcome, but an unintended consequence of that original principle in human nature to be self-interested, and leads to the industrialization and progress of society.

Although self-interest is an inherent quality in man, Smith characterizes it as “prudence” and not selfishness, and there are lesser virtues of prudence which become apparent in commercial society. Prudence rightly understood requires frugality, industry, and foresight (WN I.x.b.38, see also WN II.ii.36, II.iii.16). An examination of the accumulation of stock versus capital best exemplifies these lesser virtues. Division of labor allows each man to establish his own trade, but he cannot do so without some accumulation of stock, or capital (WN II.4). Smith says that the general tone of society as productive or lazy will be set by the proportion between capital and revenue (WN II.iii.13). As capital is put to use in the manufacturing and production of goods and revenue is not put to any productive use at all, capital tends toward industry and the other breeds idleness, and this outcome is set by the choices of the individuals in that society. Smith agrees that while some will give in to the violent “passion for present enjoyment,” most will choose to save, based on the “desire of bettering our condition, a desire which, though generally calm and dispassionate, comes with us from the womb, and never leaves us till we go into the grave” (WN II.iii.28). The accumulation of capital requires the frugality to save, the industry to put what has been saved to use, and the foresight to know best how to direct that capital once it is in use. The accumulation of capital then, just as with the division of labor, adds to the productivity and improvement of society. However, just as in the case with the division of labor, it is not by conscious choice to improve society that men exercise frugality and industry but from a regard to their own well-being. It is Smith’s “invisible hand” concept that explains how these private interests to augment capital lead to the overall promulgation of domestic business. He writes:

> every individual is continually exerting himself to find out the most advantageous employment for whatever capital he can command. It is his own advantage, indeed, and not that of the society, which he has in view. But the study of his own advantage naturally, or rather necessarily leads him to prefer that employment which is most advantageous to the society. (WN IV.ii.4).

However, to prove that economic self-interest has many positive unintended consequences to society is not to deny that it is still self-interest, which could either mean that all economic behavior is selfish, or that “bettering our condition” means economic actors base their actions on sympathy.
Smith clearly denies that economic behavior originates from selfishness, as he specifically states that commerce between individuals should be based on “a bond of union and friendship” (WN IV.iii.c.9). The other option then is to revisit Smith’s TMS to answer the question; is self-interest based on sympathy? Self-interest in both TMS and WN is referred to as “prudence,” which is the general care an individual takes to the maintenance of their health, fortune, rank and reputation (TMS VI.i.5). An individual’s health is easy enough to maintain, as it requires a proper course of diet and exercise. A person’s fortune is dependent on those lesser virtues of industry and frugality which are explicitly made reference to in TMS (TMS VI.i.11). It is an individual’s rank and reputation which “depend very much upon what… our character and conduct, or upon the confidence, esteem, and good-will, which these naturally excite in the people we live with” (TMS VI.i.4). A man who pursues fortune in order to distinguish himself among the ranks of men does so in a particular way, following all the “established decoums and ceremonials of society” (TMS VI.i.10). It is only at that point at which he has earned the respect and approbation of others which Smith believes to be the “strongest of all our desires” (TMS VI.i.4, emphasis added). Accordingly, feelings of approbation come when an individual displays propriety in their action and an adherence to the general rules of society. These rules are “ultimately founded upon experience of what, in particular instances, our moral faculties, our natural sense of merit and propriety, approve, or disapprove of” (TMS III.4.8).

How are feelings of propriety and merit established? By the use of sympathy; sympathy for Smith is not akin to empathy. Instead it is a mode by which one may enter into another’s situation, and in doing so exercise their moral sentiments in order to best make moral evaluations about the other’s behavior. When the sentiments of two individuals are in concord, approbation follows (TMS I.ii.3.1). Thus, self-interest in WN gains a moral foundation when connected to the virtue of prudence in TMS. The tension between self-interest and sympathy dissolves when one realizes that prudence is grounded on sympathy, in the sense that an individual’s prudent behavior is in accordance with “propriety,” which originates from the use of sympathy which forms social standards based on society’s moral evaluations.

Smith demonstrates that prudent behavior occasions moral approbation and respect. Man’s economic transactions therefore define his character, or at least who one wants the world to see, and men seem to engage in economic evaluation just as they engage in moral evaluation. For example, throughout WN Smith gives the fullest support for freedom of occupation. This can be seen from his extended critique of apprenticeships, which constrain and confine the individual in their preference of profession (WN I.x.c.12-16). Could this be because he supports the most liberal society? Perhaps, but it also suggests on a deeper level a commitment to allowing for moral self-actualization. Smith observes that a man’s labor is an extension of himself: “the patrimony of a poor man lies in the strength and dexterity of his hands; and to hinder him from employing this strength and dexterity in what manner he thinks proper… is a plain violation of [his] most sacred property” (WN I.x.c.12). Only by providing for the freedom of choice does Smith allow men to better their condition on their own terms. A person’s choice of career, the sole means which one proposes to support themselves, seems to be the greatest economic choice of all, but how does one choose? Most men choose a profession which affords the greatest “publick admiration,” for “what are the advantages which we propose by that great purpose of human life which we call bettering our condition? To be observed, to be attended to, to be taken notice of with sympathy, complacency, and approbation” (WN I.x.b.24, TMS I.iii.2.1). A man who prudently enters into any profession, and prudently conducts his business therefore receives all the attention and moral approbation he requires. The sole motivation behind every individual’s desire to become the object of this sympathy and approval is happiness. Therefore, prudence, a regard to one’s own station and choices in life, gives him the means to find happiness.

What does happiness mean for Smith? There are a few ways in which happiness is meant, but in all it means a sense of “tranquility” (TMS VI.i.12, see also TMS III.3.31). In the first way, happiness is economic achievement. Smith describes a man who has lived by the economic principles of frugality and industry and finally reaches a point at which “he is enabled gradually to relax, both in the rigour of his parsimony and in the severity of his application; and he feels with double satisfaction this gradual increase of ease and enjoyment, from having felt before the hardship which attended to the want of them” (TMS VI.i.12). It is at this point at which all of his lifetime struggles are met with a just amount of reward and leisure. Griswold (1999, 218) characterizes Smith’s sense of happiness as being first consisting “in one’s being at rest in the sense of lacking significant discord; it is peaceful, at a deep level. Second, happiness is more like coming to a stop than like a process of moving toward a goal.” In the second way, Smith’s happiness seems to be a sort of internal equilibrium, between how one wants and feels he deserves to be perceived by others and how others actually perceive him. Smith recognizes that happiness is absence of guilt and shame, and “…the chief part of human happiness arises from the consciousness of being beloved” (TMS I.ii.5.2). This love, however, to be satisfactory, needs to be deserved. A man earns self-approbation from being the object of praise-worthiness and not simply praise (TMS III.2). Thus, happiness occurs when a man does not want to alter either his condition, or his character.
However lovely this portrayal of happiness may sound, the great irony for Smith is that men will never achieve it. Directly after Smith asserts man’s desire to “better our condition,” which “comes from us from the womb,” he states: “In the whole interval which separates these two moments [life and death], there is scarce perhaps a single instant in which any man is so perfectly and completely satisfied with his situation, as to be without any wish of alteration or improvement of any kind” (WN II.iii.28). The causes of this deviation are found both in WN and TMS. In WN, Smith recognizes that individuals want to appear as if they are doing well for themselves; that they are smart, hard-working, etc. As society places a monetary value on those items which are scarce and most valued, these become the objects which most believe will occasion them the most attention; “with the greater part of rich people, the chief enjoyment of riches consists in the parade of riches, which in their eyes is never so compleat as when they appear to possess those decisive marks of opulence which nobody can possess but themselves” (WN I.xi.c.31). Thus, “an augmentation of fortune is the means by which the greater part of men propose and wish to better their condition” (WN II.iii.28). In TMS, Smith states, “…the pleasures of vanity and superiority are seldom consistent with perfect tranquility, the principle and foundation of all real and satisfactory enjoyment” (TMS III.3.31).

For Smith, those that deem themselves praise-worthy are no longer seeking praise from others. There is an internal moral evaluation that is sufficient enough to satisfy them. Thus, it is a perversion of the imagination and a “corruption of our moral sentiments” which makes the situation of the rich more attractive than the poor (TMS I.iii.2.2, I.iii.3.1). For, “a rich man glories in his riches, because he feels that they naturally draw upon him the attention of the world, and that mankind are disposed to go along with him in all those agreeable emotions with which the advantages of his situation so readily inspire him” (TMS I.iii.2.1). The situation is thus a spiteful paradox; men may believe accumulating wealth will make them happy, but while striving for happiness they actually move farther away from it and closer to societal economic prosperity. Smith ardently believes “it is well that nature imposes upon us in this manner. It is this deception which rouses and keeps in continual motion the industry of mankind” (TMS IV.i.1.9).

By the innate desire to “better our condition” and a perversion of the imagination, men are never happy because economic activity means men are never at rest, and always striving, and if ever attaining happiness, only doing so for a short amount of time.

The example of the “poor man’s son” best exemplifies this paradox (TMS IV.i.8). A poor man’s son is born with the ambition to become rich, believing a palace, servants, and conveniences to be the best means of happiness. Thus, he spends his entire life in hard labor, working for men he hates and perfecting his manners. Finally, “in the last dregs of life” he finds that “wealth and greatness are mere trinkets of frivolous utility,” which are more trouble in attaining than they will ever be in enjoying (TMS IV.i.8). Although this man is industrious, and contributes much to society, from his greed and vanity he never attains happiness. This means of acquiring fortune does not seem to be in accordance with the prudence grounded on sympathy and virtue stated above. In the following example from WN, it becomes clear that however deep vanity might corrupt; it is the prudent and not the greedy who win in the end and who Smith supports. In addition, it demonstrates Smith’s concern over not only political and economic consequences, but moral consequences as well.

The Moral Rhetoric of Wealth of Nations

Understanding Smith’s style of rhetoric is essential to unlocking the ends and teachings of his works. Smith differs from other modern philosophers in that he does not, in most cases, adopt a high-handed tone, but instead employs common life and literary examples addressed in the first and second person. As one example among innumerable in TMS, Smith talks of how men naturally sympathize with only “great sorrows,” and proceeds to demonstrate why this is true by asking the reader to take a journey of perhaps a decade within the confines of their imagination:

If you labour, therefore, under any signal calamity, if by some extraordinary misfortune you are fallen into poverty, into diseases, into disgrace and disappointment; even though your own fault may have been, in part, the occasion, yet you may generally depend upon the sincerest sympathy of all your friends… But if your misfortune is not of this dreadful kind, if you have only been a little baulked in your ambition, if you have only been jilted by your mistress, or are only hen-pecked by your wife, lay your account with the raillery of all your acquaintance. (TMS I.ii.5.4)

It seems only fit to quote the entire passage so as to convey Smith’s ability to captivate the reader. Smith in addition uses common place examples and experiences in WN. In the opening pages of WN, Smith utilizes many examples to demonstrate the advantages and effects of the division of labor, in each case specifically calling on the reader to “imagine it” so as best to understand (WN I.i.1-11). Smith has two motives for writing this way: to familiarize and engage the reader, which in turn serves a pedagogical purpose in exercising the reader’s moral sentiments.

Smith often writes in the first person “I” or second person “we” to generate a sense of commonality and fondness, a “we are
all in this together” sort of spirit. This not only allows Smith to make his works attractive to the average layperson, but also to uphold his principles about the discipline of philosophy as well. Smith believes that “philosophers in particular are apt to cultivate with a particular fondness, as the great means of displaying their ingenuity, the propensity to account for all appearances from as few principles as possible” (TMS VII.ii.2.14). This proclivity to turn philosophy into a “system,” Smith argues, is impossible and dangerous, as a few principles cannot possibly account for all “the different shades and gradations of circumstance, character, and situation” (TMS VI.ii.2.1). The conversational use of “we” and “I,” and the commonplace examples seen throughout his work allow Smith to preserve the user-friendly feel of his moral system based on imagination and sympathy. In addition, it keeps readers from being scared away by perhaps too much philosophy. Smith recognizes that “a written philosophical work runs particular risks of encouraging an ‘academic’ detachment from ordinary life and of reducing ethical debate to a merely theoretical, perhaps casuistical, enterprise” (Griswold 1999, 62). Far from making him simple just because he is clear, Smith’s rhetorical style reveals his desire to convey extremely complicated ideas in the most approachable way possible.

Smith’s pedagogical motives behind his rhetorical style are also twofold: he wishes to encourage individuals to become better moral critics, to in turn then foster propriety in their own actions. According to his moral there, there is a desire for man’s imagination to fill in the gaps before engaging in a serious moral evaluation. Therefore, by way of examples, Smith provides the context which the imagination yearns for in order to help facilitate the function of sympathy in the reader. Fleischacker (2004, 12-13) explains that “…since [Smith] understands sympathy as an act of the imagination, rather than of the senses alone, imaginative writing can quite directly enliven or enrich our capacity for moral judgment.” The exercise of the moral sentiments then creates an opportunity for men to become better moral critics, as “criticism is an intrinsically pedagogic activity” (Griswold 1999, 65). The second component to Smith’s pedagogical reasons for his style of rhetoric is that once the reader develops their capacity for moral criticism, they will then use this to inform their own sense of propriety. Griswold (1999, 49) terms Smith’s use of the second person in TMS as the “protreptic ‘we’;” “the pronoun is ‘protreptic’ in that it is intended to persuade us to view things in a certain light, to refine the ways in which we judge and feel, and perhaps to encourage us to act in a certain manner.” Depending on the outcome of the individuals in Smith’s examples, it is a gentle way of encouraging a particular reaction to a given situation. For example, in the section in TMS on the virtue of self-command, Smith tells the tale of Alexander the Great, who places his trust in the wrong people who, after he dies, “divided his empire among themselves, and after having thus robbed his family and kindred of their inheritance, put, one after another… to death” (TMS VI.iii.32). Alexander enjoys being flattered and in power, and thus due to “excessive self-estimation,” which Smith cautions against here, ends up destroying his empire and family (TMS VI.iii.32).

Some authors focus on Smith’s use of examples in WN, but argue that his main goal is to clarify for the reader important economic principles or political roadblocks (Fleischacker 2004, 7-26). However, it could be argued that Smith also employs examples in WN to impress moral lessons on the reader as well. If this is true, it means that not only does Smith use the same rhetoric style in TMS and WN, but they both additionally serve the same purpose, which is to cultivate positive, critical moral judgment in human behavior. Once these moral lessons are understood, men can then become better moral observers, and political and economic actors.

Agricultural vs. Mercantile Man

Smith’s characterization of the agricultural and merchant man best demonstrates the difference seen above between prudence proper and improper. By looking at these two individuals, it becomes possible to answer the question: what is the good life for Smith? Smith is not only concerned about the proper direction of prudence, but also how far that prudence will procure happiness. Smith’s preference is clearly for the agricultural system, as it allows for the “natural” pattern of growth for a nation, and supports “productive” labor (WN IV.ix.2, 38). Smith distinguishes productive from unproductive labor as being that which both replaces initial expenses in establishment and produces additional benefit to society (WN IV.ix.10). Farmers are most likely to contribute above and beyond replacing capital expenses, whereas manufacturers are not, thus manufacturing stock is “unproductive” (WN IV.ix.10). More important than the economic outcomes of these two systems, are the moral implications of both. The agricultural system is most likely to produce a “common character” of “liberality, frankness, and good fellowship,” whereas the mercantile system breeds “narrowness, meanness, and a selfish disposition, averse to all social pleasure and enjoyment” (WN IV.ix.13). The “system” is just a reflection of the character of the individual farmers and merchants, who at their core are fundamentally different. The agricultural spirit is one of community, honesty, and generosity, whereas the merchant exemplifies the “corporation spirit” of competition, cunning, and isolation (WN IV.ii.21). Farmers, as they are spread out, are much less likely to collude for the purposes of establishing a monopoly, and to feel threatened into fierce competition with another farm leagues away. To the extent that farmers may begin to act this way is only a conse-
quency of the corruptive nature of the “corporation spirit”; “It was probably in imitation of them, and to put themselves upon a level with those who, they found, were disposed to oppress them, that the country gentlemen and farmers of Great Britain so far forgot the generosity which is natural to their station, as to demand the exclusive privilege of supplying their countrymen” (WN IV.ii.21).

It is not only the nature of the two industries, but also the products of that industry which contribute to this stark contrast. Smith explains that as a country’s agricultural abilities develop, it only takes half the population to supply the entire subsistence of a nation, while the other half are put to work “satisfying the other wants and fancies of mankind” (WN I.xi.c.7). The nature of food is such that the amount desired by an individual is limited “by the narrow capacity of the human stomach,” whereas “the desire of the conveniences and ornaments of building, dress, equipage, and household furniture, seems to have no limit or certain boundary” (WN I.xi.c.7). The nature of the agriculture business is to supply the equal necessities of life to those who desire them, thus there really is no room for extravagant accumulations of profit. In contrast, as the mercantile business supplies the unequal conveniences of life to those who desire them, as long as customers who have the desire to acquire are alive, there is no end to the possible accumulation of profit. Thus, it is the inherent nature of the two businesses which makes merchants prone to vanity, greed, and improper prudence, and farmers prone to saving, industry, and proper prudence. The same observation is made in TMS: “In ease of body and peace of mind, all the different ranks of life are nearly upon a level, and the beggar, who suns himself by the side of the highway, possesses that security which kings are fighting for” (TMS IV.1.10). Men are equal in one respect, and it is only because they are unequal in a different respect as a consequence of the perversion of the imagination mentioned above that other objects become desirable. A man may be a beggar and still be happy if he can fill his belly, but most men want more than this as they believe more stuff will afford greater happiness.

The question becomes; which sort of life is most likely to produce happiness? In answer, Smith presents a choice:

Two different roads are presented to us, equally leading to the attainment of this so much desired object; the one, by the study of wisdom and the practice of virtue; the other, by the acquisition of wealth and greatness. Two different characters are presented to our emulation; the one, of proud ambition and ostentatious avidity; the other, of humble modesty and equitable justice. Two different models, two different pictures, are held out to us, according to which we may fashion our own character and behaviour… (TMS I.iii.3.2).

As stated above, for Smith happiness is tranquility and inner equilibrium. From how Smith praises the life of the farmer, it becomes clear this life is the surest means to happiness. The agricultural man does not inherently have a strong desire for profit, and thus affords a more peaceful and less restless existence. In addition, the farmer lives in the country, away from the hustle and bustle of the city. Smith acknowledges that many men will find the life of the merchant to be most rewarding, but it is only the “studious and careful observer” who recognizes the merits of the farming life (TMS I.iii.3.2). At this point, it becomes important to reinforce a point made earlier, and now confirmed by observation. For Smith, a man’s profession provides the surest means for moral self-actualization. Nowhere is this clearer than Smith’s praise of the agricultural man and censure of the mercantile man. A man’s interaction with the market is thus intrinsically tied to the consequences to his morality. Additionally, this example demonstrates how Smith uses his rhetorical style of characterization and situation to engage the reader’s sense of sympathy in order to proclaim judgments about economics and morality.

The Mental Yardstick and Political Economy

The mental yardstick is a way to make judgments about the actions of others and oneself, by looking at what is the perfect standard, the minimal expectation of action, and aim somewhere in the middle (TMS I.5.9, VI.iii.23). If the mental yardstick is the culmination of Smith’s moral teaching in TMS, it becomes necessary to demonstrate its presence in WN to prove Smith is comprehensive and deliberate in his thought across his texts. Besides using it for personal evaluations, there is evidence to show that the mental yardstick can be used more broadly to evaluate entire systems of political economy. Smith compares the health of the body to that of a system of political economy. Doctors believe there is a perfect regimen to preserve a healthy body, however, experience will show that the body can protect and correct itself on a variety of different regimens (WN IV.ix.28). The body experiences its own means for self-correction when the perfect regimen cannot be achieved (WN IV.ix.28). The same phenomena happens in the case of political economy; “…in the political body, the natural effort which every man is continually making to better his own condition, is a principle of preservation capable of preventing and correcting, in many respects, the bad effects of a political economy, in some degree both partial and oppressive” (WN IV.ix.28). Politicians and economists, like doctors, strive to achieve some perfect regimen for political economy; however, “if a nation would not prosper without the enjoyment of perfect liberty and perfect justice, there is not in the world a nation which
could ever have prospered” (WN IV.ix.28). Just as elements of the human body work to correct “sloth and intemperance,” human nature almost always remedies the “folly and injustice of man” in designing a perfect system (WN IV.ix.28). If then, the mental yardstick can be applied to find the appropriate political economy, this opens up questions such as: what are the perfect, mediocre, and worst systems of political economy for Smith? What are Smith's views on the organization of political economy? What, then, can one learn about his views of the interrelationship between politics, economics, and morality by employing this tool?

Just as Smith supports the agricultural man over the mercantile man, so does he feel the same toward those systems of political economy which personify these characters. There are two ways in particular in which Smith addresses the advantages of the agricultural system and disadvantages of the mercantile system. First, is in regards to how the two societies view wealth. A system managed by merchants views money as wealth, whereas a system managed by farmers believes “the wealth of nations [consists], not in the unconsumable riches of money, but in the consumable goods annually produced by the labor of society” (WN IV.i.1-2, IV.ix.38). The second difference is the extent of the overlap between economics and politics. In the mercantile system, merchants constantly whisper in the ears of politicians. The political regime becomes a gateway for merchants to perpetuate their own policies for their own advantage, which tend to work against the public interest (WN IV.i.10, IV.viii.49). In contrast, the agricultural system has never been known to do any public harm and represents “perfect liberty as the only effectual expedient for rendering annual reproduction the greatest possible, its doctrine seems to be in every respect as just as it is generous and liberal” (WN IV.ix.2, IV.ix.38). Despite the obvious merits of the one system over the other, Smith recognizes that a solid system of political economy requires both elements and both types of people. The agricultural system is not sufficient for any meaningful national economic growth and the mercantile system does provide a means for this growth by opening new trade. The town and the country rely on each other. Just as one might employ the mental yardstick to a moral evaluation, it becomes possible to imagine Smith does the same with regards to political economy. In a realistic system of political economy, merchants exist; however, to improve upon this system he suggests a political regime divorced from corporate influence, which will occasion high economic freedom.

Smith is extremely critical of politicians throughout WN; consequently, in his improved society he assigns a very limited role to government. He believes it should be primarily concerned with defense, administration of justice (police and courts), and “facilitating the commerce of society” (infrastructure) (WN IV.ix.51, V.i.c.2). Smith argues that it is from “innumerable delusions” that politicians attempt to devise economic policy, for which they are ill equipped (WN IV.ix.51). Politicians do not rightly understand cause and effect, which Smith seems to think is fundamental to the study of economics. Only the establishment of “perfect justice, perfect liberty, and perfect equality” will bring the “highest degree of prosperity” to all classes of society (WN IV.ix.17). Allowing for the highest degree of economic freedom, such as freedom of employment, thus allows for the moral self-actualization as stated previously in this chapter. It is only in an unregulated market that “every man, as long as he does not violate the laws of justice, is left perfectly free to pursue his own interest his own way, and to bring both his industry and capital into competition with those of any other man, or order of men” (WN IV.ix.51). This system of political economy forces men to accept responsibility for their actions, as they cannot blame it on bad regulations. Thus, Smith, in characterizing bankruptcy says is it the “most humiliating calamity” which a man can experience. To make a modern comparison, Smith would thus not be in favor of bank bail-outs, as it creates a perverse incentive for businessmen. Contrarily, it also allows men to enjoy the full approbation and respect which comes from their prudent decisions. Thus, a system of limited government and full economic liberty leads to the positive reinforcement of prudence.

Conclusion
By looking at Smith's vision of political economy, and the arguments made thus far, it now becomes possible to conclude that Smith supports economic and political structures primarily for moral reasons. This conclusion speaks to the larger concern over how Smith believes politics, economics, and morality function together. It is impossible to come to a definitive answer without reading Smith's whole corpus, as stated in the introduction, but from reading these two texts it becomes clear Smith places more emphasis on the moral consequences of action. Smith's view of society could then be synonymous with a sort of picture frame. The exterior framework would be sympathy and the imagination, which provides the way in which men establish ideas of morality and virtue. Morality and virtue would be the “matting” under which politics and economics are set. Politics and economics are relegated to their own sides of the interior, but yet experience a lot of overlap in the middle. If is it true that sympathy and morality provide the foundation of economics and politics for Smith, it then even becomes possible to assign an ideal reading of Smith. One should thus begin with TMS and then move to WN and his Lectures on Jurisprudence. Only in this way can one understand how Smith believes a society should be structured.
Although Smith is arguably the “father of modern economics,” he was nevertheless a professor of moral philosophy at Glasgow University, which means Smith was primarily concerned with the way in which people make decisions, and the extent to which they made these decisions based on some predetermined ideas of morality or ethics. By understanding Smith in this new light, it is possible he understood people to be making political and economic decisions through a permanent lens of morality. Smith would say that one cannot know the effect of economics and politics until one understands the cause, which is human moral behavior. Politics and economics do not just appear from the ground, but are based on decisions individuals make about their original formations. Whether by design or by accident, the origin of these political economic systems is individual action, motivated and informed by moral evaluation. The modern understanding of individual economic behavior has thus become severed from these ideas. Men are not “homo economicus,” “rational, calculating, and selfish,” with an “unlimited computational capacity,” who “never makes systematic mistakes” (Cartwright 2011, 3). For Smith, people are closer to moral agents, expressing their ideas of morality through action, and making mistakes along the way. As stated above, Smith is very wary of creating anything resembling a system, which he believes is both naive and dangerous. However, this picture of society does not limit the possibilities of the outcomes. It still allows for the same flexibility and practicality Smith provides with his moral theory. With this in mind, it becomes possible to critique educators who divorce his thought, economists who ignore his moral teachings, and critics of capitalism.

Bibliography


Endnotes

1. Smith’s numberings in Wealth of Nations correspond to book, then chapter, then part, and finally, section.

2. Smith believes there are typically four stages of societal development: the first is the age of hunter-gatherers, the second is the age of shepherds, the third is the age of agriculture, and the last is the age of commercial society (Lieberman 2006, 225-226).

3. Parallels can actually be drawn between Smith’s style of rhetoric and Aristotle’s, as they try and achieve similar goals of accessibility and flexibility (Hanley 2009, 86-91).
2013 Undergraduate Research Abroad in India
Hydropower Development in Himachal Pradesh: A Stakeholder Equity Analysis

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S
seen as the champion of green energy to some and environmentally dis-
sastrous to others, hydropower is a multifaceted issue. As it continues to
be developed in India, some of the most remote locations and vulnerable
people are being affected. This paper holistically examines the process of hy-
dropower development in rural Himachal Pradesh. The locus of this study is tribal
region of Bharmour Tehsil within Chamba District of Himachal Pradesh, India.
Aspects pertaining to project commission, the consent process, and government-
sponsored rural development schemes are examined, with emphasis given to equity
among rural stakeholders. The nature of this project was exploratory and hypothe-
sis-generating. A combination of secondary scholarly research and primary on-site
data collection is used to analyze hydropower. Interviews were conducted with
local villagers residing in Bharmour Tehsil. A questionnaire was also designed and
administered. In addition to interviewing local people, several other stakeholders
in the hydropower sector were interviewed, including government officials, hydro-
electricity (hydel) developers, project engineers, and academic scholars.

BACKGROUND

The Demand for Renewable Electricity
As the second most populous country in the world, India has tremendous
demand for energy. As it becomes further developed, India faces increased
difficulty in meeting the energy needs through traditional means of power
generation. This was illustrated by the world’s largest blackout, known as the
Great Indian Outage, an event which occurred in July of 2012. The blackout
caused nearly 700 million people to be without electricity. In response to
these critical energy demands, India has worked to diversify the sources of its
electricity to include renewable energy such as solar, wind, biomass, geother-
mal, and hydropower (Goswami 2012). This is reflected by Indian Ministry
of New and Renewable Energy (MNRE), which identifies the availability of
energy via clean power as a precept in their mission statement (Ministry of
New and Renewable Energy: Mission, 2013). At the forefront of India’s thrust
toward renewable energy, Himachal Pradesh has been uniquely suited for the
run-of-the-river method of hydropower generation due to its terrain and gov-
ernment initiatives.
Hydropower—Myths and Realities

The generation of hydropower is thought to usually involve massive dams, such as the Hoover Dam, which impounds the mighty Colorado River and generates electricity for Los Angeles, California. Along with this image of a large dam is usually an even larger man-made reservoir. Indeed, in the United States of America, the vast majority of the hydropower generated is from large-scale hydropower projects (LHP), which use the reservoir power generation scheme. This is not true elsewhere in the world, where small-scale hydropower projects (SHP), between 5 and 25 megawatts (MW) provides a larger portion of power production in the hydropower sector. Additionally, there are other methods of hydel power generation that do not involve submerging land.

There are several types of hydropower plants. In India, the run-of-the-river scheme is popularly used to generate electricity. This involves tapping already flowing streams and converting the kinetic energy of the flowing water into electricity. The run-of-the-river scheme is generally the most viable option for SHP.

The makeup of a run-of-the-river hydel plant can vary slightly, but usually consists of the same components. In this method, water is diverted from its natural course at a location with a high enough altitude at the diversion weir. The water passes through a desilting tank, which separates the sand, silt, and other debris. The river then flows through a man-made tunnel, typically through a mountainside. On the other side, the water passes into the penstock, which is essentially a long vertical pipe which drops the water from a great altitude and creates the maximum height, and therefore, maximum power generation. At the bottom of the penstock is the powerhouse, which is where the turbines are housed. The water spins the turbines, generating electricity, and is discharged into the river at the point of confluence (Energy Efficiency and Renewable Energy, 2001).

The Hydel Sector of Himachal Pradesh.

When compared to other states in India, Himachal Pradesh is maintaining an above-average economic outlook. As one of the fastest growing states in India, Himachal Pradesh relies mainly on four sources for its economic growth: agriculture, tourism, cement, and hydropower. In particular, the abundance of perennial rivers enables Himachal Pradesh to sell electricity to neighboring states, such as Delhi, Punjab, and Rajasthan. Himachal Pradesh has an estimated 23,000 MW of hydel potential. Of this amount, 8,368 MW are already being utilized by hydropower projects in Himachal Pradesh, with an additional 3,805 MW in the process of being exploited (Himachal Pradesh: the abode of the gods, 2013).

Since Himachal Pradesh is abundant with hydel potential and few other economic resources, hydropower has been seen as key to continued economic development. Additionally, since LHPs have already been exhausted, there has been a turn toward SHPs. Although the Indian government has identified hydropower as a key source for renewable energy, the administration is not properly equipped to achieve efficient and timely construction of said facilities. For this reason, both the national government of India and the state government of Himachal Pradesh have introduced incentives in order to attract potential hydel developers from the private sector. These incentive packages make hydropower even more profitable to investors, as they can mitigate expenses (Singh and Vaidya, 2012).

Local Stakeholders

A side effect of an increased share that renewable energy has in the energy production is the decentralization of the distribution of energy. For this reason, Himachal Pradesh has achieved 99.9% electrification, even as India’s least urbanized state (India’s urban demographic transition, 2011). Often seen as the initial catalyst for development of commerce and industry, the availability of electricity has seemingly improved for all peoples in the State. Whether rural people can afford electricity is another question altogether.

In light of the enumerated encouragements by the government, hydropower is suited to rapidly increase in Himachal Pradesh. Having such a large amount of projects densely located sensitive ecological areas has raised concerns about the aggregate effects of hydropower (Kibler and Tullos, 2013). Interviews with government and non-governmental organization (NGO) officials have revealed a diversity of opinion regarding this issue. These opinions include the dismissal of any purported impacts of hydropower generation to the outright condemnation of hydropower due to these supposed impacts (Arjumend, 2013). Where intellectuals largely disagree on this issue, local villagers are also not united. Responses from local people to the multiplication of hydropower projects on their lands widely vary, including total support, skepticism, and outright opposition (Sinclair and Diduck, 2000).

Although, Himachal Pradesh is considered to be one of the less destitute regions of India, certain areas within the State have seen greater levels of poverty, lower levels of education, and issues with infrastructure and access to health facilities (Sharma et al., n.d.). Particularly, tribal areas such as Bharmour Tehsil have been burdened by poverty, unemployment and problems related to education and access to healthcare facilities (Parmar, 1992). When confronted by such pressing issues, people cannot afford the luxury of being primarily focused on the quality of their environment, especially when the effects of hydro-
power are not so apparent. This does not mean, however, that rural Himachali people do not care about their environment and its effect of their lives. Rather, there is a focus by both rural Himachalis and officials in the hydel sector in providing for the basic needs of rural people. This attention overshadows any affect hydropower development may have on the environment. For this reason, government-sponsored rural development initiatives such as Local Area Development Fund (LADF) focus little on environmental impacts, and more on access to basic facilities (Singh and Vaidya, 2012).

LADF was created up by the government of Himachal Pradesh with the intention of ensuring local communities in project affected areas (PAAs) were receiving benefits from the development of hydropower projects. LADF mandates that 1.5% of SHP cost would be set aside for a committee to spend on local development on projects. After project completion, 1% of the power generated is given to the State and sold. The revenue from these sales is transferred to the LADF, creating continued revenue. The funds are deposited with the Deputy Commissioner, who holds them until they are requested by the relevant parties. Once development activities are requested, the Local Area Development Commission decides if the project is approved, as well as how much capital is spent. Typically, the funded developmental activities include but are not limited to construction of village connectivity (roads, bridges, footpaths), community centers, street lighting, temples, drinking water provisions, irrigation, improvement of schools, and sanitation (Singh and Vaidya, 2012).

Commission and Consent Process
The process of project commission follows a bureaucratic path. Developers must first write a preliminary feasibility report (PFR), stating the intended factors of the hydropower project to be built. The developer must then send their PFR to eight departments within the Indian government to receive an objection certificate (NOC). Among these eight developments to sign the NOC, the first in the list is the local form of village-level governance known as the panchayat raj. An assembly of five respected elders who are elected into office, the panchayat raj exists in modern India to decentralize power (Indian Const. amend LXXIII). After receiving approval, the PFR is later drafted into a detailed project report (DPR) and an implementation agreement is created in order to plan to fulfill the details outlined in the DPR. The final step for a developer in the commissioning process is receiving techno-economic clearance. While this process may seem burdensome for the developer, it is widely known that bribery of officials, including members of the panchayat raj, is the key to achieving approval (Rao, 2011).

Interview Subjects and Questionnaire Administration
In order to learn the opinions of local people regarding hydropower, semi-structured interviews were conducted with rural Himachali stakeholder residing within PAAs of Bharmour Tehsil, Chamba District, Himachal Pradesh. These interviews employed open-ended questions to solicit stories regarding hydropower development and experiences with LADF. Most of the interviews were conducted in English, but some were conducted in the local dialect using a translator.

To supplement data gathered by interviews, a questionnaire was designed to collect further data on the matter. By surveying both the demographic makeup as well as opinions regarding hydropower development, relevant insights were derived. The questionnaire was written in English and translated into Hindi, India’s lingua franca among its diverse linguistic composition. Following this, the questionnaires were distributed to those within the study area to fill out and return. To aid in distribution, local knowledge was accessed in order to receive more responses. Several copies of the translated questionnaire were given to community gatekeepers who distributed them to local people before returning the completed copies.

Findings
Research conducted in the designated tribal areas of Bharmour Tehsil, Chamba District, Himachal Pradesh indicates that the government-sponsored system of hydropower development in the State exists primarily to continue hydropower development by any means necessary.

Since the central government of India experiences extraordinary pressure to increase the level of energy production—particularly among renewable energy sources—and the state of Himachal Pradesh relies heavily on hydropower for economic growth, the national and state governments collaborated to produce a unified hydropower policy (Ministry of Power, 2008). Because both governments rely so heavily on hydropower in Himachal Pradesh, any supposed unintended negative consequence of hydropower policy on local groups must be carefully scrutinized.

The current procedure by which hydropower projects are commissioned and constructed does not allow for an open dialog between all stakeholders. Particularly, consultation with local stakeholders remains nearly non-existent in project commission. Though final approval of these projects is only achieved through official sanction by the village-level panchayat institution, basic knowledge of hydropower remains minimal. This raises questions about the efficacy of the panchayat system, seeing that the panchayat raj is supposed to represent its local constituency. Instead, the rural population remains system-
children receive a quality education. This is reflected by the Himachali people being beset by high levels of poverty. Himachali youth having completed 10+2 education, India's Barmour Tehsil (83.7%) completed 10+2 education, India's majority of people encountered in the local population indicated that education is largely ubiquitous for the local population in case public opinion reflects anti-hydel development.

Reasons for local disenfranchisement in the consent process are varied. Since hydel developers are only required to receive approval from the panchayat, one might assume that the panchayat simply did not make its constituency aware of the project. However, during interviews conducted with the local population, it became clear that the panchayat members had a very tenuous grasp on hydropower policy themselves, thus raising more questions and concerns.

The low standard for education that characterizes rural regions of Himachal Pradesh is critical to understanding and responding to hydropower development and its effect on rural people. Research shows a general discontentment by rural Himachali people regarding the education system. Particularly, rural areas of Himachal Pradesh are prone to rampant levels of illiteracy. Recent census data shows that Chamba District has the lowest overall, male-specific, and female-specific literacy rates of the twelve districts of Himachal Pradesh. Just over three-quarters (77.22%) of Chamba males and less than half of Chamba females (49.70%) can read and write. Additionally Chamba District also shows the largest male-female literacy sex ratio of all districts in Himachal Pradesh, at 27.52% (Sharma et al., n.d.).

Though education is doubtlessly lacking, Himachali people regard receiving an education as important. For this reason, local people indicated that education is nearly ubiquitous for youth. The majority of majority of people encountered in the Bharanour Tehsil (83.7%) completed 10+2 education, India's equivalent of twelve years of schooling. Although most rural Himachali people are beset by high levels of poverty, Himachali people are often willing to make financial sacrifices so that their children receive a quality education. This is reflected by the tendency for parents to enroll their children in private schools. Though private schooling is much more expensive, it is accepted that the quality of education children receive is higher. One Himachali father stated that he and his wife “want the children to be educated so that they’ll have a better job. You know, in the future.” His emphasis on his children’s occupation seems to reflect the opinions of other Himachalis—farmers of Himachal Pradesh typically do not want their children to follow their footsteps. Indeed, the vast majority of respondents indicated their occupation as farming.

Educational opportunities are seen as one clear avenue to productive employment. For rural Himachal Pradesh, getting an education can be more than a formality—for the families and generations affected, it can make a real impact on their quality of life overall. If they want to succeed in attaining an education and embarking on a career path, rural people must first overcome a stigma often applied to tribal groups. India has been working to reverse the inequalities among certain population groups. For this reason, the government has designated many scheduled castes and scheduled tribes to allocate employment benefits to members of these groups. Within Himachal Pradesh, a diverse array of scheduled tribes exists (Srinivasan, 1988).

Depending on the climactic zone a tribe lives within, their demographic make-up, livelihood and subsistence practices, rituals, myths, and values differ. Tribes often have their own languages with unique scripts, but they use Hindi to communicate outside their native tongue. Each tribe constitutes a distinctive culture, with different traditions and practices, though most share universal principals. For instance, all tribes ascribe to some degree of Hindu faith. This is not to say that they are all exclusively Hindu. While some of the tribes are characteristically mainly Hindus, others adhere to diverse beliefs incorporating Hinduism, Buddhism, Animism, Islam, and Christianity (Bisht and Bankoti, 2004).

The study area of this project included villages along the Ravi River basin in the Bharmour Tehsil. According to census reports, Bharanour Tehsil of Chamba District has an overall population of just under thirty-thousand people (Sharm et al., n.d.). This region is the most densely populated of the tribal areas in Himachal Pradesh; 82.28% of the people are from scheduled tribe. The majority of the population of Bharanour Tehsil belongs to the Gaddi scheduled tribe. For this reason, Bharanour Tehsil is also referred to as Gaderan, or ‘Land of the Gaddi’ (Bisht and Bankoti, 2004).

The Gaddi people speak in the Gadaiali language and use the Tankri script, while with others colloquial Hindi and the Deva-
nagari script are used. A rugged and mountainous group, the Gaddi having adopted themselves remarkably well to live in the high altitudes of Bharmour Tehsil. The hilly subdivision has two mountain ranges running through it—the Dhauladhar and Zanskar—and altitudes ranging from 400–19300 feet above sea level. The climate in Bharmour Tehsil ranges from temperate to semiarctic. During the summer, the climate is moderate and pleasant. In October, snowfall commences and from December to March, Bharmour Tehsil is covered with snow. During these winter months, the Tehsil is separated from the rest of the country as the means of transportation and communication are disrupted. As a nomadic group, the Gaddi traditionally leave their homes in the fall season to avoid the harsh winter before returning in the springtime (Bisht and Bankoti, 2004).

The remarkable grandeur, and on the other hand, the ruggedness and severity of nature in Himachal Pradesh have influenced the culture the Gaddi. As a subsistence society, the Gaddis are traditionally dependent on the environment for food, fuel wood, fodder, raw materials, and more. This dependence has majorly influenced the cultural and social organization of Gaddi society, shaping them into hardy, strong, and kind people (Bisht and Bankoti, 2004).

The cultural practices of Himachal Pradesh’s tribal population ordinarily do not align with western notions of progress and technology. For this reason, the concept of ‘tribalism’ has been applied by urban, non-tribal Indians, and westerners to describe a tribe’s tendency to adhere to traditional ways of practice, rather than adopting modernized techniques (Gellner, 1991). Significant government-sponsored and NGO initiatives have attempted to demonstrate the benefits of modern technology to rural Himachali people. Rather than realize the benefits and adopt the techniques as outsiders suppose would happen, rural peoples tend to continue to use traditional methods. Among the Gaddi, this can be observed in their methods of cooking, which relies on wood.

One argument often used to justify the penetration of hydropower industry into rural Himachal Pradesh relates to the increased availability of electricity to rural people. Though other cooking methods are available, rural Himachalis principally use wood stocks to cook. Concerns have been raised that rural peoples are depleting the regional forest cover by harvesting wood for fuel. From a non-local perspective, electricity can be seen as a viable replacement to wood. However, from a non-local perspective, electricity can be seen as a viable replacement to wood. However, although the State is essentially fully electrified, it has been shown that the rural people are not willing to convert from wood. This unwillingness to change their traditional ways of life is reflected by an MNRE initiative, which focused on teaching rural Himachalis how to use liquid propane gasoline (LPG) to cook. Though a few did transfer to LPG, most people found it more convenient to continue their traditional practice of utilizing wood as a fuel source.

This idea of tribalism also permeates NGO initiatives in Himachal Pradesh. The first micro-hydropower demonstration projects in Himachal Pradesh were sponsored by the United Nations Development Programme (UNDP). One advantage of hydropower outlined by the UNDP relates to the division of labor—women are said to be freed from collecting fuel wood, maintaining fires, and other household chores. As previously stated, the assumption that rural peoples would perceive this as a benefit is highly unlikely. Studies have showed that rural Himachalis of Kullu District were not any more likely to use electricity over wood with a more reliable power grid. It must be mentioned that the assumption that people would completely alter their lifestyle to modernized techniques is shortsighted and ethnocentric at best (Sinclair, 2003).

Rural people in the study area were asked about their use of electricity and their cooking methods. Results indicate that electricity is used in diverse ways, but traditional methods of cooking with wood remain unchanged. The questionnaire revealed that the top uses for electricity were lighting (67.34%), communication (40.81%), and recreation (32.65%). The least popular uses for electricity were cooking (8.16%) and heating (10.2%). Although electricity, LPG, and cow dung are all alternatives to wood, 62.3% of respondents indicated they only relied on wood for cooking.

The UNDP also claims that local economic opportunities are increased with hydropower development. As mentioned earlier, electricity is often a catalyst for economic development. However, data collected conveys a different story. Among the respondents, only 15.4% saw hydropower as a positive economic opportunity, with 77% claiming there were no effects on the economy and 7.7% indicating negative impacts on the economy. These results reflect the inherent confusion and disunity surrounding hydropower, specifically with regards to economic opportunity. Further data revealed the overall feelings of local people toward hydropower (Sinclair, 2003).

Though proponents of hydropower hail its benefits, this does not wholly translate to the local people. Certainly, some local people are claiming to have received benefits from hydropower development. Several local hydropower employees encountered certainly received benefits, whether they were employed seasonally, part-time, or full-time. These economic benefits, however, are individual cases and cannot apply to the affected population at large. A report by Singh and Vaidya showed con-
 convincing evidence for a measurable level of perceived negative impacts by rural peoples regarding hydropower development in the area (2012). Among the most frequently identified issues were adverse impacts to the environment (air pollution, water quality), cracks in the foundations of houses due to blasting, as well as impacts to livelihood and economic outlooks of project affected groups (Singh and Vaidya 2012). In our study, respondents indicated that overall, only 14.9% saw more positive impacts related to hydropower than negative. While nearly three-quarters of respondents indicated that hydropower had no negative effect on the environment, the remainder of respondents claimed there was either a “moderate” or “large” negative effect, a sizable portion considering the environmental significance of Himachal Pradesh.

During the course of the study, several informants indicated that the environment is an important concern of theirs. Research shows that project affected groups are becoming more conscious of problems associated with hydropower development. Additionally, grassroots groups protesting against hydropower have been identified. Within a context of poverty, unemployment, and lack of opportunities, however, rural communities become particularly vulnerable to those who advocate for the increased development of hydropower projects as an avenue for employment and economic development. Hydropower is presented to rural people as an opportunity for economic growth, referring to programs such as LADF. Thus, proposals that economic incentives be offered to mitigate local opposition to the establishment of hydropower projects raises troubling questions. In this manner, LADF can be seen as an attempt to coerce people to accepting hydropower development, rather than engaging in a meaningful dialog between parties.

Beyond the aforementioned issues, LADF also has implementation problems. Though rural stakeholders may be initially hopeful and encouraged by the prospect of LADF, they soon realize its complications. Namely, the lack of knowledge regarding the actual spending of LADF on a development project is frequently a problem. Important details that would allow villagers to write a proposal, a budget, and a timeframe are not readily available. Other withheld information includes the amount of capital in the fund, who holds the power to makes spending decisions regarding the balance, how long it takes to see results, and where the money is being held. As Bharmour Tehsil is particularly isolated, alternative means of obtaining relevant information are quite limited.

In one village, an informant detailed the fight to obtain schoolteachers for the village. Brhei was without schoolteachers for years due to vacancies. When a hydel developer arrived in town with hopes of building a SHP, the inhabitants petitioned the developer for three school teachers. When the developer refused, the residents of Brhei went on strike. Residents blocked access roads to the construction site, causing financial and logistical issues for the developer. Around 4 months later, representatives of Brhei finally visited the Deputy Commissioner’s office, where a deal was struck. The residents of Brhei learned of LADF only when they were somehow able to travel to the provincial capital and arrange a meeting with a high level official. This logistical nightmare eventually resolved in Brhei receiving two teachers, one primary and one secondary.

This story can easily be seen as a success because the residents of Brhei received what they desired. As the subject also indicated, however, in future the people of Brhei will be abandoned in this matter: “As long as LADF funds exist, there’ll have a teacher,” he says. “Once the LADF funds don’t exist they have no teacher [through a translator]”. In this manner, LADF was utilized as a tool by the developer to temporarily placate the people in order to finish construction. As hydropower plants require little to no maintenance, the developer never has to deal with the population of Brhei again. Once the LADF funds run out, Brhei will be again without a teacher.

Discussion

By examining the construction and proliferation of hydropower in rural northern India, a complex and multifaceted conflict between local and national interests has been exposed. This research has allowed consideration regarding what is usually considered to be a non-contentious issue. Far from being a widely celebrated developmental activity, hydropower has instead showed its potential to be a highly contested and debated.

In the course of conducting research, some problems arose that hindered the full potential of this study. One major issue pertained to a language barrier—many Indians are not conversant in English. In addition, there are areas of rural India in which English simply is not spoken by most. For this reason, interviews had to be conducted via interpreters. Those who do speak English are more educated, and therefore of a higher caste. This fact made it difficult to represent all groups within the caste system. Resulting from the language barrier, the questionnaire had to be translated from English to Hindi. Filled out surveys then had to be translated back to English to be quantified. Due to mistranslation, one of the questions had to be discarded. Though these issues were recognized, the timeframe of the project did not allow for the issues to be properly resolved.

The short timeframe of the study provided for most of the difficulties. Due to the abrupt research period in the field, fewer than the ideal number localities were visited, people in-
terviewed, and questionnaires administered. Additionally, the time and effort taken to traverse the rugged mountainous areas of Himachal Pradesh provided for even less time in the field. Of course, three weeks is a short time period for any one project. Because an interdisciplinary team of researchers was traveling and researching together, topics of geology and business economy were also explored by the team. This further shortened each investigator's time to focus their research topic.

At this time, a determination of the aggregate benefits versus damages regarding hydropower cannot be offered. The mere fact that this is a looming question, however, gives reason to pause and scrutinize the situation. As an all-encompassing list of positive and negative impacts cannot be drawn up, a conservative approach is ideal. The widespread construction of hydropower facilities throughout the sensitive environment within Himachal Pradesh should be eased to allow for more research on its impacts.

Conclusion
Though a final determination cannot be made regarding the positive and negative association of hydropower, the current hydropower development policies are not without their flaws. In order to seek greater acceptance by local people, alternative measures must be sought. Access to objective information regarding hydropower facilities and production must be made available to the tribal population in order for them to be able to make an informed decision. Ultimately, people will make a decision that is consistent with their value system, but only if relevant information is both accessible and objective. Additionally, culturally biased modes of tribal interpretation must be halted in order for real progress between local people and hydel developers to be realized. Finally, a policy of free, prior, and informed consent should be pursued with regards to the local tribal people. Formally seeking consent from project affected groups will be critical to achieving their eventual support.

References


A Strategic Analysis for Small Hydro Power (SHP) Development in Himachal Pradesh, India

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Steven Spicer is a General Management Major in the Ricciardi School of Business. This research began in the spring of 2013 and continued with field research abroad in India the following summer under the direction of Dr. Martin Grossman (Management), and Dr. Madhu Rao (Geography). The project was funded by the Shea Fellowship for Undergraduate Research Abroad. Steven is extremely grateful to the Shea Committee, the Office of Undergraduate Research, and his mentors. He plans to continue research in the Green Technology fields of emerging markets with a trip to China planned for summer of 2014.

In addition to India currently being the second most populated country in the world, economists at Goldman Sachs have listed India as one of the five BRICS countries (Brazil, Russia, India, China, and South America) projected to be most dominant economies by 2050. In spite of the rapid growth in India's economy, there are still many serious issues affecting the majority of its people. The US Energy Information Administration reports that roughly 25% of India's 1.2 billion people are living without access to electricity, which translates to 300 million citizens without power (EIA, 2013). Various estimates put India's energy supply to just 90% of its demand (Singh, 2012). To counter this deficit, the government of India is encouraging both foreign and local investment in energy production, particularly from the development of small hydroelectric power (SHP) plants. The purpose of this paper is to provide a strategic analysis of SHP projects in India, primarily in the state of Himachal Pradesh. Two frameworks, Strengths, Weaknesses, Opportunities, and Threats (SWOT) and Political, Economic, Social, Technological, Legal, and Environmental (PESTLE) analyses, are used to map out factors in the macro-economic and meso-economic environment surrounding SHP development in India.

Introduction

India has an estimated ten percent deficit of electricity according to reports from the Central Energy Agency (Appleyard, 2013). To combat this shortage, the CEA and the Ministry of New and Renewable Energy are focusing on efforts to increase the production of electricity from SHP plants (Appleyard, 2013). SHP plants generate electricity with a renewable energy source and have minimal environmental impacts (Colorado Energy Office, 2013). The government of India has attempted to encourage investment in SHP projects with various incentives (Government of India, 2013). Successful SHP projects can not only aid a developing country deal with its deficit but it also can generate a steady source of income for the firms that own and operate them. This paper is focused on providing a strategic analysis for SHP development in India, primarily in the state of Himachal Pradesh. SWOT and PESTLE analyses will be performed to provide insight into all of the factors involved with development of a SHP project. With these analyses tools, both the macro-environment and the meso-environment will be examined and explained.
Methods
Research for this paper includes a variety of methods. On-site research was conducted in India at cities including: Chamba, Chhatrari, Delhi, Roorkee and Shimla. Meetings were conducted with the Ministry of New and Renewable Energy (MNRE), the Agro-Economic Center at Himachal Pradesh University, the Alternative Hydro Energy Center (AHEC) at the Indian Institute of Technology (IIT) - Roorkee, and with Himachal Pradesh’s Forestry Department. On-site research also included visits to SHPs located in the Chamba District, located in Himachal Pradesh. The field research was supplemented and supported by research conducted before, during and after the trip, utilizing secondary sources from academic literature as well as the web.

SWOT Framework
The SWOT analysis is a strategic business framework which attempts to map out the advantages and disadvantages of a particular product, investment, or industry. SWOT can be applied by firms interested in SHP projects to assess the pros and cons of investing. The ‘S’ and ‘W’ in SWOT refer to the strengths and weaknesses of a potential investment. These are the internal factors and may include everything from financial, physical, and human resources available for use, to the processes and ideology used by the firm. The ‘O’ and ‘T’ are the opportunities and threats that the company does not control. These external factors could include everything from demographics and funding to market and economic trends (Goodrich, 2013).

PESTLE
PESTLE is a similar strategic mapping technique which can supplement a SWOT analysis. It provides a ‘meso-economic’ and ‘macro-economic’ background for organizations to consult prior to their investment (CIPD, 2013). The meso-economic environment is the organizational infrastructure which includes all procedures, policies, rules and guidelines (Shaw, 2011), and the macro-economic environment is the large scope economics trends such as interest rates, unemployment and efficiency level. PESTLE can be implemented to understand the whole picture and understand the risks that are involved in the project at hand. It can supplement a SWOT analysis by enabling a firm to maximize the opportunities while minimizing the potential threats. Additionally, most factors included in a PESTLE framework will be external to the firm. Although firms may not have control over these external factors, they must learn how to minimize the threats from such factors. That means that the external factors have no direct impacts on the profitability of the firm and planning to avoid impacts is crucial (CIPD, 2013).

ANALYSIS
Investment in SHP development is extremely complex and multifaceted. This type of investment can be profitable only if set up properly. Proper analysis of the macro-environment and meso-environments are in order and firms must possess the due diligence prior to investing in such a project. Errors in the planning, constructing or maintaining of SHPs have resulted in many failed projects which are now abandoned or closed.
The volatility in market costs, demand, and global economic trend (including the value of the rupee) pose risk for failure. Risk of damages includes personal injury, power failure, military conflict or environmental damages such as a flood or earthquake: these are in addition to any unforeseen risks which might delay the construction of the plant, which could increase cost and potentially cause a project failure (Chaurasiya et al, 2013). The risks are many and must be weighed against the other factors involved in SHP investment and development.

In order to minimize the risks and threats and maximize the strengths and opportunities analysis of both, the internal and external factors is necessary prior to engaging in SHP development in India. The use of strategic analysis tools and techniques are recommended. It is important to remember that analytical frameworks have pitfalls and may fail to predict market trends, successes, or outcomes. The PESTLE analysis identifies factors involved in SHP development in India. It does not attempt to create a plan for entry.

**Political Factors**

One factor that firms must be aware of before investing in a foreign country or industry is the political environment. The government of India offers various incentives to stimulate the growth and interest in the small-hydro industry. The Ministry of New and Renewable Energy (MNRE) is the governmental body in India responsible for monitoring and commissioning small hydro projects. MNRE offers subsidies to project developers and manufacturers of some required parts in an attempt to reduce the cost to entry. The MNRE offers programs, classes, and resources that are helpful to companies investing in SHP (Government of India, 2013). Subsidies are also offered to firms starting up SHPs as well. The MNRE offers subsidies for grid connected power for small hydro; assuming that the plans adhere to the criteria outlined in the policy regarding part types, power house capacity, and quality of transmission/development infrastructure. The size of the subsidy fluctuates with the capacity of the project and is based on Rs 2.25 crores X Megawatts^0.646 (Government of India, 2013).

A weakness that any investment in India will face is the issue of corruption. Estimates report over $400 billion being laundered out of India in just the past 10 years. That is money that could be used to fix infrastructure, help the 600 million living in poverty, or the 300 million living without electricity (Hanna, 2013). Yet corruption goes deeper than politicians lining their pockets with profits. Corruption in India has been connected to the partial cause of the energy deficit, “Transmission and distribution losses in some states are as much as 50 percent because of theft and corruption by employees in the power industry” (Nessman, 2012). Corruption appears to be rampant in India without any differentiation by industry, or state.

The Ministry of New and Renewable Energy is responsible for developing the 5 year plans. These are essentially targets for growth in the renewable energy sector. The 11th 5-year plan ran from 2007-2012 and projected an increase of 1,400 MW to the preexisting 1,976 MW of the estimated 15,000 MW potential. The actual increase in MW fell short at around 2/3rd with an addition 963MW added during the 2007-2011 span. The current plan (2012-2017) proposes an increase of 1,960 MW essentially doubling the results from the first 50 years of these plans (Ministry of New and Renewable Energy, 2011). A report funded by the World Bank found, according to current plans, 43 percent of the total small hydro potential will be harnessed by 2021 (Gaba, Cormier, & Rogers, 2011). Being aware of the policies and goals on energy and energy production presents opportunities to potential investors.

Another aspect of the political environment to consider is the issuing of no-objection certifications or NCO’s. There are nine different agencies that a NCO must be granted from in order to begin building a small hydro plant: the village panchayat (village council in the project zone), public works department, forestry department, pollution control board, wild life, fishing, irrigation, and explosives licensing. Rao (2009) explains that each NCO within a board or department has various steps and engineers that it must pass before approval and filed with the state. Typically, a NCO is granted in 2 or 3 months. However, in some circumstances, it can take nearly 10 months to receive the certification. Lack of communication and misleading information given by the street-level bureaucrats in the early stages of development can cause delays in the process. Rao (2009) contends that policy change to reduce the amount of certification and bureaucratic intervention in the process would increase appeal and implementation time for small hydro projects and that NCOs present a threat to investing in small hydro in India.

**Economic Factors**

Before starting an investment the economic factors must be weighed to ensure financial stability and the potential for profit. One of India’s attractions to international business is its highly trained yet low costing workforce. The average rate for manufacturing labor is a mere $1.26 per hour (Bureau of Labor Statistics, 2013). When visiting SHPs in Himachal Pradesh, it was noted that there was also a presence of engineers in the plants. Between 200,000 and 300,000 recent graduates of engineering colleges and universities in India are either unemployed or taking employment well below their expertise (Chaturvedi & Sachitanand, 2013). In addition to the vast
human resources available in India, their financial resources promote Foreign Direct Investment (FDI) as well. FDI is defined by the Organization for Economic Cooperation and Development (OECD) as investment by a resident of one country and its economy into another country and their economy, and attributed as “…an important vehicle for development” (Organization for Economic Cooperation and Development, 2013). As mentioned previously, subsidiaries provided by the MNRE are important financial resources. Despite large startup cost and investment the cost of energy production after the initial investment is low at Rs 3.11 per kWh (Soni, 2012). SHP projects can be extremely profitable providing the demand for electricity is higher than the supply and projects have been estimated to achieve a return on equity after interest, taxes and operating expenses of 21.48% (Soni, 2012).

The global trend for investment in green technologies and energy production should be evaluated as well. Global investment in green technology has been on the rise steadily since 2004. In 2011 there was $257 billion invested globally in green technology projects including: biomass, geothermal, wind, hydro (between 1 to 50MW) wave, tidal, biofuel and solar. This is 600% of the 2004 figures and 93% higher than pre-economic crisis 2007. While these numbers look promising the investment for projects in developing countries has fallen to just 35% of the market share in 2012 (Frankfurt School of Finance and Management, 2012).

There are also inherent weaknesses in the economic environment. The initial investment in capital is extremely high. On the lower side the Chirchinth II SHP (9.9MW) had an estimated project cost of $4 million (Rao, 2009) yet in other extremes, a project can total almost $27 million when factoring escalation in cost and interest (Soni, 2012). Another weakness and a possible threat to investing in India is the unpredictable value of the Rupee. The Indian Rupee or INR has an unstable past, and hit a record low this summer of 68 INR to 1 USD, thus impacting international business contracts (PTI, 2013). Another inherent weakness and cost is the Hydro Power Policy of 2006. This policy states that “1.5% of the final cost of the projects above 5 MW and 1% of the final cost of projects up to 5 MW shall be contributed to a Local Area Development Fund (LADF)” (Government of Himachal Pradesh, 2013). It goes on to say that after the commissioning of the hydro power plant, 1% of free electricity must be sold and given to LADF to provide regular income for welfare schemes. (Government of Himachal Pradesh, 2013). LADF was set up to help rehabilitation and resettlement programs and provide general improvements to the project affected zone (PAZ).

Sociological Factors
Since the implementation of the LADF, studies have been conducted by the Agro-Economic Center to monitor and review the spending on social wellness programs and projects within the PAZ. The PAZ is the immediate area around hydro projects. The locals living within these areas were surveyed to see what changes have been brought about and if they were positive. With the money that was paid into the LADF from small hydro developers, the Local area development council or LADC were able to make several investments: projects to improve the drinking water conditions at Tunan and Bhawa, construction of classrooms in Gadej and Kharga, repairing old temples in Kharga and RHEP, and 217 different projects to increase the connectivity of the project affected zone. In addition to the creation or expansion of educational buildings, the SHP developers created technical education workshops and seminars and also funded merit based scholarships to send students to continue their education. Another focus of LADF was to tend to those who may have been moved in the interest of building the power plant. These rehabilitation and resettlement (R&R) plans are directed to those immediately affected. These included creation of homes or fields for crop or livestock. In regard to crop yield only 3 percent of the locals thought these power plants were negatively affecting the agriculture industry. In fact 41% responded that it had a positive impact on agriculture (Agro-Economic Research Centre, 2013). The report is extensive. It maps out many other societal and economical projects and successes in the PAZ that were accomplished from funding by LADF. A societal opportunity that this market also possesses is that 25% of the Indian population is living without basic electricity (EIA, 2013). To provide electricity and connectivity to those 300 million Indians would have huge sociological impacts: such as connecting them to the globalized economy, opening them up to employment or educational opportunities and increase the general knowledge and welfare of the population.

Technical Factors
The current processes for harnessing and converting the hydroelectric power are universal. Other than the building and designing of the canal or penstock the actual mechanism behind small hydro has not changed. Rather, newer and more efficient machines have been built. Most parts are universal; the generators and turbines found in small hydro in the US are the same types of turbines and generators in Himachal Pradesh India.

Most of the technical factors are opportunities. The Ministry of New and Renewable Energy have extensive online resources and information available for developers for every step along the implementation and building process. They offer an approved list of suppliers for parts and have their paperwork
for applying for some of the NCOs online. (Ministry of New and Renewable Energy, 2011). This is just the tip of the iceberg however in terms of information available. The Alternative Hydro Energy Center (AHEC) at the Indian Institute of Technology- Roorkee offers everything from three week summer courses to PhD programs all pertaining to hydroelectric power. During field research we were able to visit IIT Roorkee. Within their buildings they had several simulation rooms and programs and were in the process of building a life-size scale model of a small hydroelectric power plant. IIT Roorkee also has some of the most cutting edge research and educational techniques for hydroelectric development and brings several international students to their summer programs each year. In addition to this, they offer advisory support for developers (Alternative Hydro Energy Center, 2013).

There are some technical threats to consider with small hydro. The water must be sifted and filtered before it enters the penstock. Debris and sediment in the water can damage the turbines; further the filters for such debris must be empty and cleared on a regular basis as to prevent blockage. The Himalayan Mountains are the youngest and most delicate mountain range on earth. The soil is soft and, not properly anchoring the supports when constructing the penstock and canal can result in disaster. The last technical threat foreseen in this research is the rolling blackouts and the shortage of power. India had the largest blackout ever recorded when on July 30th 2012 a total of 670 million people were thrown into darkness. Spanning an area of 2,000 miles, and affecting roughly 10% of the total world population, this blackout is an extreme example of a larger problem (Yardley & Harris, 2012). Throughout the day, energy shortages shut down traffic lights, manufacturing facilities, and restaurants.

Another technical factor to be aware of is the construction and design of the SHP plant. Once the head (drop of the water) and flow are calculated, the developer must decide which type of turbine to use. Different types are implemented based on the figures calculated. The most widely used turbines are: Pelton, Francis, Cross-flow, Propeller and the River Current turbines (Wheldon, 2013). The risk of damage to the turbine due to sediment must be addressed. Any sediment coarser than .20 mm in size can cause damage to the turbine blades and therefore should be removed from the water (Raju & Kothyari, 2004).

Legal Factors

There are a limited number of legal factors that have a role in the implementation and management of small hydro projects. However the same issue of corruption can also play a role in the legal environment. When the Foreign Corrupt Practices Act, 1977, passed it became illegal for a U.S. firm to engage in corrupt activities even outside of the scope of the states. Other policies have since been enacted in other countries and alliances. For example the Organization for Economic Co-operation and Development (OECD) has held anti-bribery conventions. More recently in the United Kingdom the UK Bribery Act was passed in 2010 (Illinois Tool Works Inc., 2013).

Environmental Factors

The main advantage of small hydroelectric power is its environmentally friendly design. Diversion power plants are considered a ‘green power’ source meaning that they lower carbon emission and the environmental impact of fossil fuel energy production. They also provide less economic waste and pollution than other types of power plants. The design of the diversion or run-of-the river hydro plant is also aimed at maintaining natural ecosystems. When water is diverted at the diversion weir, not all is tapped. Rather some water is left to continue the ecosystem of the river bed (ROR Power, 2012). It has been suggested that an increase in hydroelectricity in India will reduce the need to burn wood as fuel. It is this idea that supports the theory that SHPs will prevent deforestation and also reduce greenhouse emissions (Rao, 2009). The MNRE has conducted surveys and found over 5,400 potential project sites and estimates the potential for small hydro projects alone to be around 15,000MW (Ministry of New and Renewable Energy, 2011).

Silt disposition created from diversion hydro plants should be addressed. Silt and sediment are removed from the water to protect the turbine’s blades. This can alter the river’s ecosystem downstream, causing environmental risks. These risks were recorded in a study on the Okavango River in South Africa where erosion of the riverbed downstream and deepening of the channel bed was found to reduce the overflow into floodplains creating additional ecological impacts (Colin Christian & Associates, 2009).

Conclusion

Before any type of FDI can be made, it is imperative to conduct strategic analysis to determine factors that may impact the success or failure of the investment. Using frameworks, such as SWOT and PESTLE, makes it easier to understand the industry and the investment opportunities in a foreign market. This paper offered a holistic assessment of the market surrounding small hydroelectric projects in Himachal Pradesh. With these factors the macro-environment and meso-environment can be evaluated. Although a PESTLE and SWOT analysis may uncover many aspects of the investment, firms must go beyond these steps to do their due diligence before entering into SHP development.
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Environmental Considerations of Small-Scale Hydroelectric Power Plants in Himachal Pradesh, India

DARWIN WERTHESSEN

"When we try to pick out anything by itself, we find it hitched to everything else in the Universe." – John Muir

The need for increased energy production in India is high priority and hydroelectric power has been identified as having the greatest potential for achieving energy independence. The Indian government has continually created more streamlined methods for efficient implementation of hydroelectric facilities with an emphasis on small-scale (<25 MW) and micro (<5 MW) facilities in the more remote regions. Himachal Pradesh has effectively achieved one hundred percent electrification due to these initiatives and realized some of the most successful development in the nation with respect to rural electrification and improved infrastructure such as roads, schools, and hospitals. Hydroelectricity, and especially that produced through run of the river type systems, is generally embraced as a renewable source of energy by many established standards. Small scale run of the river facilities are also heralded for the minimal impact to the environment. However, with increased development and construction in continually industrializing areas, measureable human impacts have increased felt within the environment and ecosystems. Several studies and papers published by the Indian government, as well as the state government of Himachal Pradesh, identify these impacts as low to nonexistent. In contrast, a growing number of studies refute this claim and deserve consideration. There is a diversity of opinion on this subject. Some secondary sources indicate minimal to non-existent environmental impacts stemming from projects less than 25 MW, considered as Small Hydro Power (SHP); while other sources express significant concern. Interviews with government officials and researchers in the Indian states of Himachal Pradesh and Uttarakhand as well as in the capital city of Delhi revealed a wide range of views. This paper presents observations and argues for greater exploration of these issues through future research.

Introduction

India will become the most populated country in the world in the not too distant future. With this increase in population has come the ever present dilemma of providing energy needs to the people. At present the country falls disastrously short of providing an accepted western standard of access to affordable electricity.

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In response to this shortage, village people burn propane, kerosene, wood, cow dung, hay, and other materials to meet their personal energy demands. These actions tend to result in effects such as deforestation and accelerated erosion of soils. And, thus, the vicious cycle is created whereby a need is met by a solution that perpetuates the problem. Nowhere else are these issues more pronounced than in the remote regions of India where the tribal village culture is still predominant, dictating societal norms and modes of survival.

This paper attempts to enlighten the reader as to how India has tried to alleviate the challenges in satisfying energy needs while conforming to the policies of the industrialized world and the United Nations. There are implications both moral and financial at stake.

Background
Conventional fossil fuels are a known driver of economic progress and while the benefits are broadly known, the environmental impacts are many. Pollution in the form of increased carbon emissions, acidification of meteoric water, and destruction of natural landforms in the pursuit of natural resources are just a few of the known negative impacts of this energy source. The International Energy Agency (IEA) has identified hydroelectric power as an efficient and more environmentally friendly form of energy production compared to similar carbon based systems. This is primarily achieved through reducing greenhouse gas production which is non-existent during the operational stage of a hydropower facility.

India began its current thrust toward green and renewable energies in the early portion of the 1980s. Small and micro hydroelectric production began increasing along with the establishment of the Alternate Hydro Energy Centre (AHEC) in Roorkee in 1982. This establishment was founded by the Indian government on the campus of the Indian Institute of Technology (IIT) at Roorkee, with the charter to perform research and development in the area of hydropower in India. The staff and student body are responsible for development of new technologies, methods and systems for creating energy (chiefly hydropower). The objective of IIT Roorkee is coupled with the added mission of researching the effects of hydroelectric plant implementation on the environment and Indian people.

India has one of the greatest potentials for hydroelectric power on the planet with an estimated 150,000 MW, equivalent to 84,000 MW at 60% load factor. Of this, SHP and MHP can contribute an estimated 15,000 MW-(EIA, 2012). India’s installed capacity of 37 Gigawatts (GW), which is 3.3% of the world’s total output, comprises 11.9% of the country’s total energy generation- (International Energy Agency, 2009). These staggering values help to portray the massive energy potential which stands to be harnessed in Northern India. India seeks to harness the energy by combining the abundant water supply with the effects of gravity.. India’s location south of the Himalayan mountain range, which has one of the planet’s largest reserves of glaciers and glacial melt-water, gives it the best potential for production.

Most hydroelectrically-produced power in India is fed into the national grid which supplies larger cities downstream, such as New Delhi and Chandigarh. Unreliability and inadequate production coupled with aging and sometimes dilapidated transmission infrastructure lead to periodic power outages and frequent rolling blackouts in these urban areas. Remote locations of sub-Himalayan villages and difficult topography can lead to similar interruptions in these regions.

Classification schemes and limits of Mega vs. Small vs. Micro scale power production vary across the globe. In India, Small hydropower (SHP) is limited to production of less than 25 Megawatts (MW) of electricity while Micro hydropower (MHP) is limited to producing less than 5 MW. Hydropower production can be roughly grouped into two different types of operations, Impoundment and Diversionary. Impoundment implies that somewhere within the system there will be storage of water at elevation (ponding, damming or pumped storage) for release at a prescribed time for energy production. Diversionary systems imply there is no storage of water and energy production is dependent upon water flow at a given point (the production facility). Such facilities are commonly termed Run of the River (RoR) type schemes. Universally, larger scale facilities employ impoundment technology while small scale production can utilize either. MHP is almost entirely diversionary in design. An important note is that some systems may employ both types of technology within the same operation (e.g. diversion to an impoundment location).

Large scale impoundment type hydroelectric facilities have many known detractors such as submergence of land leading to deforestation and dislocation of inhabitants. A loss of biodiversity in the form of aquatic life and biota can also be expected in such scenarios. Many examples of this can be seen in countries such as China, Brazil as well as India. One example of large scale impoundment is the Three Gorges Dam along the Yangtze River in China. Although producing up to 22,500 MW of electricity, there have been several notable effects such as landslides and massive deforestation.

However, SHP doesn’t typically involve water storage and is generally observed to be a benign, renewable energy source.
Furthermore, diversion type schemes are especially noted for the negligible impact on the surrounding environment. In a report published by the AHEC in 2007, it was stated that the effects of SHP in India are little to non-existent and any impacts are temporary in nature (Sharma, 2007). While this may indeed be true, there has yet to be a longitudinal study several years in duration which could empirically substantiate such a claim.

Method
The primary method employed to understand the situation was to compile several journal articles relevant to the topic of hydroelectric production prior to departure for field investigations in India. Current events in the region were also closely monitored in the media (e.g. international newsfeeds, websites, and social media) before and after the field excursion. Interviews were conducted with several state officials and researchers within Indian government who are responsible for implementation of energy production projects. These visits took place in the capital city of Delhi and in the Indian states of Uttarakhand and Himachal Pradesh.

The initial field visit was completed at the IIT’s Alternative Hydro Electric Center (AHEC) in Roorkee in the state of Uttarakhand. At this campus, a tour of the learning facilities and the training modules for educating future production facility personnel was led by a graduate student and faculty member of the AHEC. A presentation on the AHEC’s objectives and research activities was received as well. Insights and details were provided about preliminary procedures and future SHP facilities completed prior to construction.

In Delhi, the Director of the Ministry of New and Renewable Energy provided numerous insights into the larger dilemmas public officials face during investigation of potential projects and licensing. A project developer was also briefly interviewed on his personal experiences while developing a project in the state of Jammu and Kashmir. Together, the director and developer provided a glimpse into one of several such meetings that must take place before construction begins.

In Shimla, the capital city of Himachal Pradesh, the Himachal Pradesh State Electricity Regulatory Commission was visited; however, information was not readily accessible. Also in Shimla, library materials were accessed and literary research was performed on the campus of the Indian Institute of Advanced Study.

In the city of Chamba, the Deputy Commissioner was interviewed and provided several of his concerns relative to the topic of SHP in the region. He provided information on the proper avenues developers must take in this region to obtain licensing as well as the concerns the Deputy Commissioners office must observe regarding residents and impacts when issuing permits. Also in Chamba, the Ministry of Environments and Forests (MoEF) was visited at the main office location in downtown Chamba and the Chief Conservation Officer was interviewed. The objectives of this department were outlined as were the many types and instances of improper procedures that occur during construction (e.g. illegal dumping of waste material or muck disposal and improper forest reporting procedures). Additionally, three SHP facilities were visited in the Chamba region during operational periods. Facility tours were taken at Churchind II, and two unnamed sites, one of which in the planning stages.

Small Hydro
As previously noted, hydropower can take two primary forms, Impoundment and Diversion. RoR schemes utilize a diversion weir placed at a strategic location, typically along an existing stream route, and water flow is diverted to a desired location (the powerhouse). This system is known to have far fewer environmental impacts on the ecosystem while providing such benefits such as high-efficiency electricity production with no carbon emissions.

Facilities such as the one seen in Figure 1 are typically small in building footprint (>3000m²) and adequate for projects producing less than 25 MW of production. (Refer to Figure 2 for a simplified diagram of the typical components of a hydroelectric facility). Larger facilities can produce more energy but need storage space located on larger streams providing adequate water flow. This requirement is not always feasible in more remote regions.

Figure 1. typical small scale hydroelectric production facility located in Chattrarri, Himachal Pradesh, India. Note visible penstock left of the building, and the discharge, not visible in the picture, at the bottom near the stream.
Construction costs rise as a result of the difficult nature of the terrain in this region. Such advantages make SHP a more attractive option over construction of larger hydro sites which typically require greater infrastructure investments (e.g. damming and reservoirs).

Small-scale hydro has flourished not only on the Indian subcontinent but in many other parts of the world. Norway, for example, has utilized small scale (1-10 MW) production for decades and now has 480 such facilities in the country along with 291 Mini (100kW-1 MW) and 211 Micro (<100kW) (Glette, 2013).

There is scant literature published on studies of the effects of SHP in particular studies conducted in India and the Himalayan Range. Bakken et al. (2012) examined the accumulated effects of 27 small-scale facilities (in Norway small-scale is <10 MW as compared to India which classifies small-scale at <25 MW) versus the effects of three large-scale facilities. The results indicated the accumulated effects of several small-scale facilities were slightly more than those of the few larger facilities and the benefits of the larger facilities were greater than the combined benefits of several small-scale facilities.

In India, however, long term studies of small-scale hydro and the aggregate effects of several facilities which are located within the same catchment area have not been conducted in this region. In addition, within the nation of India, and the state of Himachal Pradesh in particular, there is a major thrust for development of several such run of the river type schemes; many are already in the construction phase and are located along the same river routes within the same catchment area (Rao 2011a). Although the adverse environmental impacts of an individual SHP may not be significant, the aggregate impact of several projects in the same vicinity could be of a magnitude to cause significant damage to the environment (AHEC, 2011).

In similar research, the Water Resources Institute at Oregon State University has studied the effects of SHP in both China and India. Their work has identified possible negative impacts as well, particularly with respect to damming procedures and water diversion. Although, in many cases the studies are preliminary or need further sampling to make confident assertions, these introductory findings are a basis for further examination. The issues stemming from the accumulated effects of such environmental impacts such as stream diversion, increased sediment load due to construction, and immediate loss of stability due to deforestation and accelerated fracturing of bedrock are topics that merit continued study.

**Issues**

There are many impacts on the environment resulting from the construction of a hydroelectric power plant. Any effect resulting from human activity is termed an “anthropogenic effect,” and construction can create many of these effects. These anthropogenic effects have been highlighted by several people interviewed in the state of Himachal as the true source of pollution and negative environmental impacts. The following section will describe three such major impacts associated with facility construction in remote regions of India, deforestation, muck creation, and bedrock fracturing.

Deforestation is the removal of stands of trees for the purpose of construction, fuel, or some other motive. Currently most deforestation in this area occurs for the procurement of building materials not directly used in the construction of hydroelectric facilities. Although wood is used in home construction, the primary building material for power plants of this region is brick and concrete. So where is the deforestation resulting from hydro really taking place? The answer is in road construction. Road construction for the transit of commercial vehicles involved in the construction of hydro facilities and the associated infrastructure construction that comes with development.

Clearly not every tree can be replaced or conserved. While the construction of a production facility may not result in massive deforestation, the associated road construction does create a significant amount of deforestation. This does not seem to be accounted for in most Project Development Reports produced. The Ministry of Environment and Forests is aware of this problem and has vowed to address it in the soon to be published “Revised Interim Report, Comprehensive CAT Plan for the Ravi River Basin” (2014).
Muck disposal is another serious problem associated with SHP. Muck is the term for any by-product from the construction activities, such as waste rock material generated during tunnel excavation to soil and/or excess building materials. There are numerous examples of disposed muck contaminating and polluting river systems. Unfortunately, the impact may not always be observed at the construction site but further downstream where the suspended load of sediment is deposited. These locations can be far removed from the construction site making it difficult to identify the source of pollution.

There are many guidelines and policies in place to govern the proper disposal of construction debris. However, few, if any, of these are followed to the letter of the law. An official of the Indian Forest Ministry displayed footage of one such instance. In his opinion, the most notable environmental impact is not created by the power plant itself, but is created during the construction and use of the roads upon which materials and personnel are using. This is where the distinction between a human impact and an environmental impact becomes a gray area. While it may be true that humans have caused the effect, the impact is sustained by the environment.

Bedrock fracturing occurs as part of the construction phase during tunnel blasting. Some of the facilities in Himachal Pradesh do not require much tunneling at all and this effect is mitigated extensively. However there are several other such facilities (figures are unobtainable at this time) which do require extensive tunneling and, as a result, extensive blasting of bedrock. The composition of the study area in Chandigarh and much of Himachal Pradesh is that of highly deformed, steeply dipping, metamorphosed mudstone. The region has also been heavily deformed due to tectonics resulting in the steeply dipping beds. This can be seen in Figure 3, with the author for a scale of the inclination of the bedrock.

Generally, the effects of blasting are observed by villagers in the form of cracks and fractures in homes. These instances are handled on a case by case basis and are usually remedied with compensation. A connection of damage to the underlying bedrock has been weakly addressed. There are alternatives to this practice as in the case of open channel diversion and trench construction. This relatively non-intrusive method is generally abandoned for tunnel construction which provides a safer transport system of water resulting in a more secure system.

Another impact worth noting, but generally overlooked, is the loss of biodiversity due to stream diversion. This is almost unavoidable in nearly all small projects. The national requirement is that a developer must provide at least 15% of original stream flow to an existing water body to maintain the aquatic and floral life. This guideline is weakly enforced and there appears to be no repercussion in the event a developer violates this requirement. In the case of small hydro plants, these facilities are not required to file an Environmental Management policy. For this reason, the aggregate effect of several projects’ impacts may not be realized, or even observed, until irreversible damages with respect to aquatic and biotic life have taken place.

Environmental Monitoring
It is the resounding opinion of Indian academia, notably the Indian Institute of Technology, Roorkee, that the nation need not implement nor integrate monitoring systems of the aforementioned small and micro hydroelectric power production facilities. The current environmental monitoring system in India is Environmental Information Systems (ENVIS). The main objective of this system is to record data measurements in the atmosphere, in water quality domains and compile these recordings into a central repository. This data would be available to staff of the Indian ministries. This data is not readily available to outside nations and cannot be utilized in any fashion to the general public, such as for climatological modeling for instance.

IndoFlux is a monitoring system devised and modelled after FluxNet, the environmental monitoring system used by several developed nations such as the United States. The objective of IndoFlux is the same as described above with the added benefit of data being readily accessible to outside parties. FLUXNET is a global collection of >300 micrometeorological terrestrial-flux research sites that monitor fluxes of CO2, water vapour, and energy-(Sundereshwar, et al. 2007). It is not only conceivable but also possible that such monitoring equipment could be installed at small and micro hydroelectric sites, likely at an added cost to the developer.
Inconsistencies within the framework of reforestation

As part of the Environmental Impact Assessment (EIA) associated with all major energy construction projects >25 MW as well as small and micro projects less than 5 MW, an inventory of forested lands is created and assessed. This standard phase of the environmental clearance portion of all Development Project Reports (DPR) determines the amount of monies which a developer must apportion to the Himachal Pradesh Ministry of Environment and Forests (MoEF) for reforestation. In theory, this money is then used by the department to replant trees in lieu of those taken down for construction purposes. This is a novel idea and in theory will replace the wooded footprint which is destroyed.

The unfortunate reality is most of these funds are depleted through administrative costs and never actually replace tree stands, especially larger primary growth. There is also the component of corruption within this system in which the value of a tree, which is assessed based on size and age, is understated; thereby decreasing the amount of funds a developer is responsible to pay and consequently the amount of funds the state MoEF realizes. It is also very possible that the authorities involved in these practices are unaware of the harm caused to the state by these illicit actions.

The understating of tree stands and the level of growth-for-value assessment is only one form of possible corruption at this level. Other similar schemes were noted by developers that bribery does occur between themselves and paid ministry officials. Rao (2011b) in his article “Role of Street Level Bureaucracy in India” notes extensively the many challenges and forms of bribery that take place during the course of licensing and permitting of project development. Although no names were provided, it is clear that some developers utilize the influence and position of paid government officials for the purpose of reducing the amount of funds needed to pay or to expedite licensing paperwork. This type of corruption and bribery could prove to be severely harmful if not rectified and monitored at some level.

Reforestation is perhaps the most important factor in preserving the Himalayan ecosystem and the accompanying fauna. Slopes devoid of vegetative cover are more prone to landslides and soil slumping—(Negi, 1998). The Himalayan range is characterized by extreme slopes and in the lesser range much of the surface geology is that of loosely consolidated shale and clay. These lithologies are extremely prone to potential natural disasters such as mass wasting in the form of landslides. An added component to the complication of this scenario is the very active fault zones which bind much of the Himalayan region. The lesser Himalayas have experienced numerous devastating...
earthquakes in recent history, namely in 1803 and 1905 in the Delhi and Kangra regions, respectively-(Bilham, et al., 2001).

Although forestation will do nothing to prevent ensuing damage due to an earthquake of these magnitudes, they will mitigate the after-effects of mass wasting associated with non-vegetative ground cover. The likelihood of an earthquake occurring in the future within this region, Himachal Pradesh in particular reinforces the idea that remotely located monitoring devices should be implemented wherever possible. Construction sites and production facilities are well-positioned remote locations. They are adequately suited to host remote seismologic devices which could provide insightful data when forecasting devastating events.

Current Events in the Region
There have been several recent events and rulings in the region to support the prior claim of insufficient research and data collection regarding the accumulated or aggregate effect, of multiple locations located on the same river or tributary river system. One specific example is a Supreme Court ruling in Delhi which has postponed all construction on hydroelectric projects in the state of Uttarakhand indefinitely.

Another recent article on this topic was published by Kelly Kibler and Dr. Desiree Tullos from Oregon State Universities Water Resources Program. In this study, which was conducted in nearby China where information is very difficult to obtain for academic purposes, the Nu River basin was examined. The results found were that the biophysical effect of several small scale facilities (in China >50 MW is small-scale) can outweigh those of large facilities when compared to the amount of electricity produced. The authors of this study concluded that further investigation is necessary to fully understand how several small facilities affect a larger singular basin.

Conclusion
Although at present the negative environmental impacts associated with small and micro hydroelectric production facilities have been measured to be low to insignificant in recent studies, it is necessary for not only Himachal Pradesh and the nation of India as well as those of other nations employing this technology, to continue to observe what little changes there are. In the author's opinion, it would be a beneficial idea to integrate remotely collected data into a globally accessible network such as Indoflux. Although seemingly cumbersome and likely another burden placed upon developers of facilities which would result in commissioning delays, the benefits of the readily accessible data would over-ride these detractions.

In regard to the inconsistencies of reforestation through funds provided by project developers, there must be a higher level of integrity instilled within the respective parties. Whether this is done through education on the effects of deforestation or the heavy hand of penalty in the face of offense, something should be done to rectify this problem. Continued corruption and inadequate reforestation may not have initial impacts under certain circumstances, however, the possible loss of life and property to natural hazards such as landslides are immeasurable. In both scenarios continued monitoring through satellite imagery and station specific devices are just samples of the methods to track the issues.

As John Muir wrote in the opening quote from *My First Summer in the Sierra*, “When we try to pick out anything by itself, we find it hitched to everything else in the Universe.” The topic of environmental impact monitoring, regardless of scale and type, will continue to persist in India as well as the rest of the world for years to come. How the country addresses their present issues and pushes forward with progress will indeed be a topic to cover from the research perspective and the historical implications those actions may have. For this reason I suggest continued research and continued funding regarding the topic of SHP and the associated environmental impacts not just in India, but around the globe.

References
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