The FURJ staff wishes to thank the following for their support: Fordham University’s Office of Marketing and Communications, especially Jessica Baker and Nicole Sano; the faculty and students who served as our faculty and peer reviewers; the FURJ Faculty Advisory Board; and the FCRH and FCLC Dean’s Offices.
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A Letter from the Editor

To the Fordham Community:

It is my pleasure to present the fifth volume of the *Fordham Undergraduate Research Journal*. Over the past five years, the undergraduate research community at Fordham has flourished. The broad spectrum of research interests and the impressive array of accomplishments earned by Fordham students are testaments to our faculty’s encouragement and guidance and to the value of a strong liberal arts education. This year our readers can analyze the economics of an MLB qualifying offer, examine robotic exploration of complex environments, and investigate the relationship between NGOs and the Chinese government. At Fordham, students do not seek simply to know or learn but rather to know more and learn more, so that they may do more and do it well.

FURJ has undergone a variety of changes since our last volume was published. The Editorial Board consists almost entirely of new members, and we transitioned from two editors-in-chief to one. Our record-setting number of submissions included a large increase in submissions from students in Fordham’s scientific community. We were only able to publish one-quarter of the submitted articles. We hope that you will take a moment to read through the lists of selected undergraduate research accomplishments, which lists only a subset of our Fordham students who were published or accepted research awards last year. Also inside this year’s journal is our first photo essay, which it focuses on the Greatest Generation. FURJ has worked to expand outside of the journal pages, as well. We enhanced our social media presence, launched a new website, and renewed our contribution to Fordham’s active academic community with a lecture series. We are on the way to registering with the Library of Congress for an international serial number to improve citations and retrieval of our journal volumes and articles.

The progress made this year would have been impossible without the support of the Fordham administration. I would like to thank Jane Suda, Head of Reference for Fordham libraries, for her help in working toward an ISSN and a DOI. I would also like to thank the FCLC and FCRH Dean’s Offices and their student workers for their assistance. Advice from our Faculty Advisory Board was instrumental in selecting the published articles. This journal exists thanks to our general staff and our Editorial Board members, all of whom worked tirelessly on this volume. Participation from underclassmen and from authors representing both the Lincoln Center and Rose Hill campuses ensures that FURJ will enjoy a strong future. Finally, on behalf of the entire FURJ staff, I would like to thank our adviser, Dean Erin Burke, for her devotion to the journal’s success.

Sincerely,

Megan McLaughlin, FCRH ’15
Editor-in-Chief
The transition to college life presents new and difficult challenges for the average student. During college, students often find themselves lacking in sleep, energy, and motivation, thus becoming slaves to coffee. Though this state has come to be expected of college life, a recent study by Gerard L. Markham at the University of Rochester suggests that a student’s sleep and class schedule during this pivotal developmental window may have a greater impact on mental health than traditionally believed. Analyzing data collected by the National Longitudinal Study on Adolescent Health, or ADD Health, Markham believes that disruptions in a person’s circadian rhythms, the cycle of waking and sleeping periods, during early adulthood is directly related to greater susceptibility to health risks later in life.

The study, conducted by ADD Health, sought to find a link between health-related behaviors in adolescence and well-being in adulthood. The study consisted of four separate waves of data collection over a period of 15 years in the form of questionnaires answered by over 90,000 students in grades 7-12. The first two waves of data collection focused on risk factors identified in adolescence, having students indicate their likelihood to take risks on a scale of 1 to 5. The data collected later in Waves III and IV came from the same students, now 18-21 years old, who were asked to identify experiences during their transition to adulthood and college with the hope of linking these behaviors to the earlier, self-reported inclination towards risk-taking and impulsiveness.

Among the questions presented in Waves III and IV were questions asking students to identify when they normally wake up in the morning and go to sleep at night. These questions were used to classify the young adults as either evening or morning types (E- or M-types). Students classified as E-types reported that they were more active at night and felt best when they were able to sleep late into the day. The M-types reported that they enjoyed waking up early and had difficulty staying awake past their normal bedtime. These classifications indicate the circadian rhythms of the various students. An individual’s circadian rhythm acts almost as a biological clock, dictating when the person naturally feels tired and when he or she wakes up.

Considering the self-reported data from the questionnaires, Markham’s analysis shows that there is a link between E-types and health risks later in life when the circadian rhythm of E-type individuals is consistently disrupted. Given the rigorous nature of college, students are typically compelled to wake up early for their morning classes, which is a serious divergence from the natural rhythm of an E-type individual. Accustomed to rising later in the day, an E-type student who wakes up too early after going to bed late will have far fewer hours of restful sleep per night. Because they are active late into the night, E-types who repeatedly wake up earlier than they normally would experience sleep deprivation, a result seen less in M-type students.

Having analyzed the risk factors reported in early years against the experiences of the students and grouping them by their sleep chronotype, Markham believes there is a very clear link between risky behaviors in adulthood and E-type circadian rhythms. Students who identified as E-types in the third wave of questions were statistically more likely to disregard their health and engage in substance abuse than M-type students. This propensity towards impulsive behavior seems to be linked to E-type students rather than M-types due to the continual disruption of their circadian rhythm, especially with the new stresses of college. The fixed daily schedule of early classes can ultimately put E-type students at a disadvantage mentally, socially, and even academically when not properly handled. Based on the results of the study, if sleep deprivation and unsafe behavior carry on for long enough, E-type individuals can be more susceptible to hypertension, obesity, and even cognitive decline later in life.

Lack of sleep and onslaughts of stress have come to be associated with college life, but many students brush off the real health problems that this lifestyle poses. Markham believes that circadian rhythms, regardless of whether a person is an evening or morning type, need to be monitored more closely especially when transitioning into the unfamiliar college environment. As students, we must often take early morning classes and stay awake until our homework is finished, but perhaps it is time we took a cue from our bodies and plan our schedules the way we naturally need them.

Carolyn Allain is a sophomore from Connecticut, and this is her first year on FURJ. She is a chemistry major and an English minor in the Fordham College Rose Hill Honors Program.
Experiment with Caution

Valerie Marquez Edwards
FCRH ’17

During the often-experimental college years, it is no secret that sexually transmitted infections are prevalent on college campuses. Because of this, college students at risk for sexually transmitted infections might ask: What is this bump? Why does this itch? Is there a reason I feel unhealthy?

Though such questions might apply to a wide range of infections and symptoms, they all might also be pointed toward a potential infection caused by the human papillomavirus. The human papillomavirus, also known as HPV, consists of 40 different virus types that can infect both males and females of any age. Often, the virus creates an asymptomatic infection, meaning that in some people, it can take years before any outward, or questionable, sign of infection occurs. Due to the virus's asymptomatic nature, infections caused by HPV are dangerous and often left untreated.

Amidst the 40 different virus types, there are different levels of HPV that can affect the body. These levels are constituted as either high-risk or low-risk. Some types of HPV cause outward, low-risk symptoms such as genital warts. Other types of HPV cause more discreet, high-risk symptoms like cervical cancer in women. In fact, in the United States, two different high-risk virus types, HPV16 and HPV18, have been linked to 70 percent of cervical cancer cases in women.

HPV16 and HPV18 are constituted as high-risk virus types, as opposed to low-risk virus types, because they proliferate throughout the body at a higher rate than low-risk virus types. HPV16 and HPV18 generally cause asymptomatic infections, which cause sexually active individuals who carry these types of infections to be at a higher risk for having more than one type of HPV infection simultaneously. While HPV is transmitted primarily through sexual contact, it is also possible for a woman with HPV to pass along the virus to her child during childbirth.

Today, however, two primary HPV vaccines exist that guard against these risks. One vaccine, Gardasil, targets two high-risk and two low-risk HPV types. Another vaccine, Cervarix, only targets two high-risk HPV types. Nevertheless, both vaccines create antibodies that ward off high-risk, cancer-causing HPV infections, meaning that both vaccines protect against HPV's most fatal effect in women: cervical cancer.

Although the vaccine has proven effective for many patients, fundamental problems with the vaccine still exist. When the vaccines first came out, they were tested primarily on women of European descent, and the vaccine is less effective in women in of non-European descent. Women of non-European descent are therefore at an even greater risk for HPV infection, even after having been vaccinated.

Dr. Patricio Meneses, professor of molecular biology and virus-host interactions of papillomavirus at Fordham University, acknowledges the vaccine's setbacks, and so pioneers HPV research and awareness efforts in the university and the laboratory setting. As part of the preventative medicine research he and his students conduct, they examine HPV to see how it enters and binds to the body's cells. They are then able to interfere with one of the steps of HPV’s infection process in the hopes of creating a mutation in the virus that might prevent it from spreading throughout the body's cells.

One of Dr. Meneses' students, senior Fordham student Fenizia Maffucci, FCRH ’15, researches one very specific component of HPV called L2. By muddling the L2 components of HPV, Maffucci attempts to mutate the virus so that it loses its contagious nature. Maffucci believes that the Meneses lab is one that fosters “independent thinking.” Maffucci also believes that her research and the research of her colleagues and classmates present hopeful prospects for HPV prevention in the future.

At Fordham, the Meneses lab is one that empowers students in the university's community to educate themselves about the risks of HPV while contributing to the greater issue at hand: HPV’s worldwide impact on human health. Students like Maffucci and scholars like Dr. Meneses use the tools and resources at their disposal to contribute the welfare of the community within and beyond Fordham’s gates. The Meneses lab is notably the first to have shown how HPV traffic within the vesicles of a cell. Today, the lab continues to explore the biology of the virus's binding and entrance into the body.

As HPV’s complications pose a direct health threat, sexually active students and other adults at risk for infection might consider exploring preventative measures they can take to guard against possible HPV infections. One way to avoid contracting HPV is by getting vaccinated. Another way to avoid contracting HPV is by becoming educated about the potential risks involved in sexual activity. HPV causes 70 percent of cervical cancers, 80 percent of anal cancers, 60 percent of vaginal cancers, and 40 percent of vulvar cancers. There are resources available for sexually active adults’ protection against these odds, because at the end of the day, the experimental college years come to an end. HPV, on the other hand, does not.

A double major in English and Spanish language and literature, Valerie Marquez Edwards hopes to attend law school after graduation. Valerie enjoys researching and authoring pieces on education and, in the future, she hopes to use her language skills to help those who have not been as fortunate as she in experiencing academia.
Depression: Not Solely an Illness of the Mind

Victoria Mulhern

Depression is a polythetic diagnosis, meaning that there is no singular symptom required in order to receive the diagnosis. The symptoms manifest differently in everyone, making a reliable and consistent treatment plan for depression unachievable thus far. However, it is possible that the real issue in treating depression may be the way in which the general public conceptualizes the disorder. At least that is what Kristen Tobias, a doctoral student in Fordham University's Clinical Psychology Program, is researching. As part of her dissertation, she is proposing that perhaps “our conceptualization of depression as a singular disorder is impeding efforts to understand that there might be different neurobiological routes to getting depressed.” In other words, depression may not be solely a problem with the mind. Her research is examining the possibility of depression having a subtype, in which the body’s inflammatory response is the culprit behind depressive symptoms in some people.

Tobias compares the symptoms of being ill with those of being depressed. “Think of the last time you were sick. How did you feel? You felt fatigued, [you] probably didn’t want to socialize, your appetite changed, you felt less interested in things. These are all symptoms that overlap with depression.” Tobias’ research was inspired by the work she did with Dr. William Breitbart, a psychiatrist at Memorial Sloan-Kettering Cancer Center, with whom she had a research assistantship. During her time at Memorial Sloan-Kettering, Tobias was able to participate in Dr. Breitbart’s research, which looked closely at the prominent relationship between depression and cancer. The high rates of depression in cancer patients compared with those in non-cancer patients is not surprising due to the immense stress the illness causes both physically and mentally. Researchers also noticed, however, that there are even higher rates of depression in patients who have a type of cancer that strongly affects the immune system and inflammatory responses, such as pancreatic cancer. While it is true that the poor prognosis that accompanies pancreatic cancer could be the cause of the high depression rates, case studies have shown depression symptoms appearing in the patient before he or she is even diagnosed with cancer.

For her dissertation, Tobias, with the help of her mentor, Barry Rosenfeld, Ph.D., is creating a biometric scale that combines elements of the Hamilton Rating Scale of Depression, the Pittsburg Sleep Quality Inventory, which is frequently used in cancer studies, and the Pain Inventory. This scale will compare sickness behaviors to depression symptoms and observe which has the stronger association with inflammation. Depression is diagnosed using the Diagnostic Statistical Manual, now in its fifth edition, which requires patients to meet five of nine possible symptoms that can be cognitive, affective, or somatic in nature. Sickness behavior, on the other hand, is a construct of about 10 symptoms that are more clearly defined and have been associated more with inflammatory markers.

For her experiment, Tobias plans to administer her scale to cancer patients ages seventy and above because the body’s sensitivity to the inflammatory response naturally increases under conditions of sickness and depression. In addition, she will be monitoring the biomarker, C-Reactive proteins, which are acute-phase proteins. Their levels rise during periods of inflammation throughout the body and can be determined from a simple blood sample. By comparing the protein levels to the results from her scale, she will be able to make assumptions regarding the role of inflammation in depression within a specific population. Currently, Tobias hypothesizes that sickness behaviors will in fact show a stronger association with markers of inflammation than will depression as it is currently conceptualized.

What does all of this mean for the future of depression treatment? It could mean potentially successful alternatives to psychotherapy and selective serotonin-reuptake inhibitors that are used in anti-depressants. Tobias says, “If we could identify an inflammatory-based depressive subtype, then the treatment implications would be different. There are anti-inflammatory medications and a number of small trials that are looking at anti-inflammatory medications as augmentation strategies for depression.” If more supporting research can be found to link inflammation and depression in a subgroup of people, treating the symptoms for people in this cluster as sickness behavior, or a physical issue with the inflammatory response, rather than treating it as depression or mood disorder, would be the best way to treat these patients. For more information on Tobias’ research, her master’s thesis will be published in an upcoming issue of the journal Medical Hypotheses.

Victoria Mulhern is a junior majoring in psychology and minoring in bioethics. This is her first year as the News & Features editor of FURJ, and she is thrilled to continue working with such a talented and dedicated staff.
What are the ethical implications of the development of artificial wombs? What is the relationship between human trafficking and peacekeeping? How should scientists consider ethical issues in HIV prevention research? These are but a few of the pressing issues regularly considered by Dr. Elizabeth Yuko, bioethicist at the Fordham University Center for Ethics Education.

Bioethics is defined as the ethics of medical practice and biological and behavioral research, but the conclusions reached in the discipline are by no means standard. “It’s all about sharing ideas and understanding the viewpoints of others,” Yuko said. “Unfortunately, not many ethical conclusions can be reached on most of the controversial matters, especially because the important issues are largely politicized.”

In December 2014, Yuko was appointed to the advisory board of the Global Bioethics Initiative (GBI), which is “an independent, non-profit organization dedicated to improving quality of life in vulnerable populations globally, through research, education and policy change recommendations.” The GBI concentrates on public health issues created by the wealth gap on an international scale. Yuko will be serving alongside other noted bioethicists, including Dr. Peter Singer of Princeton University and Dr. Arthur Caplan of New York University.

Yuko currently serves as the program administrator for the Fordham University HIV and Drug Abuse Prevention Research Ethics Training Institute. According to the Institute’s website, “the burdens of HIV/AIDS falls hardest on a nation’s poor, people who inject drugs, the disempowered (women, prisoners), stigmatized populations (men who have sex with men, drug users), and marginalized racial/ethnic or tribal groups.”

“It is this reality that makes ethical decision-making in HIV prevention research so difficult,” Yuko added.

Yuko coordinates a yearly institute for early-career social science HIV investigators, in which fellows receive a small grant to conduct a study on HIV prevention research ethics. The institute takes place at Fordham in July over a period of ten days, where incoming fellows receive research ethics training and returning fellows present their findings.

Yuko is also the founder and senior editor of Ethics & Society blog, which regularly posts ethical analyses and news from the Fordham University Center for Ethics Education. She is currently writing several book chapters and a journal article on research ethics, the ethics of mental health therapies, and the role of genetic testing on reproductive decision-making and human enhancement.

Though thoroughly immersed in the world of ethics today, Yuko’s academic background is noticeably diverse. After earning her B.A. from Wooster College in 2005, she moved to Ireland, where she earned her M.A. in international security and conflict studies, her LL.M in migration law, and her Ph.D. in bioethics from Dublin City University.

“I didn’t start working in bioethics until I earned my Ph.D., and only then by chance,” Yuko said. “Since my master’s and law dissertations were in human trafficking, I saw the connection between what I was doing and what the European Union was doing in updating their human tissue directive, which involved the transferring, storing and procuring of human cells and tissues. My work shifted from the illegal movement of bodies to the legal movement of body parts.”

In March, Yuko will serve as an ethics expert for the European Research Council in Brussels, reviewing scientists’ research proposals that have been approved from a scientific perspective but have yet to undergo ethical considerations. Having been involved in the European and American bioethics communities, Yuko has observed some major philosophical differences in the field.

“There is definitely not as much overlap as people would think,” Yuko said. “European bioethics tends to use the precautionary principle more, so when new or emerging technologies are developed, such as genetically modified foods, they are more wary of introducing them to the general public without fully acknowledging the ethical principles in play.”

Despite the interdisciplinary nature of bioethics, she noted that certain ethical questions are gaining more prominence in this day and age.

“There is a lot of study being done on pre-implantation genetic diagnosis, in which doctors diagnose embryos with diseases,” Yuko said. “There has also been increased attention given to research involving LGBT youth, as well as ethical questions that arise from the emergence of new reproductive technologies, and, in turn, the evolving concept of the family.”

The ethical questions surrounding these issues seem insurmountable, but Yuko stressed that having an open mind is the key for a good bioethicist to make a value judgment call.

“People have strong visceral reactions to [certain ethical issues] based on sets of beliefs or religion or morals, but having tunnel vision about an idea does nothing for the advancement of the field,” Yuko said. “One of the benefits of being a bioethicist at Fordham is that whether you are a liberal feminist bioethicist or a conservative Catholic bioethicist, you are in an environment that encourages the open discussion of ideas.”

Laura Sanicola, FCRH ’17, is an international political economy major in the Fordham College Rose Hill Honors Program. She is from Syosset, NY. Laura is a student journalist who aspires to work in law or journalism.
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Research is often mistakenly viewed as an academic pursuit meant more for liberal arts students studying science, history, or English than business students, but it is applicable and valuable across all disciplines. For Boniface A. Zaino, FCRH ’65, it is research that has led him to success during his more than five decades of work in the financial sector. In recognizing that research is a vital component of personal and professional growth, he and his wife, Alison Zaino, have continued to promote undergraduate research at Fordham. In addition to supporting research through financial donations, Zaino also serves as an advisor for the Gabelli Center for Global Security and as an advisor to the dean on of the FCRH Board of Visitors.

Zaino worked his way through Fordham while earning a bachelor’s degree in economics before going on to Columbia Business School for a Master of Business Administration. He had little time to pursue independent undergraduate research, but admired those who were able to make the time for it. After entering the job market, Zaino’s job consisted of high-intensity research and analysis, and he was able to draw on his Jesuit education, especially in the area of philosophy, to satisfy the requirement. “Logic,” he says, “is very important to our business. Gathering all the data is an important factor, but drawing the necessary conclusions is where the Jesuit education really helps.” As a young research analyst in the pre-Internet days, Zaino flew across the country to spend time with executives at their companies and gather as much information as he could. Much like in academic research, each question he asked led to another and another which ultimately lead to the bigger picture. “That’s how you could do better than the competition.” After all, Zaino says, “The more you know, the greater your advantage is,” especially in a situation where “everyone’s doing the same things the same way.”

Though Zaino spent three decades at Lehman Brothers and currently manages a mutual fund with Royce & Associates, his day-to-day work remains research-oriented. One key lesson he learned in his first years as an analyst still holds true: “One piece of information gives you the upper hand.” That upper hand is necessary in a world where Zaino says it is “each for himself.”

During the financial crises in the 1970s, Zaino recalls that businesses that “were very concentrated on their own individual functions and making money” were those that most often filed for bankruptcy. Then as now, it was important to keep in mind the real-world context and implications of those business decisions, something that research can help do. Zaino remembers the lesson to fight preconceptions. “When I go to conferences,” he says, “I always go to things that I don’t know anything about, as opposed to a reaffirmation of things I already know.”

Zaino approaches his work with this objective in mind in order to avoid becoming trapped by a narrow pattern of thinking that is sometimes found in the business world. To business-oriented students today, he advises, “Always ask the question, ‘why?’ Why is this happening? ...What is behind the numbers? What nuances could change those numbers?” Confirming one’s expectations is no longer sufficient; those expectations must be challenged before they can be built upon. At Royce, Zaino deliberately strives to clear his mind of preconceptions and examine the numbers without biases. The desire, and the pressure, to increase profit margins at the expense of all else is a hard one to resist, and Zaino invokes his favorite movie, “Network” (1976) to encourage his team to avoid that temptation. In one scene from the movie, a high-powered executive warns the protagonist, “The world is a business, Mr. Beale.” The executive’s message to Beale is to fall in line and stop protesting a network merger, which would require Beale to silence his ethical objections and accept that the way of the world is to turn a profit. This message, Zaino points out, is as alive and well now as it was in 1976.

One method to combat the allure of money is, in fact, research because it allows the individual to develop a better grasp of the larger picture. Zaino insists on thinking critically about all aspects of a business decision before moving forward with it. His donations to undergraduate research at Fordham are designed to help students learn firsthand the implications of those business decisions, something that research can help do. Zaino remembers the lesson to fight preconceptions. “When I go to conferences,” he says, “I always go to things that I don’t know anything about, as opposed to a reaffirmation of things I already know.”

According to Zaino, “Research is an intellectual process. It should energize you.” His donations to Fordham’s undergraduate research community are intended to vitalize the research community on campus and get students interested in expanding their knowledge base and challenging themselves. He cautions all students against believing the philosophy represented in “Network” but is confident that Fordham students will think more critically. “That’s why they go to a Jesuit university,” Zaino says, “so they can look outside the box.”
Consultative Authoritarianism in China and the NGO Response

By Jonathan Uy

Abstract:
In contemporary China, political authoritarianism and booming economic development have overshadowed the social welfare of the population. International and domestic non-governmental organizations (NGOs) have utilized this discrepancy in order to expand their influence and address these issues in Chinese society. However, while political and economic opportunities provided the legal framework for their expansion, challenges remain for these agencies. This paper will address some of the political, legal, and social boundaries that prevent NGOs from fully achieving their goals, boundaries that have vacillated as a response to international pressures and historical events. This paper will also address China’s 4th Plenary Session of the 18th Central Committee of the Communist Party of China, which marks the most recent reforms implemented by Xi Jinping’s regime, and its relevance to the future of NGOs and their operations in China.

Acknowledgements
I would like to thank my thesis advisers: Professor Masood Hyder, who kept my writing progress on track and offered direction regarding what a thesis should look like; and Professor Michael Marme, who provided useful resources and invaluable “broader picture” information on China. I would also like to thank Fordham College at Lincoln Center’s honors program and international studies program, which helped me develop the critical thinking and writing skills that made this paper possible.
The China of today presents itself to the Western world with an image of strength, emphasizing its political steadfastness and economic vigor. While China is indeed on the rise as an international and regional influence and possesses the largest economy in the world, this persona fails to illustrate a complete and comprehensive understanding of China. The nation still receives hundreds of millions of US dollars in aid every year, a surprising fact in the face of the purported image. In 2008, China received over $2.5 billion in aid, mainly from Japan, Germany, and France (Fernando, 2010). Behind the bravado, the Chinese government struggles with many problems in trying to maintain a harmonious society while at the same time encouraging further economic development. The reforms that fueled the economic success of China also exacerbated some of the existing problems in Chinese society and created others. Economic gains often came at the expense of the well-being of the Chinese nation and people, and only recently has the Chinese state begun to address these issues. Upon doing so, the state realized the inefficiency of its capacity to deal with the problems in Chinese society and consequently turned to an unlikely ally: non-governmental organizations (NGOs). The activities of NGOs have had a profound impact on mobilizing Chinese society, generating social capital, and addressing societal issues. However, the Chinese state's relationship with NGOs remains ambivalent, as it recognizes the need for NGOs, but warily eyes their expanding influence. International NGOs in China are often seen by the government as channels for foreign governments to exert influence and undermine the state, and even domestic NGOs are viewed as subversively imitating Western organizations. Even though NGOs play a pivotal role in developing civil society by providing crucial social services in China, they face serious challenges from the Chinese government and cannot continue to thrive within the uneasy and restrictive relationship between the state and third sector actors.

In order to define this relationship, Jessica Teets (2013) has created the term consultative authoritarianism to describe this new social landscape in China that allows NGOs to exist. This model consists of two elements, the first of which is “the existence of officially tolerated social pluralism,” where NGOs, social groups, and social organizations (SOs) “no longer serve as appendages to the state, but possess independent staff, resources, and projects” (Teets, 2013, p. 33). While social groups and organizations may need to have a relationship with government officials in order to gain discreet access to additional resources, enhance the reputation of the organization, or gain political protection, and are also required to register with the government, they still maintain autonomy in deciding the goals and operations of their own projects. The state also allows multiple groups to exist and compete for resources within the same policy space or region, creating a degree of pluralism among the social landscape.

The second element of this definition is the new set of control mechanisms implemented by the state over these groups. These mechanisms have been termed as differentiated control by Kang Xiaogang, who “finds that the state increasingly uses more sophisticated and indirect methods to create positive and negative incentives encouraging groups to work toward meeting state goals” (Teets, 2013, p. 34). While these various carrot-and-stick mechanisms, such as offering monetary rewards for successful programs or banning universities from collaborating with organizations that target politically sensitive groups, often vary in their implementation and effectiveness, the lack of direct administrative control over these groups and the granting of some degree of autonomy has opened up the space for civil society to bloom, so long as it refrains from criticizing the state. This concept of consultative authoritarianism demonstrates the relationship between the budding civil society and the restrictive Chinese government: precarious but relatively open in comparison to the Cultural Revolution era of China's history.

The state’s recognition of the need for NGOs began following the 1979 reforms undertaken by Deng Xiaoping’s administration. The reforms, which aimed to create a market-based economy, did not have the intended effect of solving the problems present in Chinese society, but instead created new ones:

The forced closure of state-owned enterprises has left a large number of citizens unemployed; services that were once a birthright are now an infrequent luxury. All the while, the income gap has increased significantly. Under political and economic reforms of the post-Mao era, the once large state apparatus has been stripped to the barest of bones, and social services once provided by the central government are no longer available (Hildebrandt, 2013, p. 31)

To address this issue and with the aim of creating a more economically efficient China in mind, the government adopted a policy of “cooking in separate kitchens” (renrou chiyan 分灶吃饭) with regards to the provision of social services (Teets, 2013). This entailed the strategic decentralization of funding and responsibility for these services, placing it on the shoulders of local governments. Officials thought that local governments, by virtue of being located nearer to the people, would have a more complete understanding of the needs of constituents than the large central government and be more able to supervise the providing of services. Thus, by “cooking” in separate, local “kitchens,” citizens’ needs would be better met.

However, this approach to the provision of social services fails due to the limited capacity of the local governments. While the responsibilities have been delegated to the lower levels, the funding has not followed:

Although political and economic decentralization has significantly contributed to the growth of the economy, local officials are asked to implement central government policies with little or, more frequently, no financial resources. For instance, in response to public outcry about water pollution, the central government mandated pollution control efforts in major lakes, but puts the onus on local officials, without providing adequate funding to implement it. The central government is not shy about acknowledging the financial burden that local governments must now carry and the difficulty of doing so. Nearly all medical institutions, for instance, were recently transferred to local health authorities; Beijing noted that they are presently underfunded but promised more funds. The central government rarely extends funding to improve environmental conditions and meet policy mandates. But promises from Beijing, like policies at the local level, tend to go unfilled (Hildebrandt, 2013, p. 32)

While the Chinese government succeeded in promoting economic growth and efficiency, it did so at the expense of the people’s needs. The reforms place a great strain on local governments, as the insubstantial efforts of the central government offer little help. The administrative gap between these two entities exacerbates the needs of Chinese communities that go unfulfilled, needs that call for other entities to step forward.
The recognition of the need for these organizations manifested itself in the creation of a legal basis for their existence by the Chinese government since the reforms. As early as the 1970s, the government made an effort to distinguish SOs from those of the party or the state. The adoption of the 1982 Constitution recognized the right to freedom of association. According to the 1984 Decision on Reform of the Economic Structure, SOs, defined as any organization not created and administered by the Chinese Communist Party or state, were seen as important to the policy of economic reform, "and were given a significant role in the restructuring of the state bureaucracy after the end of the Cultural Revolution" (Simon, 2013, p. 188). Also in 1984, the Central Committee of the Communist Party and the State Council issued Document No. 25, which stated, "every social organization shall be associated with a government line agency in its professional field and shall be reviewed and supervised by the State Commission for the Restructuring of the Economic System" (Simon, 2013, p. 187). In addition, the General Principles of Civil Law further institutionalized SOs in 1986 by recognizing them as legal entities, along with enterprises, independently-funded official organizations, and public institutions (Simon, 2013).

Although the main guidelines for the establishment and operation of SOs had been set, there were few other regulations to limit them. Professor Qiusha Ma states, "The founding of social organizations was almost unregulated. Any government bureau or organization, or even a social organization, could approve new organizations and place them under supervision" (Simon, 2013, p. 188). Not until 1988 was the Department of Social Organizations Management (shetuan guanli si 社团管理司) created within the Ministry of Civil Affairs (MOCA). The issue surrounding this initial freedom will be addressed later on in the paper.

Once the basic legal framework had been established, key political and economic opportunities allowed for SOs to take hold in society. One significant opportunity arose from the cadre system through which public officials were evaluated. In order to be promoted and receive other benefits such as bonuses, officials at the local and provincial level are evaluated on the basis of their success in two areas: the amount of economic growth generated and the delivery of social services (Teets, 2013). On the one hand, many officials prioritize economic growth as a more easily presentable form of success. On the other, officials also recognize the potential of utilizing social groups and NGOs as a means of accessing a key advantage: the ability to tap into the foreign funds that support these SOs. By partnering with these SOs, a “new line of finance with little risk” becomes available, “unlike common extra-budgetary channels, such as increasing fees and taxes or selling land, both of which create social protest” (Teets, 2013). The fragmented and decentralized form of authoritarianism that developed following the reform period meant that laws and policies made at the state level did not necessarily trickle down to local governments and officials.

While the cadre system of benefits and promotions often led to the provision of social services, this system also emphasized economic growth which often contradicted the goals of social welfare and environmental protection. It is indeed true that the Chinese government today possesses massive amounts of economic clout, but because the system of promotion within the Chinese Communist Party places little incentive to provide social services and instead emphasizes economic production, local government officials utilize their own limited funds for this end and then ally with NGOs to provide social services instead. This allows for them to maximize their own resources to better their career prospects and creates a mutually beneficial relationship where social groups administer services with resources provided by primarily foreign donations and expertise from the international community to aid in government officials' prospect for promotion. While the amount of foreign aid represents only a fraction of China's GDP, it mainly benefits the rural and marginalized provinces of China that lack organizational capacity. And while the funding provided is significant, it is the personnel and their expertise that NGOs bring that provide invaluable assistance. NGOs then enjoy the support of local leaders in lending legitimacy and administrative support to their programs and organizations.

However, despite these needs, the government imposes institutional challenges on NGOs. One of the most significant is the complex and difficult dual registration system. The state requires two forms of approval: one from a party, government department, or state-affiliated organization that works in a related field to the NGO, and the second from the MOCA (Ling, Lam, Wickeri, & Tan, 2007, p. 120). The state allows only one organization with the same mandate per administrative area, making the registration process exclusive and difficult. Without registration status, organizations cannot legally raise funds or open a bank account, cannot enjoy preferential tax policies, and face potential legal risks (Liu, 2013). The MOCA is comprised of Chinese Communist Party (CCP) members who typically take a stance of wariness towards any non-state organizations and concern themselves primarily with their own career advancement. They frequently attempt to place strict controls on these organizations by strongly encouraging NGOs to involve or hire CCP members. While intended to facilitate the operations of NGOs, the attitude of CCP officials that operate MOCA makes it more of a controlling agency that often antagonizes the attempts of NGOs to accomplish their mandates and affect policy. While many organizations choose to avoid bureaucratic control and register as businesses or corporations, they face higher tax rates than their registered counterparts. Other organizations elect not to register at all and retain their functional freedom despite the high risks. Over 500,000 organizations have registered over the past 25 years, but the number skyrockets to more than 1.5 million when including unregistered organizations (“Enter the Chinese NGO”, 2014). Despite the substantial number of unregistered organizations that strive to effect change in China, their efforts have strict operational limits so as to avoid the scrutiny of the state.

Even registered NGOs face challenges as they endure constant surveillance by the state. Registered NGOs must submit an annual report to their sponsors, who then send it to the MOCA. The MOCA holds the power to renew, suspend, or revoke the organization's registration license (Ling et al., 2017, p. 121). This ensures that the government can maintain constant control over the actions of NGOs and that these actions remain within the prescribed limits of the state. Another potential danger of NGO operations is the sensitivity of information in China. The information that NGOs require to operate often ventures to sensitive topics classified under the broad term state secrets. For example, in 2002, “Wan Yanhai, a doctor and HIV/AIDS activist, was detained on suspicion of ‘leaking state secrets’ for publishing a document on the internet detailing deaths from AIDS in Henan Province as result of government-sanctioned blood-selling centres” (Ling et al., 2007, p. 122). While attempting to spread awareness of the issue of
HIV/AIDS, Wan Yanhai revealed information deemed harmful to the state and received punishment. The case of Green Watch presents a similar scenario:

More recently, in October 2005, Tan Kai, founder of the grassroots environmental group Green Watch based in Hangzhou, was detained together with five other founding members by local authorities. Their detention was believed to be in relation to their monitoring of the situation in Huashui Town in Dongyang City, Zhejiang Province in April 2005 following local complaints that pollution from a chemical factory was destroying crops and causing birth defects. (Ling et al., 2007, p. 122)

These cases illustrate the difficulty in maintaining political neutrality while at the same time influencing policy and society in a positive manner. Organizations must refrain from politically sensitive topics such as these in order to continue existing. This severely limits the kind of work that NGOs can undertake. An issue such as industrial pollution, for example, is a grave and significant problem in China but could affect the economic growth of the nation, so it would be difficult to start an organization to deal with that issue.

NGOs also struggle to obtain funding for their work. As a method to control NGOs, they are not allowed by the Chinese state to fundraise independently. Thus, a significant portion of their funding comes from the state itself, particularly for domestic NGOs (Liu, 2013). Many funds then go to organizations with political connections rather than the most well-established and effective organizations. There is also the problem of corruption, as many shell organizations bid for funding with no intention of implementing these funds for their intended purpose (“Enter the Chinese NGO”, 2014). This diverts funds away from organizations that could potentially contribute to Chinese society in a meaningful way.

In addition to domestic funding, many internationally- and domestically-operated NGOs in China receive funds from international sources. Chinese officials, however, often view international funding with suspicion, as Western influence seeking to sabotage. This type of funding tends to go toward international hot topics, such as environmentalism. Other less glamorous sectors, such as the domestic issue of migrant workers, receive less funding and struggle to accomplish much as a result. Sources of domestic funding then need to develop in order to make up for a lack of stable international funding. However, since the concept and terminology of NGOs has only entered into the Chinese paradigm very recently, the philanthropic culture of China remains lacking. Public awareness of NGO work is still low, especially in a society where the state has traditionally provided for its citizens (Liu, 2013). While the philanthropic culture of China has yet to be extensively developed, the state does little to incentivize donations, lacking effective tax policies that would encourage donations from ordinary citizens. Despite its reliance on these organizations, the state does little to provide institutional support.

Much of the caution exhibited towards NGOs by the state stems from China’s history of dealing with these organizations. The freedom granted to early SOs did not necessarily benefit Chinese society:

The reasons why these developments were less than helpful are twofold. First, too many organizations were set up without oversight. Chen Jinluo, the first director of the social organizations bureau in MCA, mentions that the number of registered organizations in Shanghai grew from 628 in 1981 to 2,627 in 1984. In addition, Universi-

ty of California Professor Thomas Gold suggests that the 1989 Tiananmen demonstrations, based as they were on student organizations that were not registered, may be directly attributable to the unregulated atmosphere of the late 1970s and the late 1980s. (Liu, 2013)

The emergence of a myriad of SOs created an overabundance of competition that did not necessarily benefit those organizations nor their causes, and indeed the repercussions of the Tiananmen Square incident placed greater restriction on SOs. Following this incident, a dual management system required SOs to have a so-called sponsor agency or organization (affectionately known as a mother-in-law) to assist the MOCA in the oversight of these groups. The Chinese government viewed SOs, with NGOs lumped into the broad category as a driving factor behind the demonstration and the bloody aftermath. The Tiananmen Square incident in 1989 and the Falun Gong crackdowns in 1998 both presented the Chinese state with the dangers of citizen organization. These incidents both led to crackdowns on NGOs directly afterwards, as the Chinese state sought to reassert its power over what it saw as potentially subversive organizations.

More recently, however, NGOs have demonstrated their worth to the Chinese government. The 2008 earthquake in Sichuan province prompted domestic and international NGO responses, bringing NGOs into the public view and demonstrating the positive work that these organizations do (Yang, 2008). The Chinese government recognized its inability to address this catastrophe on its own while the media’s extensive coverage demonstrated to the Chinese population how necessary these NGOs are to Chinese society. This softened the state’s stance on NGOs and opened the door for a stronger relationship between NGOs and the state that has and will hopefully continue to gain momentum in the future. Yet this demonstration of meaningful work has only had a nominal impact on improving the relationship between the state and these NGOs.

Xi Jinping’s reform at the Third Plenum and the subsequent contradiction between rhetoric and action demonstrate the state’s wary view of NGOs, yet still acknowledges their invaluable work. The rhetoric of the Third Plenum of the 18th Central Committee held on November 12th, 2013 expresses the government’s desire for NGOs to play a larger role in society, describing “positive interaction between government administration on one hand and social self-management and resident self-management on the other” (NGO law monitor: China’, 2014). The promise of greater autonomy follows the national reform of the dual-registration system, which had been previously experimented with in Guangdong province. NGOs would no longer be required to seek an official sponsor, who might be unwilling to sponsor an organization as it would mean taking on additional duties and responsibilities, and potential liability (Cohen, 2013). Replacing suspicion, officials have increasingly viewed NGOs as practical and efficient tools for social services and hope to create a more competitive process by allowing NGOs to multiply and bid for government contracts to provide these services.

However, the actions of Xi Jinping’s regime appear contrary to this rhetoric and instead display his guardedness. While domestic NGOs have strengthened their relationship with the Chinese state, NGOs with foreign influence and international NGOs in China continue to endure harsh scrutiny by the Chinese government. Even after the Third Plenum, officials investigated the Chinese Academy of Social Sciences on which institutes had been penetrated by foreign NGOs or foundations (Liu, 2014). Many other Chinese universities, colleges,
and NGOs could be subject to similar investigations, prompting many partners of Western NGOs to back out of joint projects following these investigations (Liu, 2014). Indeed, in the period leading up to the 25th anniversary of the June 4th 1989 Tiananmen Square incident, many civil society activists, lawyers, and NGOs were investigated and a significant number were detained, harassed, or arrested (“NGO law monitor: China,” 2014). While the cause of these crackdowns remains unclear, it demonstrates the Chinese government’s commitment to the image of power and desire to maintain control over any entity wielding influence in its own sphere. This mitigates the positive rhetoric previously employed by the state and mystifies the future of NGOs in China. While there some level of inclination to allow NGOs to develop Chinese society exists, the state remains unwilling to grant them the power necessary to realize their full potential.

The environment for foreign aid in China’s consultative authoritarianism can be understood through the metaphor of a leash: NGOs utilizing this aid guide Chinese society towards modernization of its social services and yet remain under tight control. Many official barriers exist to prevent the possibility of subversive activities from these organizations. Even when political rhetoric favors them, action rarely follows. And yet, the failures of the administration necessitate NGO involvement. NGOs complete the work that the state lacks the willpower or capacity to address and still the government impedes their work with structural roadblocks. And while this relationship has made significant progress since the legal allowance of NGOs, the work that NGOs have made over the past decade in improving Chinese society in many aspects such as environmentalism, HIV/AIDS, and poverty reduction, prove that NGOs can in fact benefit China as a whole, even with the state-perceived risk of allowing their influence to grow. The Chinese government must fully and sincerely implement its rhetoric and allow NGOs to continue their work unimpeded for China to truly become a more harmonious society.

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By Caitlin Ramiro

Abstract:
This paper explores Christian sexual ethical discourse specifically related to the virgin-whore paradigm. Mary Magdalene, although historically not a prostitute, has been labeled as such throughout the centuries. Commonly misrepresented as a promiscuous figure, she stands paradoxically juxtaposed to Mary, the mother of Jesus, who is usually believed to be a perpetual virgin. This paper attempts to resolve why these women have been dichotomized into neat categories and consequently treated as the extremes on a sexual spectrum in a problematic way. Using modern sexual theory alongside Christian texts, it examines how these two Marys become sexualized within discourse and, in turn, how as paradigmatic figures they impact sexual norms.

Acknowledgements:
I would like to thank Dr. Benjamin Dunning for his constant support, patience, and intellectual generosity throughout this entire project.

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Introduction
Within the New Testament, two major female figures—Mary of Nazareth and Mary Magdalene—remain a locus of theological discussion, one that is specifically related to feminine sexuality. Because there are only a handful of women in the New Testament identified by name, both Marys receive significant attention as subjects of Christian sexual discourse. Early Christian father Gregory of Nyssa claims that Mary of Nazareth “expressed an intention or vow of virginity, to which she purported to remain faithful even after having heard the angelic message.”1 Gregory of Nyssa’s view represents that of a larger Christian tradition, presenting Mary of Nazareth as the archetype of feminine sexuality:2 she controls her sexuality in accordance with the divine will. By contrast, according to scholars Jane Schaberg and Melanie Johnson-Debaufre, Mary Magdalene, although not a prostitute, “became a whore in the historical imagination through a process of ignoring some texts and focusing on others.”3 Thus, misconstrued as a prostitute, she stands in the tradition paradoxically juxtaposed to Mary, the mother of Jesus, who many Christians believe to be a perpetual virgin. Within Christian sexual discourse, then, Mary Magdalene not only fails to meet the virgin ideal but in fact becomes Mary of Nazareth’s inverse—an example of perverse feminine sexuality. Together, the two Marys form a kind of virgin-whore paradigm, one that deeply and negatively pervades Christian perceptions of feminine sexuality. Because the virgin-whore sexual paradigm neatly categorizes women (and even men) according to their sexuality, the dichotomy remains destructive insofar as it reduces women to two specific sexual labels—either virgin or whore.

Mary of Nazareth’s Sexual Legacy
Because Mary of Nazareth’s virginity was crucial for theological and doctrinal debates related to Jesus’s divinity and humanity,4 her transformation into a sexual paradigm precedes that of Mary Magdalene chronologically. Discussions related to Mary of Nazareth’s sexuality begin almost immediately after the establishment of the Church. Among the earliest Christian works is an apologetic work entitled The Protoevangelium of James. In the Protoevangelium, the author identifies himself as James, Jesus’s brother from Joseph’s previous marriage, and he adamantly affirms and defends Mary’s virginity. By making Mary of Nazareth’s perpetual virginity and exceptional motherhood a subject of utmost importance, the author of the Protoevangelium inadvertently creates a sexual ideal for women. Mary’s archetypal body sets a precedent for other female bodies; it inscribes an impossible set of normative practices for Christian women, namely maintaining perpetual chastity while simultaneously conceiving and birthing children. Yet no woman will ever achieve this idealized sexuality because Mary is the ultimate paradox: She is both mother and virgin.

Mary receives the “supreme blessing, which cannot be superseded.”5 O God of our fathers, bless this child and give her a name eternally renowned among all generations . . . Look upon this child and bless her with a supreme blessing—which cannot be superseded.6 Not only does the author portray Mary as a woman “eternally renowned among all generations,”7 but she becomes impossible to imitate. Mary receives the “supreme blessing, which cannot be superseded” by any other woman. She represents the perfect woman because she maintains her virginity while bearing and eventually birthing Jesus. As the author presents her, Mary remains unmarked by sexual desire. Female actions driven by sexual desire, then, appear corruptible and naturally perverse. A woman who expresses sexual desire and especially one who acts upon these urges cannot emulate Mary of Nazareth—Christianity’s sexual ideal for women. Similarly, a virgin does not and cannot imitate Mary’s motherhood because a virgin cannot conceive a child without sexual intercourse. In this way, the archetype of the virgin mother haunts all Christian women who can never achieve this ideal.

The Protoevangelium quotes the Gospel of Luke in order to call attention to the contradiction of Mary’s virgin motherhood and subsequently reconcile this paradox theologically. The author presents Mary of Nazareth as a woman who excels spiritually because of her idealized sexuality or, arguably, her lack of sexual desire. The author of the Protoevangelium portrays Mary as a woman of unfailing obedience, sacrificing her sexual desire for God. In the Protoevangelium, as in the Gospel of Luke, Mary does not understand how she can conceive a child because she is a virgin. She questions God, “Shall I conceive by the Lord, the living God, and bear as every woman bears?”8 God responds to Mary:

Not so, Mary: for the power of the Lord shall overpower you; wherefore that holy one who is born of you shall be called the Son of the Most High.9

Mary willingly accepts her vocation as the mother of “the son of the Most High”:10 “Behold, [I am] the handmaid of the Lord before Him: be it to me according to your word.”11 God confirms that Mary shall “bear as every woman bears” because she will give birth as a virgin.12 Through this birthing, she faithfully serves as the “handmaid of the Lord”—a woman who humbly and selflessly accepts her maternal vocation.13 The Protoevangelium links Mary’s virgin motherhood to her docile nature, a characteristic associated with the Christian feminine ideal. In other words, her virgin motherhood allows Mary to become all the more obedient to divine will. The archetypal woman is not only virgin and mother, but also a subservient woman. Mary’s virgin motherhood allows her to avoid the stain of sexual desire while mothering Jesus. Yet this dual identity remains problematic for Christian women. Normal women either bear the mark of sexuality, which, in the terms of the Protoevangelium, hinders spiritual distinction, or they cannot experience the spiritual rewards from carrying and birthing children.

2 According to Gambero, Gregory of Nyssa is “numbered among the greatest fathers of the Eastern Church.” Because he played an instrumental role in the development of Trinitarian theology, Nyssa’s ideas carry great authority in Christian discourse. Ibid., 142.
4 In the writings of the Cappadocians, Marian texts have “significant theological value, above all because they are inspired by the unbreakable and fundamental relationship between the Blessed Virgin and her Son.” For the Marian thought of the Cappadocian Fathers, see George Soll, “Die Mariologie der Kappadozier im Lichte der Dogmengeschichte,” Theologische Quartalschrift 131 (1951): 165–88, 288–319, 426–57.
5 Gambero, Mary and the Fathers of the Church, 36.
7 Ibid.
8 Ibid.
10 Ibid.
11 Ibid.
13 Ibid.
14 Ibid.
Even as the archetypal woman of the New Testament, however, Mary remains susceptible to sexual shaming. When Joseph initially discovers Mary's unforeseen pregnancy, he accuses Mary of adultery and expresses his frustration:

If I conceal her sin, I find myself fighting against the law of the Lord; and if I expose her to the sons of Israel, I am afraid lest that which is in her be from an angel, and I shall be found giving up innocent blood to the doom of death. What then shall I do with her?²⁵

Joseph cannot logically assent to the paradoxical notion of a virgin mother and assumes that Mary has committed adultery. He understands that by publicly denouncing Mary's alleged adultery, he will condemn her to the “doom of death.”²⁶ In this way, he calls attention to the social expectations of women and sexuality. An adulterous woman loses personhood because she does not cohere to normative sexuality, and Joseph foresees that his society will execute Mary. Thus, Mary's position remains, in some ways, an ambivalent one. To turn to a point aptly made by Michel Foucault, sexual discourse is "not once and for all subservient to power or raised up against it" because it can serve as an "instrument and an effect of power, but also a hindrance, a stumbling-block, a point of resistance and a starting point for an opposing strategy."²⁷ Power relations remain unstable (and neither consistently positive nor negative), as they permeate sexual discourse.

Insofar as Mary of Nazareth's virgin motherhood as portrayed in scripture produced the theological conundrum described above, early Christian writers sought to reconcile her paradoxical nature. In the writings of Tertullian, an early Christian writer who remains an anomaly in discussions related to Marian sexual discourse, we can see powerfully illustrated Foucault's point about the instability of power relations within sexual discourse. Tertullian attempted to resolve the contradiction of virgin motherhood by denying Mary of Nazareth's perpetual virginity while reaffirming Jesus's purity. His ideas have arguably contributed to the history of devaluing women's sexuality within Christian sexual discourse. Tertullian transforms Mary of Nazareth's paradoxical nature into one of sexual shame:

[If] as a virgin she conceived, in her child-bearing she became a wife. For she became a wife by the same law of the opened body, in which it made no difference whether the violence was of the male let in or let out: the same sex performed that unsealing. This in fact is the womb by virtue of which it is written also concerning other wombs: Everything male that opens the womb shall be called holy to the Lord. . . . Who in a strict sense has opened a womb, except him who opened this that was shut? For all others women marriage opens it. Consequently, hers was the more truly opened in that it was the more shut. . . . In stating, on these considerations, not that the Son of God was born of a virgin, but of a woman, the apostle acknowledged the nuptial experience of the opened²⁸

According to Tertullian, penetration, which can occur either from childbirth or sexual intercourse, denotes a woman's non-virginity. In the case of Mary of Nazareth, then, Tertullian claims that Jesus deflowered his own mother when he exited her "uulua," or vagina, because he opened her body.²⁹ As described by Jennifer Glancy, Tertullian refers to what he calls the law of the opened body in order to affirm that Jesus's birthing, which opened Mary's Virgin body, was an erotic and violent moment of intercourse:

While Tertullian does not represent child-birth as an obviously erotic moment, a moment when desire is expressed, he does imply that the erotic encounter of intercourse, at the very least a woman's first intercourse, is a moment of intimate violence when the man forces his violence to the uulua. . . . By the law of the opened body, Tertullian says, Mary becomes a wife, thus inscribing Mary into a legal and therefore symbolic register. Sexually possessed by her son, she becomes his property.³⁰

According to this law, Jesus inherits "intimate violence" onto Mary's body by simply being born.³¹ Jesus's virginity, however, remains intact because, through the law of the open body, his body remains unopened and un-penetrated. In the words of Benjamin Dunning, "Mary's body will forever bear the marks of rupture, while only Christ remains the paradigmatic virgin."³² A gendered sexual hierarchy exists within Tertullian's Marian sexual discourse, as he deems a woman's physiology, specifically her natural ability to conceive and birth a child, inherently corrupt and inferior to that of a man. Through the act of childbirth, Tertullian claims that "the violence of sexuality leaves its mark on Mary's opened body."³³ Tertullian also presents Mary as subservient to Jesus. Consequently, he precludes Mary from the highest mark of Christian morality—virginity—because she loses that virginity when she gives birth to Jesus. Through this law of the opened body, birthing Jesus works to mark Mary with moral corruptibility and sexual perversity. In this way, Tertullian's figuration of Mary holds parallels to the modern concept of a whore. We can thus see the virgin-whore tensions at work in Tertullian's law. His discourse contributes to the debasement of sexuality, especially a woman's sexuality, because he condemns Mary's opened body on the basis that her physiology and sexuality is inherently defiled.

As Glancy shows, Tertullian's law, as well as his understanding of other aspects of parturition, stems “both from medical sources and everyday knowledge (or perhaps better: everyday prejudice).”³⁴ Tertullian contends with but ultimately relies on the “Greco-Roman view that the bloody discharges of gestation and childbirth are polluting and degrading.”³⁵ He gives in to the persistent idea that women's bodies should be “analyzed—qualified and disqualified” because they are "thoroughly saturated with sexuality.”³⁶ Tertullian's law thus testifies to the constant and unstable fluctuation of power relations in sexual discourse. Sexuality becomes a way in which one can qualify, categorize, affirm, and/or condemn women. Though certain theological treatments, such as the Protevangelium, greatly esteem Mary of Nazareth as the feminine sexual ideal, others, such as Tertullian, attempt to diminish her archetypal sexual image.

¹⁶ Ibid.
¹⁸ Tertullian, De Carne Christi, 23.4–5.
¹⁹ Ibid.
²¹ Ibid.
²⁴ Ibid., 268.
²⁵ Ibid., 267.
²⁶ Foucault, The History of Sexuality, vol. 1., 104. It should be noted that Foucault makes this claim in relation to Victorian ideas of sexuality. Foucault's observations, however, bear a similarity (admittedly within a vastly different cultural context) with Tertullian's views on feminine sexuality.

The Sexual Legacy of Mary Magdalene

Except by early Christians such as Tertullian, Mary of Nazareth has mainly been viewed as a positive sexual archetype. Christian history writes her as the paradigmatic woman because she deliberately chooses a chaste vocation. Her intentional chastity sets a precedent for other Christian women. Meanwhile, set in stark contrast is the example of Mary Magdalene. Not only does Mary Magdalene fail to meet the Christian feminine ideal, but Christian sexual discourse rewrites her as Mary of Nazareth’s antithesis: an excessively prudish and ashamed whore. Mary Magdalene, regularly misrepresented as a prostitute, becomes the alternative identity for women who do not adhere to the virgin archetype. Christian sexual discourse condemns Mary Magdalene’s body on the grounds of sexual perversity. Simultaneously, it depreciates all women’s bodies insofar as it assumes that women specifically, and in ways more serious or intense than men, remain highly prone to sexual sin.

Though many factors went into Mary Magdalene’s misrepresentation as a prostitute, Pope Gregory the Great was the first person to conflate her with other women: the unnamed sinful woman of Luke 7, and Mary of Bethany from the story of Mary and Martha. In a medieval homily, he claims:

She whom Luke calls the sinful woman, whom John calls Mary, we believe to be Mary from whom seven devils were ejected according to Mark [Mary Magdalene]. And what she did these seven devils signify, if not all the vices.27

Gregory connects multiple unrelated stories about women to the narrative of Mary Magdalene’s demonic possession. He draws a thread between Luke 7:36–50, John 12:1–8, and Mark 14:3–9 because each of these stories mentions a woman anointing Jesus. Yet Mary Magdalene’s only explicit association with anointing is in Luke 24, when she attempts to anoint Jesus’s dead body only to find the tomb empty. By writing Mary Magdalene into these biblical stories, Gregory participates in the creation of her legacy as whore:28

It is clear, brothers, that the woman previously used the unguent to perfume her flesh in forbidden acts. What she therefore displayed more scandalously, she was now offering to God in a more praiseworthy manner. She had coveted with earthly eyes, but now through penitence these are consumed with tears. She displayed her spoken proud things with her mouth, but in kissing the Lord’s feet, she now planted her mouth on the Redeemer’s feet. For every delight, therefore, she had had in herself, she now imolated herself. She turned the mass of her crimes to virtues, in order to serve God entirely in penance, for as much as she had wrongly held God in contempt.29

Gregory stresses the “demonic” and “erotic” in order to emphasize how Mary Magdalene’s body was “misused for lust—her flesh, her eyes, her hair—are now properly used for adoration of the Lord.”30 Mary Magdalene now uses the same mouth that “once spoke proud things to kiss Jesus’s feet.”31 According to Gregory, Mary Magdalene encompasses “all vices,” but his erotic language implies that she remains especially guilty of sexual sin. Because the act of anointing

耶稣连接这些故事，格列高利呈现这种姿态为一种举足轻重的赎罪，特别是涉及性道德羞辱的女性。在这种情况下，格列高利将“政治”和“预告”行为作为安息耶稣的行为，赞美“圣堂纯洁”的观念，以及喜爱。

By associating her sexuality with her moral and spiritual character, Gregory presents Mary Magdalene, and other sexually promiscuous women, as “too proud.”32 As Tertullian did with Mary of Nazareth, Gregory identifies Mary Magdalene by her presumed bodily sins. Licentious women are overly individualistic in the eyes of Gregory. As a “woman of the city,” Mary Magdalene exerts an unhealthy and perverse amount of sexual autonomy. She deviates from the normative Christian ideal, the portrait of the obedient Mary of Nazareth. Gregory thus portrays Mary Magdalene as both prudish and ashamed, qualities he associates with sexually promiscuous women. He describes her as someone who decided to “serve God entirely in penance, for as much as she had wrongly held God in contempt.”33

Gregory therefore simultaneously condemns and sanctions Mary Magdalene’s body; he criticizes her sexually sinful body while lauding her bodily actions of repentance.

Particularly important to Gregory’s conflation of biblical texts to produce Mary Magdalene the whore is his exegesis of Luke 7, where he draws a connecting line between female sin and bodily actions. Luke 7, however, provides no evidence to support the contention that the sinful woman was in fact Mary Magdalene or that the sin of this woman was specifically sexual:

A woman in the city, who was a sinner, having learned that he was eating in the Pharisee’s house, brought an alabaster jar of ointment. She stood behind him at his feet, weeping, and began to bathe his feet with her tears and to dry them with her hair. Then she continued kissing his feet and anointing them with the ointment. Now when the Pharisee who had invited him saw it, he said to himself, “If this man were a prophet, he would have known who and what kind of woman this is who is touching him—that she is a sinner.”34

By presenting the sinful woman of Luke 7 in erotic terms, Gregory suggests that this woman commits sexual sin and that sexual sin encompasses all sins. He thereby writes into scripture the notion that Mary Magdalene’s demons represent “all vices,” even though the Gospel of Luke does not identify what type of demons Mary Magdalene struggles with. Luke 8:2 states that some women “had been cured of evil spirits and infirmities,” but Luke does not note whether or not sexual sin induced these spirits. By contrasting Gregory’s conflation of several scriptural stories to the actual biblical accounts as they stand, we can draw a distinction between his representation of Mary Magdalene and her actual depiction in the canonical gospels.

As the canonical gospels show, Mary Magdalene is one of the most significant women in the Bible and arguably the first apostle, insofar as she is one of the first, if not the first, to proclaim Jesus’s resurrection. All four Gospels write her as an active participant in Jesus’s Galilean ministry. As Suzanne Scholz interprets the Gospels, Mary Magdalene “follows [Jesus] to Jerusalem, she mourns at his crucifixion, and on the first Easter, she goes to his tomb and finds it empty.”35

28 Schaberg and Johnson-Debaufre claim that Mary’s construction as a prostitute begins with Gregory, but the origins of this development remains an open historical question.
29 Gregory the Great, Homily 33.
30 Schaberg and Johnson-Debaufre, Mary Magdalene Understood, 48.
31 Ibid.
32 Ibid., 40.
33 Gregory the Great, Homily 33.
34 Ibid.
36 Suzanne Scholz, “Mary Magdalene and Other Women Disciples,” in Biblical
In Mark 16:9, John 20:14–18, and Matthew 28:1–10, the resurrected Jesus initially appears to Mary Magdalene.37 In every gospel with the exception of the Gospel of Luke, Mary Magdalene “is said to have been sent with a commission to proclaim to the disciples that Jesus has risen from the dead.”38 Eastern Christian traditions in particular hold Mary Magdalene in high regard, referring to her as isapostolos or equal-to-the-apostles.39 The historical rewriting of Mary Magdalene’s authority, however, is not accidental. Her misrepresentation as a prostitute stems from the Christian tradition’s misogynistic history, so negative depictions of women are not surprising. Because a woman’s body has more openings than a man’s, as Scholz points out, many people of the ancient world “thought women were more susceptible than men to being invaded by spirits—good or bad ones.”40 The Hebrew and Christian Testaments also present the “powerful woman” as “disempowered” and “whore or whorish.”41 Schaberg and Johnson-Debaufre argue that the gospel writer Luke is to blame for de-faming Mary Magdalene. Luke juxtaposes the story of the unnamed sinful woman next to the story about Mary Magdalene’s exorcism. He also downgrades the woman who anoints Jesus in Mark 14 to a “sinner,’ implying that her sin was sexual promiscuity or prostitution.”42 Rosemary Ruether claims that “the tradition of Mary Magdalene as a [sexual] sinner was developed in Orthodox Christianity primarily to displace the apostolic authority claimed for women through her name.”43 By the same token, the power relations within Christian sexual discourse transformed Mary Magdalene from a significant female apostle into a whore.

By implicating Mary Magdalene as a prostitute, the Christian tradition has taken one of the highest female spiritual authorities and reduced her to the sexual sinner, an identity supported neither by biblical texts nor by historical evidence. Ruether claims that “by choosing a female saint rather than a male one—Peter, [Gregory] cements Christian views of women’s bodies as sexual and as highly susceptible to sexual sin and the demonic.”44 Gregory, then, suggests that all women’s bodies are inherently sinful, reinforcing negative Christian perceptions of feminine sexuality. He identifies women by their sexual bodily actions and further solidifies the notion that women who fall into sexual sin are significantly more shameful than other sinners. Gregory also emphasizes the theological significance of female bodily actions, specifically in the ways women deliberately and consciously act. Here bodily actions take on physical, mental, and intellectual dimensions.

Conclusion
Although Gregory highlights Mary Magdalene’s bodily actions, he does not acknowledge the effects of his own intentional actions.

Through preaching, Gregory participated in the same social processes that created and continue to perpetuate the virgin-whore paradigm. By making adamant claims against feminine sexual promiscuity, Gregory does not transcend sexual discourse; rather, he remains bound within it—“fastened by the deployment of sexuality,” as Foucault would put it.45 Thus, while Gregory attempts to offer a sexual discourse that liberates women by condemning promiscuity and freeing them from sexual shame, he ends up subscribing to a virgin-whore paradigm that undermines whatever liberating potential he may be after. The virgin-whore model in Christian discourse is meant to serve a moral function, presenting the virgin status as the ideal and whoredom as the only alternative, contemptible but avoidable. As seen in the prototypical examples of Mary of Nazareth and Mary Magdalene, the paradigm continues to negatively and inaccurately characterize women as either virgins or whores—two neat categories that do not do justice to the complexity of women’s embodied experience. Because power relations within Christian sexual discourse are unstable, the Marys continually function as both subjects and instruments of power—archetypes and antitheses of feminine sexuality. The model ultimately fails the entire Christian community because it does not perform its intended function, which is to inspire Christians to live virtuously. Instead, the paradigm forces Christians, especially women and sexual minorities, to wrongly think of their morality predominantly in relation to their sexual experiences. This, in turn, enables Christians easily to shame others and degrade sexuality. By dismantling the problematic paradigm, we can redistribute the power over women’s bodies, allowing more possibilities for Christian women, namely as martyrs, apostles, and disciples.

37 Note that Mark 16:9 is likely not original, but nonetheless remains an important witness to early Christian tradition on this point.
38 Scholz, “Mary Magdalene and Other Women Disciples,” 114.
40 Ibid., 42.
41 Ibid.
42 Schaberg and Johnson-Debaufre, Mary Magdalene Understood, 41.
44 Ibid., 48.
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Knowledge of MDMA and Risk Propensity Relating to the Perception of MDMA-assisted Psychotherapy in Young Adults

By Ryan Scanlon and Oriana Mayorga

Abstract:
MDMA has been documented to be an effective adjunct to treat certain psychological conditions, including post-traumatic stress disorder (PTSD), yet it does not receive much publicity. This research examines the young adult demographic (ages 18–23) to investigate an existing relationship between one's background knowledge of MDMA and one's perception of its use as an adjunct in psychotherapy. Risk-taking propensity is also looked at as a possible indicator of a participant's positive or negative perception of this treatment option. There was no significant correlation between one's knowledge of MDMA and one's perception of the therapy ($r = .014, p = .894$). There was, however, a significant correlation ($r = .239, p = .025$) between one's risk-taking propensity and one's perception of the therapy. Psychedelic substance utilization in the psychotherapeutic environment is still growing, and this study is an interesting step in attempting to understand public reception of this field of study.

Acknowledgements:
Zach Kornhauser, PhD Candidate, Applied Developmental Psychology, Fordham University
Emily Brackman, PhD Candidate, Clinical Psychology, Fordham University

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Ryan Scanlon, FCRH ’15, studies psychology and is looking to attend graduate school in the fall of 2015 to earn a master’s degree in Mental Health Counseling. His work and interests cover a wide range of topics in the field including phenomenological research, alternative treatments and interventions, outpatient care, inpatient care, and community based care. He has presented his work at conferences such as the Association for Psychological Science Symposium (2014), Fordham Undergraduate Research Symposium (2014), and International Society for Psychological and Social Approaches to Psychosis Conference (2015). Ryan hopes to contribute to the field of mental health in two capacities: as a careful clinician and an innovative researcher.
Given the recent attention surrounding the illegal substance MDMA (3,4- methylenedioxymethamphetamine), the idea of utilizing it as a possible psychotropic healing agent would certainly be compelling to the public in evaluating its clinical potential. MDMA is considered a psychedelic drug by the pharmacological community and is the chemical base of the street drug, "ecstasy" (Multidisciplinary Association for Psychedelic Studies [MAPS], n.d.).

The use of MDMA for medicinal purposes began in 1912, when it was used to aid heart circulation. Research later exhibited the substance’s psychotherapeutic potential in the 1970s (MAPS, n.d.). Today, MDMA is commonly used as a recreational drug at raves, as it is known to induce elated feelings of closeness and emotional connection between its users (Lad, 2008). Over time, researchers have become interested not only in the physiological effects of MDMA, but also its relational benefits within a psychotherapeutic environment and its ability to adjust the mindsets of participants and practicing therapists (MAPS, n.d.).

**MDMA-assisted Psychotherapy**

This substance has been used experimentally to treat patients suffering from treatment-resistant post-traumatic stress disorder (PTSD), anxiety disorders, and addictive disorders (Parrott, 2007). Specifically, PTSD treatment requires confronting "recurrent and intrusive distressing recollections" or "intense psychological distress at exposure to cues" in patients (American Psychological Association [APA], 2000, p. 468). MDMA's classification as an empathogen substance denotes its ability to touch the psychical side of the human mind, to enable users to recognize more positive aspects of themselves and others, and to elevate feelings of love and empathy (Parrott, 2007). In response to many cases of treatment-resistant PTSD where traditional psychiatric treatment plans have been ineffective, MDMA-assisted psychotherapy has developed as an alternative.

The MDMA-assisted psychotherapy model refutes the typical approach most Western clinicians use to treat patients. This approach, specifically in psychopharmacology, involves the administration of medication and individual dosage compliance on a daily schedule, with years of symptom management typically serving as the prognosis. The MDMA-assisted psychotherapy model instead offers a more interactive, experienced-based treatment. In this model, MDMA is used as a psychotropic agent to assist a psychotherapy session. The goal of a session is to bring about physical healing, psychological problem solving, and spiritual awareness to reach a state of consciousness that has yet been untouched in the patient (Adamson & Metzner, 1988). The idea is that once the patient is in this MDMA-induced mindset, psychotherapy can become more intense and effective.

For some, this intense experience may be welcome, but for others it may be overwhelming, as MDMA has been reported in clinical trials to increase heart rate and blood pressure, cause rigidity of the jaw and neck area, and create difficulty in concentration and memory formation (Jerome, Schuster, & Yazar-Klonsinski, 2013). In a study comparing its physiological effects to those of its chemical relative, methamphetamine, MDMA had a negative effect on psychomotor performance such as eating habits and sleep as compared with the unaffected control group (Kirkpatrick, Gunderson, Perez, & Haney, 2011). Such as it is with any widely used medication or substance, there are possible negative side effects. Even though MDMA has physiological risks the potential benefits of this substance make it deserving of experimental medicinal application.

Clinical trials have tested the use of a d-cycloserine partial agonist as an adjunct to cognitive behavioral and exposure therapies to address obsessive-compulsive disorder (OCD) and certain phobias, a treatment that is comparable to MDMA-assisted psychotherapy. This substance helps suppress the fear response and encourage the extinction process in behavior-based therapies (Ressler et al., 2004). This treatment method has been gaining momentum, offering another alternative to traditional treatment methods. Although they are both emerging as alternative treatment methods, however, d-cycloserine may not face the same stigma and public criticism that MDMA does as a schedule 1 substance (MAPS).

There is no existing research that specifically looks at preconceived attitudes toward MDMA-assisted psychotherapy. With MDMA outlawed in the United States, a treatment option that utilizes the substance's unique psychological effects within the context of a therapeutic environment may generate some skepticism. The stigma of using an illegal, psychedelic drug to aid psychotherapy is prevalent among the general public and presents a barrier towards treatment, as well as education. Investigating the perceptions of MDMA as an alternative treatment method is valuable, especially the perceptions amongst the young adult population, a demographic that has already been exposed to numerous socio-cultural changes in recent history. The demographic has also been linked to high rates of substance abuse, as the peak of illicit drug use typically occurs between ages 18–20 ("Age and Substance Abuse", n.d.).

**Risk Propensity**

The concept of risk propensity provides interesting insight into an individual's personality and outlook (Nicholson, Soane, Fenton-O’Creevy, & Willman, 2005). Risk-taking behavior involves making a choice without certainty of the positive or negative outcomes, often stemming from instinctual or emotional roots (Reynolds et al., 2013). With MDMA-assisted psychotherapy, there is an element of risk because this method is considered experimental at this stage. Even so, in the context of a treatment-resistant condition, this therapy may generate more interest because it is considered to be the last possible alternative. Those who show a high level of risk propensity may favor this therapy regardless, but when in a treatment-resistant situation, those who have a lower level of risk propensity may very well take that leap of faith. This therapy is risky because there is a large degree of unfamiliarity when it comes to this particular drug and the effectiveness of its use in therapeutic healing. This research expects the reception of MDMA-assisted psychotherapy to reflect the individual characteristics and preferences of a given participant.

**Research Goals**

The purpose of this study is, firstly, to investigate the level of knowledge young adults have of MDMA, its effects, its historical and societal background, and its social implications. Secondly, the overall perception of this substance as an adjunct to psychotherapy will be investigated within the overall sample. The overall perception will be determined using two constructs: a) the hypothetical willingness of participants to pursue this treatment and b) the participants' perception of the usefulness of this treatment in a given context. The responses will be compared within demographic groups as well, specifically age and gender. Thirdly, this study will search for any associations between MDMA knowledge, individual risk propensity, and overall perception of MDMA-assisted psychotherapy in the young adult demographic. It is predicted that those who have a higher level of knowledge and understanding of MDMA will have a positive overall perception...
of its use as an adjunct in psychotherapy. It is also predicted that those who hold a high propensity to take risks will be more likely to have a positive overall perception of this therapy.

These findings could be a contributing factor in determining which patients would be eligible for this therapy in the future. Preparation for MDMA-assisted psychotherapy is rigorous and thorough, and the patient’s willingness and positive expectancy going into the session is critical (Parrott, 2007). A secondary aim of this study is to determine which, if either, of the two variables could lead to the acceptability of this form of psychotherapy. The expected outcome is that each variable, knowledge of MDMA and risk propensity, will hold a positive correlation with overall perception. This result could contribute to the therapy’s acceptability and practical application to future patients.

Methods

Participants

There were 116 total responses to the online survey distributed by researchers. Out of 116 survey responses, 98 were used because they had at least one section completed, 18 were excluded because participants failed to complete at least one section two did not give consent. The only eligibility criterion for this study was the age of the participant: A survey introduction message asked those to participate only if they were between the ages of 18 and 23. The age breakdown was as follows: 18 (n = 6), 19 (n = 12), 20 (n = 39), 21 (n = 28), 22 (n = 6), and 23 (n = 5). Participants were recruited through Facebook and during an undergraduate class at Fordham University. Gender was noted as 52% male (n = 51) and 46.9% female (n = 46), with 1% missing (n = 1). The third demographic investigated was whether or not the participant had received psychotherapy or any sort of professional mental health counseling in the past. There were 61.2% (n = 60) of participants who reported that they had not received any mental health counseling, while 38.8% (n = 38) of participants reported that they had received at least one session of mental health counseling. The Fordham University Institutional Review Board for human subjects research approved the study. There was an anonymous online consent form at the start of the survey clearly indicating the risks and benefits of participating.

Measures

This study was exclusively survey-based. Researchers utilized the survey software Qualtrics for survey distribution. Distribution took place via Facebook recruitment and emailing undergraduate students at Fordham University with a direct link. Three separate surveys, all compiled on one link, were used in this study, with the addition of an introductory demographics section. The demographics questionnaire asked participants to indicate their gender, age (if they were between 18–23), if they had ever received any form of mental health treatment and number of sessions attended, and if they could identify the term MDMA and its colloquial alias. At no point in the survey were participants asked about personal drug use or experiences.

The first scale used was designed to measure each participant’s background knowledge of MDMA and its recreational alias, molly. The researchers generated this scale in an effort to illustrate each participant’s familiarity with the term MDMA, its psychological effects as a recreational substance, its societal implications, and other background knowledge. This section consisted of 13 multiple choice questions, with a maximum score of 16 and a minimum score of 0. One knowledge question asked the participants to identify the common sensational effects of MDMA. Participants could select options such as (a) sense of closeness with other people, (b) flat affect, (c) difficulty concentrating, (c) minor visual hallucinations, and (d) increased alertness. The participant was instructed to select all the answers that applied in this case.

The researchers generated a second scale in an effort to measure each participant’s overall perception of MDMA-assisted psychotherapy. The survey clearly noted to all participants at this point, regardless of their prior knowledge of narcotics, that MDMA is the chemical base of the street drugs ecstasy and molly. The perception scale consisted of seven items broken down into two subscales: the hypothetical willingness to pursue the therapy and the potential usefulness of the therapy. Four items were used to measure participants’ willingness to pursue this treatment option for themselves or loved ones. Three items were used to measure participants’ perceptions of the usefulness of MDMA in psychotherapy. Together, willingness to pursue and perceived usefulness made up overall perception, and each item was rated using a Likert scale (1–5 rating, where 1 = not at all willing/useful and 5 = very willing/useful). The maximum score for overall perception was 35 and the minimum score was 7. The score of 21 was held as the distinction between positive and negative perception, since this score would indicate an average item rating of 3 out of 5 (rating the item as indifferent). Scores that fell below 21 indicated participants who negatively perceived MDMA-assisted psychotherapy while scores that exceeded 21 indicated participants who positively perceived MDMA-assisted psychotherapy.

Lastly, the Risk Propensity Scale (Nicholson, Soane, Fenton-O’Creevy, & Willman, 2005) was used to measure each participant’s overall tendency to take risks. This scale asked how often the participant engages in risky behavior. These risky behaviors included taking recreational risks, financial risks, career risks, health risks, social risks, and safety risks. Participants were asked to rate on a Likert scale, where 1 = never and 5 = very often how often they take part in these risk-taking behaviors in the recent past (now) and their adult past. The maximum score was 60 and the minimum score was 12.

Procedure

Using the Qualtrics survey software, distribution of the survey link was done online. Both researchers reached out to their Facebook networks and shared the link with students through statuses, as well as through an event page. Any extra messages that accompanied the link on Facebook did not contain any information that could not be gathered by reading the anonymous online consent form. The researchers also utilized their undergraduate psychology classes to collect data. With the permission of their professors, the researchers distributed their survey via email to students in their classes.

There were no independent control groups; however, it was the goal of the researchers to analyze overall perception scores as they pertained to individual demographics. Descriptive statistics were collected to achieve this goal. Their other goal was to determine if a young adult’s background knowledge of MDMA and propensity to take risks would correlate with his or her overall perception of MDMA-assisted therapy. It was predicted that there would be a positive relationship between knowledge of MDMA and perception of MDMA-assisted psychotherapy as a treatment option. Further, a positive relationship was expected between risk-taking propensity and perception of this treatment method.

Statistical analyses were carried out with SPSS version 18. Descriptive data was compiled in the form of survey means and standard deviations. An inferential statistical analysis was also implemented. A Pear-
The results certainly warrant not only further research, but further development and education of MDMA as a possible psychotherapeutic aid. The descriptive means of the three primary inventories indicated quite a bit. The mean score of MDMA knowledge suggested that participants were not answering questions blindly and that young adults are somewhat informed of this substance and its role in society. Most of the scores fell just above 50% correct (8.00), yet scores did not range towards superior knowledge (15.00–16.00). With the majority of scores being above average but not superior, knowledge of this substance is mixed. A central point to be considered is the implication of the limited information available to the young adult population regarding MDMA as a substance. These findings show that it may be difficult to develop expertise or true awareness of this substance in today's society. One reason for this phenomenon may be that unlike marijuana, which is often discussed both at the state and federal levels, MDMA is not as frequently in the public eye. In addition, the knowledge that participants do have regarding MDMA may stem from uniform drug education programs and may explain why participants held similar levels of knowledge regarding the substance. Indeed, MDMA knowledge score frequencies were found to gravitate toward the middle possible score (8.00), possibly allowing to some inconsistencies in the information and exposure these young adults have had regarding this substance.

Table 1: Mean scores of MDMA knowledge, perception of MDMA-assisted psychotherapy, and risk propensity

<table>
<thead>
<tr>
<th>Scale</th>
<th>N</th>
<th>MD</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of MDMA</td>
<td>98</td>
<td>8.9694</td>
<td>(16)</td>
</tr>
<tr>
<td>Perception of MDMA-assisted psychotherapy</td>
<td>96</td>
<td>24.0729 (35)</td>
<td>4.84550</td>
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<tr>
<td>Risk Propensity Scale</td>
<td>88</td>
<td>30.9545 (60)</td>
<td>7.98549</td>
</tr>
</tbody>
</table>

The overall perception scores of MDMA-assisted psychotherapy in this study could be interpreted in a similar way. With possible scores ranging from 7 to 35, the mean score of overall perception was 24.07. This number, again, is placed just above the overall neutral or indifferent mark (21.00). This mark symbolizes the distinction between positive and negative perception of this substance's use in psychotherapy. A mean of 24.07 indicates that participants perceive this therapeutic approach as slightly positive, but are not fully convinced of its application. This trend toward the middle accurately captures how a participant would perceive any controversial treatment option. However, there are numerous controversial topics that exist today in other contexts (e.g. abortion, gay-marriage, gun control) where a perception scale might pick up more extreme and polar scores. Therefore, it may not be the controversial nature of MDMA-assisted psychotherapy that leads to these perception results, but perhaps the lack of knowledge the participants have regarding the subject. These young adults may know a limited amount about this treatment, hindering them from making a strong, educated judgment. Hypothetically, an increase in knowledge would generate firmer stances and thus more extreme perception scores as a result. This is an avenue that future research can address.

Table 2: Overall perception of MDMA-assisted psychotherapy

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>50</td>
<td>24.0200</td>
<td>4.94249</td>
</tr>
<tr>
<td>Female</td>
<td>45</td>
<td>24.0667</td>
<td>4.82607</td>
</tr>
</tbody>
</table>

The overall correlation was used to examine a possible relationship between each independent variable and the dependent variable. Specifically, the overall perception of MDMA-assisted psychotherapy scores acted as the dependent measure while knowledge of MDMA scores and risk propensity scores acted as the independent measures.

### Results

**Descriptive Statistics**

Descriptive statistics were gathered from each of the three scales to determine the overall trends of the participants' responses. The mean score for participants of the MDMA knowledge survey was 8.97 (SD = 2.06) out of a possible 16. The mean score of the MDMA-assisted psychotherapy perception survey was 24.07 (SD = 4.85) out of a possible 35. The mean score of the Risk Propensity Scale was 30.95 (SD = 7.99) out of a possible 60. Perception scores were examined more closely to reveal possible demographic trends. Table 1 examines the mean scores of each of the three scales: MDMA knowledge, perception of MDMA-assisted psychotherapy, and risk propensity. Table 2 examines the mean perception scores in the context of participant gender. Table 3 examines mean perceptions in the context of participant age. See Appendix for Tables 1–3.

### Inferential Statistics

Knowledge and risk propensity scores, respectively, were expected to each hold a significant positive correlation with perception scores. The Pearson correlation analysis found that despite there being a positive relationship, the correlation of MDMA knowledge scores to overall perception scores was not significant, r(96) = .014, p = .894. A positive correlation also existed between risk propensity scores and overall perception scores, indicating a significant relationship r(88) = .239, p = .025. The correlation that existed between risk propensity and perception of MDMA-assisted psychotherapy was moderate yet statistically significant. The collective correlational data presented a mixed conclusion in relation to the central hypotheses.

### Discussion

With the potential clinical value of MDMA, the purpose of this study was to investigate the overall perception of this substance as an adjunct to psychotherapy in the young adult population. This survey-based approach compared a total score of perception of MDMA-assisted psychotherapy (made up of subscales willingness to pursue and perceived usefulness) to other relevant variables and exhibited demographic patterns. The survey included a portion that tested each participant’s basic background knowledge of MDMA’s role as a recreational substance, its neuro-physiological effects, and its implications in today’s society. Knowledge scores were examined both for their own sake and for the purpose of discovering a possible correlation with overall perception of MDMA-assisted psychotherapy. The survey also addressed the propensity of participants to take risks. These findings were solely used to discover a possible correlation with overall perception.
A participant knowing about MDMA as a substance did not relay any statistical indication that he or she would hold a positive perception of it as a psychotherapeutic adjunct.

Participants’ risk propensity scores were predicted to correlate with overall perception scores. This hypothesis was validated with a moderate correlation ($r = .239$) that was statistically significant ($p = .025$). As MDMA-assisted psychotherapy is still considered experimental by nature, it was hypothesized that those who engage in frequent risk-taking behavior would hold a more accepting and positive perception on this substance as a therapeutic adjunct. In order to consider this treatment, it is necessary to trust what is potentially unfamiliar. Many daily tasks and obstacles contain elements of ambiguity, and those who are more inclined to be risky overcome them without distress. While risk taking may lead to unhealthy and somewhat irrational decisions, the very nature of a risk taker is to confront the unknown (Nicholson, et al., 2005). Concerning an unconventional treatment method using an illicit substance, participants who were more comfortable with this subject matter or held a higher propensity to take risks were more likely to hold a positive perception of it.

There were limitations to this study, especially with regards to the sample. With 98 total participants and 88 full completions of the survey, a larger sample could make for more significant and representative results. Sample recruitment was done through social networking mediums such as Facebook and Fordham University email. The sample was subject to the primary investigators’ social network on Facebook and their fellow college students. To gain a more representative sample of young adults, recruitment should be executed on a larger scale. Despite stressing confidentiality as a vital part of the procedure, participants may have answered the survey with some social or researcher desirability. An internal limitation would include the novelty of the scales used. Researchers devised both the MDMA knowledge scale and the overall perception of MDMA-assisted psychotherapy scale. These scales were carefully put together but were not tested to confirm convergent validity. Also, with an entirely electronic distribution of the survey, there exists the possibility of participants using online information sites to aid them in the MDMA knowledge scale, posing a threat to validity.

This study was unique in its central hypothesis. There has been no previous research that has closely examined the public perception of MDMA-assisted psychotherapy comparatively with other variables. The importance of this study will be heightened based on the emergence of MDMA as an adjunct to psychotherapy. If this treatment option progresses through its developmental stages and gains publicity, studies resembling this one will, perhaps, become more frequent. Researchers were careful to ensure that MDMA-assisted psychotherapy was fairly portrayed throughout the survey. One useful way this study could be directly utilized is in the selection or preparation process prior to MDMA-assisted psychotherapy itself. This therapy is very personal in the sense that one who undergoes it must fully believe in its benefits and expect a lasting positive outcome. This study can also highlight what characteristics are present in those who would be willing to pursue. Perhaps when screening and preparing a patient to possibly undergo this treatment, the patient’s propensity to take risks and prior experience with mental health treatment could be taken into account in order to determine if he or she is a good candidate for this therapeutic experience. Knowledge as a whole must increase in this area of psychopharmacology in order to build a more accurate representation of young adults’ actual perceptions. An increase in factual knowledge about MDMA as a substance and as an aid in psychotherapy would lead to the accumulation of more definitive opinions or perceptions. These are factors to look at in the future in order for this treatment option to gain momentum.

**References**


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The Unavoidable Challenges and Preventable Weaknesses of Housing New York

By Riley Edwards

Abstract:
There is a significant gap between the 200,000 units of affordable housing that Mayor Bill de Blasio’s housing plan, Housing New York: A Five-Borough, Ten-Year Plan, proposes to build and preserve in 10 years, and the much larger number of units needed to truly address the affordability crisis. This paper explores the reasons for that gap and proposes improvements to the plan based on its response to these obstacles. I define 4 challenges to building more affordable housing—lack of sufficient city funds, developer resistance, neighborhood resistance, and competing land-use priorities—and analyze the extent to which Housing New York addresses each of these challenges, focusing on the latter 2. I apply this framework to the case of Brooklyn Bridge Park, where neighborhood resistance and competition with parkland created significant challenges that were not effectively addressed. Finally, I propose a more comprehensive response to the problems of neighborhood resistance and competing land-use priorities.

Acknowledgments:
I’d like to give many, many thanks to Dr. Christina Greer for her guidance, support, and encouragement through this project. Thanks also to Dr. Roger Panetta, who first pointed me toward Brooklyn Bridge Park as a particularly fascinating convergence of interests, and to Dr. Frank Boyle, for granting me the freedom and flexibility to pursue my eclectic interests. Finally, thanks to anyone and everyone who has nodded gamely along while I talked about Robert Moses, the destruction of the neighborhood of San Juan Hill, or affordable housing.

Riley Edwards, FCLC ’16, is a double major in Political Science and Physics and a member of the Lincoln Center Honors Program. Since moving to New York from a small town in Washington State, she has become passionate about urban policy. She plans to work in policy or government for a few years before pursuing a master’s in public policy, incorporating her quantitative skills and her interest in issues of social and economic inequality.
The need for affordable housing in New York City has reached the proportions of a crisis for the middle class, working class, and poor residents of the city. Mayor Bill de Blasio's Housing New York plan, which aims to build and preserve a total of 200,000 affordable units, comes at a time when it is desperately needed. The plan, released on May 5, 2014, is ambitious, calling for new programs, greater cooperation between agencies, and increased resources directed to affordable housing. Despite the bold goals laid out in the plan, it does not go nearly far enough to make the necessary impact on the affordable housing crisis.

Some of this shortfall is inevitable because of limits on the city’s resources and inherent conflict with market interests. The plan goes a long way toward addressing these challenges, but hardly acknowledges two other obstacles: opposition from current residents and competing government priorities. This conflict can be seen in the example of Brooklyn Bridge Park, where the administration has pushed for an increase in affordable units in two planned residential towers. Backlash from current residents has exposed neighborhood resistance to the planned income diversity, as well as the clash between the contradictory priorities of open space and additional affordable housing. Beyond this specific case, increasing income diversity in other parts of the city will not happen unopposed, and the conflict between housing development and other priorities for land use, notably for parkland, will continue as well. Although the challenges themselves are unavoidable, the plan’s weak response to them is avoidable.

This paper will first examine the need for affordable housing in New York City. It will then examine how the Housing New York plan addresses the possible challenges of neighborhood resistance and competing land-use priorities, and how this response falls short. To provide an example of these challenges in a current affordable housing project, this paper will look at the case of Brooklyn Bridge Park. Improvements in response to the two challenges could have made the Brooklyn Bridge Park project run more smoothly and should be kept in mind in future projects.

The Need for Affordable Housing

Housing affordability is a growing problem across the country, as rents have risen more quickly than in the past while wages have been close to stagnant (Jain & Brecher, 2014). Affordability is measured by comparing housing costs to income, and housing is generally considered affordable if it costs a 30% share or less of income. A report by the Citizens Budget Commission (Jain and Brecher, 2014) found that New York City has neither the highest rents nor the least affordable rents in the country. However, the housing supply in New York City has increased more slowly since 2000 than it has in all other large U.S. cities with growing populations, and New York City has the largest share of rental units out of total occupied housing units (more than two-thirds) of any major U.S. city (Jain & Brecher, 2014). Although New York City is just one of many American cities with affordable housing crises, this certainly does not mean that the problem does not need to be dealt with here. Rather, it needs to be addressed before New York City climbs any higher on the rankings of unaffordability. Attracting newcomers from all different socioeconomic backgrounds is vital to New York City’s economy, and losing its competitiveness in this area due to an inability to house these people affordably could have very negative consequences.

The Housing New York plan was written with an acute awareness of this pressing crisis. In its first few pages, the plan enumerates some alarming statistics. The average monthly rent for an apartment in the city has risen by 40% over the last 20 years, while wages have risen by less than 15% in the same time span (see Figure 1). More than half of all households in the city spend more than 30% of their income on rent and utilities, a threshold that defines these households as rent-burdened. Nearly one million New Yorkers earn less than half of the Area Median Income (AMI), yet there are less than half a million housing units available at rents that are affordable to them (see Figure 2; Office of the Mayor, 2014, p. 6). In more and more parts of the city, rising rents are pushing out people and families who have lived in those neighborhoods for decades, and the wealthy are moving in to take their place. Besides the millions of New Yorkers who struggle to afford the housing they are living in, there are about 60,000 homeless individuals in the city, the majority of whom depend on the city’s shelter system (Department of Homeless Services [DHS], 2014a; DHS, 2014b). Housing for these individuals should be part of any comprehensive housing plan. Finally, the total population in the city is projected to grow by more than 400,000 people by 2030 (Department of City Planning [DCP], 2014; DCP, 2013). The total number of housing units is projected to grow by 230,000 units by 2030 (Capperis et al., 2013, p. 54; DCP, 2013). In addition to improving the current affordability conditions of the city’s housing market, the city must also be prepared to provide new housing stock at affordability levels that match the income diversity of these new residents. Altogether, the 200,000 units promised by Housing New York are only a fraction of the units needed by those who are currently rent-burdened or homeless and those future New York City residents who will arrive while the plan is being implemented.

The Weak Response of Housing New York to Two Potential Challenges

Housing New York and the Challenge of Neighborhood Resistance

When the authors of Housing New York write about increasing the income diversity of New York neighborhoods, it is through the lens of providing more equal opportunities for all. This perspective is summed up in a description of the economic segregation of the city:

"...the highest income and the lowest income neighborhoods have little income diversity. Similarly, some neighborhoods have tremendous racial and ethnic diversity, while others are racially homogenous. . .The inequality and lack of diversity in many neighborhoods means that some families do not have access to the education, jobs, and other opportunities others enjoy. It also means that low-income households often are unable to find homes in the neighborhoods in which they would like to live. (Office of the Mayor, 2014, p. 26)"

Interestingly, the economic segregation and racial segregation described here are only described as “similar,” not as overlapping or
stemming from the same causes, which oversimplifies the relationship between the two. Rather than examining the causes of the current inequality, the plan jumps ahead to a solution that requires a percentage of new units in “strong markets” to be “permanently affordable to low- or moderate-income households in order to ensure diverse and inclusive communities” (Office of the Mayor, 2014, p. 8).

Income diversity in neighborhoods is something the plan should strive for, but the apparent assumption that creating this will be as easy as requiring wealthier neighborhoods to absorb a certain proportion of low-income residents in every new development is shortsighted. Low-income communities have been fighting for decades against influxes of wealthy residents. Low-income residents in wealthy neighborhoods will not be pricing out and displacing their neighbors, but they are likely to be unwelcome anyway because they will change the character of the neighborhood. Suddenly introducing moderate- or middle-income residents into an economically homogenous community (which is likely to be racially homogenous as well) will not be a simple transition for either group, and this challenge deserves a more thoughtful treatment. The Housing New York plan does not acknowledge this hurdle or provide solutions for overcoming it.

**Housing New York and the Challenge of Competing Priorities for Land Use**

The plan more thoroughly examines the challenges of competing priorities for land use than it does the previous challenge of neighborhood resistance. For example, in a section about infrastructure investment to set the stage for housing growth, the report says, “the potential for new housing can only be fully realized if improvements to infrastructure such as upgrades to storm water and sanitary sewers, or the construction of new streets and public open spaces, are made” (Office of the Mayor, 2014, p. 9). The plan also discusses current zoning requirements that limit the amount of land that can be used for housing. These include a stringent requirement for a certain amount of parking spaces for a new building and setback regulations that encourage “tower-in-the-park” zoning, where a high-rise is surrounded by parking or lawns. The authors note that the parking requirement is no longer in line with the number of New Yorkers who own cars and propose a revision of this and related requirements. However, no suggestions are made to ensure that other uses for the land, like parkland, are prioritized in tandem with housing development. These two visions for land use came into direct conflict in the Brooklyn Bridge Park case, and this is likely to happen again.

**A Case Study of Brooklyn Bridge Park Development**

The case of proposed affordable housing development in Brooklyn Bridge Park illuminates all of the unavoidable challenges of affordable housing development that I have examined and is useful in understanding the weaknesses of the Housing New York plan. Although it is unique in many of its circumstances, it demonstrates the pressures that Housing New York will face over the next decade. Brooklyn Bridge Park is unique among parks in the city in that it is funded by a public-private model first conceived by Mayor Michael Bloomberg and Governor George Pataki’s administrations in 2002. The Brooklyn Bridge Park Corporation (BBPC) was established in 2002 as a non-profit entity to operate the park, with a board selected by state and city officials. A 2006 update to the 2002 Bloomberg-Pataki plan included several future residential towers and commercial developments around the edges of the park. Revenue from these developments would pay for the upkeep and operations of the park, with no taxpayer contributions at all. The plan included three luxury residential towers near Pier 6, at the southern edge of the park (see Figure 3; Robbins, 2014).

One of the towers, One Brooklyn Bridge Park, was converted from a printing plant to a condo in 2009, and a Request for Proposals (RFP) for the final two towers was issued in May 2014. However, the RFP featured a significant change from the updated 2006 BBPC plan: To help reach the de Blasio administration’s goal of 200,000 new units of affordable housing, the two towers would be required to set 30% of their units at rents affordable to moderate- or middle-income residents. According to the BBPC, the park was in better financial shape than expected, so three towers comprised solely of market-rate housing were unnecessary. Requiring affordable housing in the two planned towers would get the de Blasio administration closer to its goal (Robbins, 2014; The New York Times Editorial Board, 2014).

The RFP sparked opposition that took several forms. Residents of One Brooklyn Bridge Park took to their condo’s message board to share not-in-my-backyard (NIMBY) sentiments. Residents of Brooklyn Heights, the surrounding neighborhood, joined them in worrying about disappearing views, overcrowding in schools, and a possible drop in property values. Some mounted a more philosophical opposition, arguing that parkland is always a greater good than housing. Others pointed out that the 2002 plan called for development only to the extent necessary to fund the park. Established neighborhood groups have taken sides, and new groups have sprung up as well. In 2007, the Brooklyn Bridge Park Defense Fund lost a legal battle to prevent any housing from being built in the park (Robbins, 2014).

In the newest round of the conflict, particularly vocal opposition has come from neighborhood residents Lori Schomp, Martin Hale, and Joseph Merz. Schomp founded an activist group called Save Pier 6 and a foundation called the People for Green Space Foundation (PGSF). Schomp’s boyfriend, Hale, is the chairman of the PGSF; Schomp, Merz, and the PGSF mounted a legal challenge to the development, trying to require that an updated environmental impact statement be prepared, which they hope would take into account “the enormous popularity of the park, the growth of the surrounding neighborhoods, increasing traffic, and overcrowded schools” and stop the city from choosing a developer for the towers (Barbanel, 2014). One Brooklyn Bridge Park is a recipient of tax abatements from the city. When these expire in 2020, the revenue the building contributes to the BBPC will increase. Hale, Schomp, and the PGSF argue that with this upcoming increase in revenue, there is no need for additional housing in the park (Randazzo, 2014). The BBPC, however, points to the future need to restore
rotting piers, which will take significant investment on top of regular annual expenses (Barbanel, 2014).

The Two Challenges as Seen in Brooklyn Bridge Park

The case of Brooklyn Bridge Park shows an ineffective response to the two challenges of neighborhood resistance and competing priorities for land use. According to The New York Times article by Liz Robbins (2014), some of the comments on the message board of One Brooklyn Bridge Park veered toward NIMBY-ism and resistance to changes in the socioeconomic makeup of the neighborhood. Brooklyn Heights is a very liberal neighborhood, where the State Assembly candidate running on the Republican ticket in 2014 received less than 1% of the vote, so its residents might be expected to be more supportive of affordable housing in general (Board of Elections in the City of New York [BOENYC], 2014). However, the neighborhood is also much wealthier than the city as a whole, with a 2011 median income of almost $120,000 as compared to that of just over $55,000 for the whole city (City-Data.com, 2015). The backlash shows that neighborhood residents are not eager for the increased income diversity that affordable housing would bring.

The organized resistance to the towers has also taken the form of advocacy for preserving parkland. The availability of green space is certainly an important priority as the city becomes more densely populated, and advocates argue that the growth of housing or parkland should not come at the expense of the other. The conflict between parkland and affordable housing is perhaps the most problematic part of the Brooklyn Bridge Park case. On one hand, the final two towers were part of the 2006 plan, and the subsequent legal challenge from the Brooklyn Bridge Park Defense Fund failed. On the other, the 2002 agreement by Bloomberg and Pataki to build the park did specify that development would be limited to the amount necessary to fund the park. There is some disagreement between the BBPC and activist groups over the revenue that the buildings will generate and the budgetary needs of the park, but it is clear that the park is financially ahead of the projections for this point in time. Thus, it may not be strictly necessary to build the two towers as large as they were proposed to be, which would keep the development more in line with what is currently there, but would preclude the inclusion of affordable housing.

The tug-of-war between green space and housing development is a battle that urban planners have fought for decades and still have not resolved. Interestingly, Joseph Merz, one of the plaintiffs in the new legal challenge to development in the park, was also an opponent of the construction of the Brooklyn-Queens Expressway through Brooklyn Heights in the 1950s. Merz, an architect, helped to get a small subsection of Brooklyn Heights, where he lived, declared the city’s first historic district in 1965. Fitting with this background, Merz, Schomp, and Hale cite lofty reasons for not wanting affordable housing located in the park. In an interview with the Brooklyn Heights Blog, Hale says, “The message is, affordable housing is not a free pass to ignore and violate the other variables of a good city, including park space, neighborhood character, and urban design” (Randazzo, 2014, p. 2). Although this is a noble sentiment, as noted by a lawyer representing an affordable housing developer in a similar case of neighborhood resistance in Westchester County, “in an era when discriminatory language might not be publicly palatable, opponents of such projects resort to other explanations” (Berger, 2014). The city will need to anticipate this kind of nuanced argument whenever affordable housing is introduced into a homogeneously wealthy neighborhood.

Weaknesses of Housing New York and Proposals for A Stronger Response

The Housing New York plan includes many measures to use city resources efficiently and incentivize developers to build affordable housing. What the plan lacks, however, is an evident and comprehensive response to potential neighborhood resistance to increased income diversity and to conflict surrounding the use of available land for affordable housing or parkland. In each case, I will briefly explain the importance of resolving the challenge, discuss cases of success and/or failure in addressing the challenge in New York City or elsewhere, and put forth suggested measures to respond to the challenge.

A Transition to Economic Diversity

A commitment to economic diversity appears in the third guiding principle of Housing New York, which asserts, “Economic diversity must be a cornerstone of housing development” (Office of the Mayor, 2014, p. 7). Income segregation has been shown to be bad for economic growth for cities and for income growth for workers at all skill levels. An analysis of the 2013 study “Residential Segregation, Spatial Mismatch and Economic Growth across US Metropolitan Areas” in Chicago Policy Review explains that two elements of income segregation, spatial mismatch and skill complementarity, have a negative effect on economic growth (Chan, 2014). Spatial mismatch occurs when low-income individuals live “far from potential places of work” (Chan 2014), so they miss out on participation in growing industries. Spatial mismatch leads to a low level of skill complementarity, or an ideal ratio of high- and low-skilled workers. If the ratio is too far off, economic growth may be inhibited (Chan, 2014). Actively fighting income segregation by developing new affordable housing in the midst of higher-income neighborhoods could increase economic growth by placing more low-skilled workers closer to where they are needed.

In the same vein, a 2013 report by the Pew Charitable Trusts, Mobility and the Metropolis, found that “[n]eighborhood economic segregation is linked to economic mobility. American metro areas with distinct pockets of concentrated wealth and concentrated poverty have lower economic mobility than places in which the wealthy and the poor are more integrated” (Sharkey & Graham, 2013). Economic segregation has many indirect effects as well, including being detrimental to educational outcomes for children who live in areas of concentrated poverty, according to the “Modern Segregation” report by the Economic Policy Institute (Rotstein, 2014). Reducing economic segregation by increasing income diversity throughout the city would have many positive effects.

The goal of income diversity faces, however, the challenge of neighborhood resistance. The kind of backlash seen in Brooklyn Heights has occurred in similar situations in and around New York City in recent years. In Westchester County, a settlement in a federal lawsuit that alleged that county officials misrepresented their efforts to encourage fair housing required the county to build 750 units of affordable housing in areas with overwhelmingly white populations and to make a substantial effort to market those units to black and Hispanic residents of Westchester and New York City (Roberts, 2009; Timiraos, 2009). The lawsuit was filed under the False Claims Act and pertained to a section of the county’s application for Community Development Block Grants, which overstated its efforts to comply with the 1968 Fair Housing Act’s requirement that cities “affirmatively further” fair housing. This requirement is generally not enforced, but a new rule proposed in July 2013 and not yet finalized would clarify the mandate and help cities measure existing segregation by “publishing extensive local data on patterns of integration and segregation, discrimination,
poverty, access to good schools, jobs and transit, among other things” (Badger, 2013).

An affordable housing development that was being built in the hamlet of Chappaqua, New York as a result of the settlement faced similar arguments as those seen in the case of Brooklyn Bridge Park. Residents cited worries about potential fire hazards and a concern that “the location is terrible because it is on a forlorn, polluted field” (Berger, 2014). Advocates for the development said these worries were baseless and simply intended to delay a change to the status quo of a homogeneous-wealthy, white community.

Finally, even closer to Brooklyn Heights, a similar conflict unfolded in Carroll Gardens, Brooklyn, over a planned homeless shelter. In response, the head of the Carroll Gardens Association said, “I didn’t spend my whole life helping make Carroll Gardens a decent place to let somebody do a dumb idea like this” (Berger, 2012). On the other hand, an immigrant owner of a local deli said that residents of the proposed shelter, as well as current clients of a methadone clinic in the neighborhood, “don’t harm you…They just buy and leave,” whereas the wealthier residents “don’t give me no business” (Berger, 2012). The presence of the wealthier residents’ self-interest in their opposition to an incursion of low-income people to the neighborhood is even clearer in this case.

These three cases clearly illustrate the likelihood of opposition to building affordable housing in wealthy neighborhoods in New York City, but provide few hints of measures that could ease the tension. If current residents of wealthy neighborhoods gained a greater understanding of the benefits of housing integration to themselves as well as to potential new low-income residents, the “us versus them” outlook seen throughout these examples could be reduced. This could be achieved through a city-sponsored messaging campaign about the current extent of economic segregation and its deleterious effects as well as the potential benefits of more diverse neighborhoods. An example of a similar effort can be seen in WhyNIMBY.org, a project of the Delaware Housing Coalition’s Good Neighborhood Project to educate residents of Delaware on the benefits of fair housing and to fight the NIMBY instinct (Delaware Housing Coalition, 2014). A campaign like this will not change all minds, of course, but could encourage a bigger-picture perspective.

It is also important to involve communities early on in the planning process — not to provide a vehicle for residents to fight an increase in income diversity, but as a way to educate them about the importance of the change and give them an advisory role in the form that affordable housing will take. Residents who understand that increased income diversity can bring economic benefits to them as well as create a more vibrant community may be more welcoming to newcomers. Also, the low-income individuals who move into the neighborhood should not be segregated to their building with no interaction with the community. Affordable housing developments should, wherever possible, include public and community spaces to encourage mixing between neighborhood residents new and old, breaking down the feeling of difference and separation.

Managing Conflicting Land Use Priorities
Land is a very limited resource in New York City, and there are competing interests in how it should be used: luxury condominiums, affordable housing, commercial space, schools, infrastructure, or parkland. With an ever-growing population, there is more pressure on the mayor and City Council than ever before to make the right choices to preserve and improve livability for all its residents. In order to make the city a place for all, affordable housing and parkland are both essential.

While I agree with Merz, Hale, and Schomp that parks are vital, I believe that if people of middle, moderate, or low income cannot afford to live near a park, it loses its purpose and becomes instead a backyard for the wealthy. This city already has Gramercy Park, a truly private park that is only accessible to those privileged enough to live on its perimeter and have one of a few hundred keys (Finn, 2012). Addresses on the west, south, and east edges of Central Park are among the most coveted in the city. Parks with private conservancies (including Central Park, Prospect Park, Bryant Park, and the High Line) are maintained far better than those that do not have wealthy benefactors and must rely only on city funding (Foderaro, 2014). Brooklyn Bridge Park, with its funding coming from private revenue streams, runs the risk of becoming too focused on serving the wealthy neighborhood that surrounds it and keeps it running. Although its funding is private, Brooklyn Bridge Park is meant to be a public good. As such, so long as the park still receives enough income from the market-rate development, affordable housing in the park is a fitting opportunity to increase equitable park access.

Although new parks are rare, they can have a dramatic effect on their surrounding neighborhoods. For example, the High Line project created a park where there had previously been an abandoned railroad track, using space that could not have been used for housing anyway. The park raised the property values of the surrounding buildings enormously. However, before the construction of the park, the neighborhood included a significant number of working-class residents, who likely can no longer afford to remain there (McGeehan, 2011; Moss, 2012). As seen in the case of the High Line, creating too much coveted green space can push out those who most need access to it.

The case of Brooklyn Bridge Park is unique, so when the conflict between parkland and housing development arises again in the future of Housing New York, it will take a different form. In order to make progress toward the overarching goal of a livable city, accessible to people all income levels, both parkland and affordable housing are essential.
There is no simple answer to the question of when to choose which option in a zero-sum situation, but planners should take into account the proximity of parks to low-income neighborhoods, an equitable but also reasonable distribution of parkland throughout all five boroughs, and the opportunity to turn an apparently zero-sum conflict into a positive-sum one by imagining parkland in new ways without taking space away from housing. The High Line does this, albeit with a gentrifying effect. Future projects with a similar potential for intense economic growth should be tempered with higher mandated ratios of affordable housing to prevent them from creating further exclusivity and disparity.

Another possible way to avoid the “High Line effect” is to increase green space but limit it to only what is necessary, without adding the amenities that bring in an influx of wealthy people and upscale businesses. In a presentation at the American Planning Association, Winifred Curran referred to this strategy as “just green enough” (Curran, 2013). Incremental increases in green space, with a focus on necessities rather than amenities, could improve neighborhoods without rapid gentrification. Although not applicable to the Brooklyn Bridge Park case, where a park chock-full of amenities was built alongside neighborhoods that were already wealthy, it would be a useful guiding strategy in future instances where the needs for parkland and affordable housing come head-to-head.

**Conclusion**

New York City is changing rapidly. Bloomberg’s notion of the city as a “luxury product” is taking hold in many places, often leading to displacement of people who can no longer afford to stay. Williamsburg, once home to immigrants from Eastern Europe, Italy, Puerto Rico, and the Dominican Republic, is now home to an Apple Store, J. Crew, Starbucks and Whole Foods. Rising rents due to the allure of a vibrant, creative community have pushed out many of the area’s long-term residents and made the neighborhood more and more indistinguishable from other parts of the city. Alongside this process of gentrification, there is an increase in areas of concentrated poverty. This kind of extreme disparity and segregation between the so-called “Two Cities” of New York is not sustainable for the city’s future. Poor working-class and middle-class residents need places in the city where they can afford to live, and those cannot be segregated from the enclaves of the wealthy.

Housing affordability is already a critical problem in New York City. The mayor’s plan to build and preserve 200,000 units in ten years barely scratches the surface of what is needed to improve the current inequities and keep up with growth. Because of inherent challenges, including limits to the city’s funding, resistance of developers to limiting their potential profits, opposition of wealthy neighborhoods to incoming affordable housing, and competition of land-use priorities, it would be impossible for the city to publish a plan that would completely solve this problem. All of these challenges are substantial. However, as seen in the case of Brooklyn Bridge Park, the Housing New York plan is better equipped to deal with the first two challenges, and provides little or no response to the latter two.

Because of the necessity of income diversity, affordable housing cannot simply be built in places where people already have low incomes. In order for the transition to greater economic integration to occur as smoothly as possible, the cooperation and understanding of those in wealthy neighborhoods is critical so that the future prosperity of the city is not threatened by NIMBY-ism. Along with neighborhood diversity goes neighborhood livability. People need more than just housing and workplaces—they need parks and schools and community space, so-called “third places” in their lives. The city will have to carefully and creatively balance all of these needs, making sure that affordable housing and parkland are distributed equitably and with an eye toward necessity rather than extravagant possibility, in order to preserve affordability. Integrating these challenges into the Housing New York plan will help the city be as successful as possible, given the limitations, in achieving the goal of affordable housing.

**References**


Department of City Planning. (2013, December). New York City


Undergraduate Research Accomplishments: Awards and Recognitions

Katrina Colletti (FCRH ’14) was awarded a Graduate Diversity Fellowship to pursue studies in physics at the Dwight Look College of Engineering at Texas A&M University in College Station, TX.


Elaina Mansley (FCRH ’16) won a Boren STEM Scholarship to study Arabic language at Al Akhawayn University in Ifrane, Morocco for the summer of 2014.

Giuliano Pichini (FCRH ’16), Steven Romanelli (FCRH ’16), and Grant Knoll (FCRH ’16) were selected for presentation in the SCI-MIX session for “Peptide bolaamphiphile synthesis and their interactions with Fibrin” at the New York American Chemical Society Annual Undergraduate Research Symposium, Queens, NY, May 2014. (mentor: Ipsita Banerjee, Chemistry).


Steven Romanelli (FCRH ’16) won Outstanding Platform Presentation in the Chemistry Division for “Chitosan bound Peptide Nanoassemblies for Tissue Regeneration” at the Eastern Colleges Science Conference, Poughkeepsie, NY, April 2014. (mentor: Ipsita Banerjee, Chemistry).
An Economic View of the MLB Qualifying Offer

By Sanjay Pothula

Abstract:
When Major League Baseball (MLB) agreed on a new collective bargaining agreement in 2012, the qualifying offer system was instituted within MLB free agency. The new system effectively changed how players entering free agency were being evaluated in the market. In order to measure the average annual value (AAV) of the qualifying offer, this study used 3 years of signing and extension data from 2012 through 2014 for an ordinary least squares (OLS) regression analysis. Through this analysis, the goal of this document is to explore the decision-making process for MLB teams during the offseason free agency period. Thus, the OLS regression analysis provides an understanding of the valuation process for MLB free agents and shows high accuracy for future transaction predictions.

Acknowledgments:
Special thanks to Dr. Phillip Shaw for his guidance and contribution.

Sanjay Pothula, GSB ’15, is a major in Marketing with a minor in Economics. He has interned with the New York Islanders during the summer and fall of 2014. Now, he is a staff writer at AriBall.com, where he writes articles on recent baseball topics through an economic point of view. In his senior year, he became passionate about econometrics under the tutelage of Dr. Philip Shaw. After graduation, he hopes to work in analytics for a sports team.
In its first three years of existence, the qualifying offer in Major League Baseball (MLB) free agency has been a hot topic. The new system has created market efficiency, where MLB teams must weigh the pros and cons of losing or signing a free agent. For any team looking to offer or sign a qualified offered player to a contract must weigh three decisions during the process: the player’s value to the team, the team’s draft pick status, and the desirability of the player within the free agent market. All of those factors play a huge role in the economics of modern-day MLB free agency. Since MLB is one of the only sporting leagues to support relatively open salary caps, team budgets differ widely among the 30 MLB teams. Although seemingly counterintuitive, MLB teams with the highest average salaries are not necessarily the best teams. The best teams are constructed through sound economic decisions. This thought process is totally subjective on a team-by-team basis, but it is still built on the foundation of the value delivered based on the player’s performance, contract, or a combination of both. Rightfully so, the qualifying offer plays an important role in this decision-making process for MLB executives in the valuation of MLB free agents.

History of the Qualifying Offer
The qualifying offer in the 2012–2016 MLB Collective Bargaining Agreement (CBA) represents a significant change from the previous 2007–2011 CBA’s Type A/Type B compensation system. In the new system of free agency, the qualifying former club of a qualified free agent may offer a specified one-year contract to their qualified free agent equivalent to the average annual salary of the 125 highest paid players in baseball, which was $15.3 million in the 2014–2015 offseason (Associated Press, 2014). If the player accepts the qualifying offer, the player becomes a signed player at the annual value of the qualifying offer for the next season. However, if the qualified free agent declines the qualifying offer and signs with another major league club, the former club receives an amateur draft choice, a free agent designation is only relative per position. In the last year of the old system, the Statistical System for the Ranking of Players designated 37 players as being either Type A or Type B free agents. With the new qualifying offer system, the ambiguities of the Statistical System for the Ranking of Players are eliminated, and teams are forced to assess the value of their own players against the given annual value of the qualifying offer. Thus, the new qualifying offer system provides a more defined distinction for the premium free agents in the free agency market.

This new system differs from the old Type A/Type B compensation system in two significant ways. First, the agreement on a one-year contract between the former club and its free agent occurred through an arbitration process in the past. In the old system, the former club could offer a one-year contract to their free agent. If the player agreed to the offer, the player would be signed for the next season, and a salary arbitration proceeding would be conducted. Second, if the player declined the one-year offer, the player would become a free agent and would be subject to compensation to the former team as a “Type A or B Player” in the statistical system for the ranking of players, which used two-year averages of statistics for each respective position. Type A free agents were designated as such based on “who rank[ed] in the upper twenty percent (20%) of his respective position group” (“2007 – 2011 CBA,” 2006, p. 73). If a Type A free agent signed with a new team, the former club of the free agent would acquire the new signing team’s first-round draft pick and a special draft pick in the compensation round. For example, if the Type A free agent signed with Team B, Team A would receive Team B’s first-round pick and compensation pick at the end of the first round. Type B free agents were designated as such based on “who rank[ed] in the upper forty percent (40%) but not in the upper twenty percent (20%) of his respective position group” (“2007 – 2011 CBA,” 2006, p. 73). In this case, if a Type B free agent signed with a new team, the former club would only receive a “special” draft pick, a compensation round pick (“2007–2011 CBA,” 2006, p. 70–74).

The major problem with the old Type A/Type B compensation system was that too many players were being designated as Type A or Type B free agents. Essentially, it caused inflation on player value because the free agent designation was only relative per position. In the last year of the old system, the Statistical System for the Ranking of Players designated 37 players as being either Type A or Type B free agents. With the new qualifying offer system, the ambiguities of the Statistical System for the Ranking of Players are eliminated, and teams are forced to assess the value of their own players against the given annual value of the qualifying offer. Thus, the new qualifying offer system provides a more defined distinction for the premium free agents in the free agency market.

### Table 1: Estimated AAV Model

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Coefficient</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>998,011</td>
<td>0.00097</td>
</tr>
<tr>
<td>Years</td>
<td>724,895</td>
<td>1.61*10^-10</td>
</tr>
<tr>
<td>Qualifying Offer</td>
<td>4,304,869</td>
<td>3.01*10^-13</td>
</tr>
<tr>
<td>Average WAR</td>
<td>2,130,764</td>
<td>6.07*10^-14</td>
</tr>
<tr>
<td>Average WAR Squared</td>
<td>112,881</td>
<td>0.032165</td>
</tr>
<tr>
<td>Multiple R-squared</td>
<td>0.763</td>
<td>N=373</td>
</tr>
<tr>
<td>Adjusted R-Squared</td>
<td>0.7605</td>
<td></td>
</tr>
</tbody>
</table>

In order to best explain the effect of the qualifying offer, signing and extension data from 2012–2014 was used to build the explained model. The multiple linear regression model above illustrates the application of the Ordinary Least Squares (OLS) method. Only three years of signing and extension data was used for this analysis because the qualifying offer system only began in 2012. Thus, within the analysis performed, a sample size of 373 was used. The ordinary least squares (OLS) regression analysis was used to measure the dollar effect of the qualifying offer. Average annual value (AAV) was used as the dependent variable within the model. To define AAV, it is the price that a team pays for its player on an annual basis. Although it would seem logical to use the total dollar amount as the dependent variable, AAV is an easier variable to use in order to measure the annual effect of the three independent variables. After running a regression with AAV, as shown in Table 1, the data show that 76.3% of the variation in AAV is explained by the independent variables of years, qualifying offer, wins (WAR), and WAR squared (see Figure 1). Thus, the model acts as a fairly reliable predictor of properly valued AAV.

The number of years assigned to a signed contract was used as the first independent variable in the model because it proved to be significant toward AAV. At first, age was considered as an independent variable within the model, but the age variable was considered insignificant toward AAV because, holding all other variables constant, AAV fluctuates too much with age. The years variable proved to be

Data and Methodology

\[ y_i = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + u \] (1)
a better independent variable and there is a logical reasoning for its having a positive effect on AAV. With an incremental change in years, AAV should increase consistently based on a higher value placed upon the free agent. By using years as an independent variable, holding all other factors constant, the incremental change of years increased AAV by $724,895.

The qualifying offer was used as the second variable within the model. In order to label a player as a qualified offered player, a binary code was used for the variable. A qualified offered player was designated with a 1 and a non-qualified offered player was designated with a 0. Based on the model, with the use of ceteris paribus, the effect of the qualifying offer on AAV was shown to be $4,304,869. Average WAR and Average WAR Squared were the third and fourth variables used within the model. An average of three years of player WAR data was used in order to really understand the true indicative performance value of a player.

There were two factors that were important in the use of WAR. First, a measurement for player performance was needed to properly valuate player performance toward AAV. Second, the measurement needed to prove consistent between batters and pitchers. Average WAR proved to be the best measure for this regression analysis because it is a measurement that fulfills both factors. By holding other variables constant, the effect of WAR on AAV was shown to be $2,130,764. An important variable was discovered through this analysis: an exponential term. As shown within the model, WAR has a marginal increasing effect upon AAV. The squared effect of WAR on AAV was shown to be $112,881.

**Discussion**

**The Effects of the Qualifying Offer on AAV**

Since the introduction of the qualifying offer in 2012, qualified free agents earn approximately $4.3 million more on average than non-qualified free agents do. The reason for the difference in value, assuming all other variables constant, is most likely differences in desirability. Thirty-two players have been offered the qualifying offer. However, in all 32 situations, the player has rejected the qualifying offer. The implications of understanding the dollar effect of the qualifying offer is important in both cases for the former club and the potential signing club. The free agency and trade market play an important role in offering or signing a qualified free agent. If a player of the same performance value is available on the market, it might actually prove to be beneficial to avoid offering or signing the qualified offered player.

Another important factor in play with the qualifying offer is the draft slot bonus allotments. Any former team that loses its qualified free agent to another team will gain a compensation pick at the end of the first round of the MLB draft. For instance, in the 2013–2014 offseason, the Cincinnati Reds offered the qualifying offer to Shin-Soo Choo with the knowledge he would reject the offer in pursuit of a long-term deal. With long-term deals already tied to Joey Votto, Homer Bailey, Jay Bruce, and, potentially, Johnny Cueto, resigning Shin-Soo Choo was not an option for the Reds and the acquisition of compensation pick was actually worthwhile for the club. In contrast, the signing club that signs a qualified free agent must relinquish its highest eligible pick. For example, when the Texas Rangers signed Choo to a seven-year, $130 million deal, the Rangers effectively forfeited the 20th pick in the 2014 MLB draft (Cransick, 2013). The 20th pick would have ensured a slot bonus allotment of approximately $2 million. Thus, the Rangers were essentially willing to pay the premium on the differential between the value of the qualifying offer and the 20th pick slot bonus for the services of Shin-Soo Choo.

Obviously, there is risk involved with forfeiting a draft pick and signing the qualifying offered free agent. The biggest risk is whether the team will achieve the expected value from the player over the course of the contract. In any situation, the team is paying based on past performance. There is no guarantee that the future performance will reflect past success. Therefore, it is important for any team to weigh the decision to sign a qualified offered free agent based on factors such as the strength of their minor league system, the performance value of the player, and the quality of the team.

As a final point, the presence of the qualifying offer seems advantageous for players because it creates a market in which high performing MLB players are paid for their worth as evidenced by the approximately $4 million differential in qualifying offered free agents and non-qualified offered free agents. The qualifying offer is an interesting change from the Type A/Type B compensation system of the 2007–2011 MLB Collective Bargaining Agreement. Instead of incoming free agents being designated as compensation or non-compensation assigned players, the qualifying offer forces MLB teams to place a value on their players. In many arguments within baseball circles, people have viewed MLB teams submitting qualifying offers to all of their soon-to-be free agents as a loophole in the qualifying offer system. However, the qualifying offer system de-incentivizes this type of action. For example, if the model above predicts the player’s value as approximately $10 million per year based on three years of WAR, a given qualifying offer incentivizes the player to take the offer. Thus, the team will automatically be paying about $4 million more than the player is actually valued at without any type of negotiation process.

The best example of the qualifying offer exhibiting better efficiency in the market was Stephen Drew’s signing situation during the 2013–2014 offseason (Edes, 2014). Being valued at about $9.5 million after a productive 3.4 WAR season, Drew was offered the qualifying offer, which at the time was approximately $14.1 million, by the Boston Red Sox. At the time, Drew quickly rejected the qualifying offer. As time passed during free agency, it was quickly evident that his value had diminished in the eyes of other MLB teams that saw Drew as not being deserving of the qualifying offer. In other words, MLB executives viewed other players as having equal or more value (in terms of WAR). Another factor that played a huge role in the Drew’s diminished value was the attachment of a first-round pick (highest draft pick). In retrospect, Drew should have signed the qualifying offer because at the time, the Red Sox were valuing Drew at a number far beyond his worth. Overall, the method of sending qualifying offers in a less strategic method points to an economical deficiency in the team's valuation.
of its own players.

Obviously, the specificity of the position, future performance value, and age play very important roles in any analysis of the free agency market. However, the $4.3 million effect of the qualifying offer on AAV provides important insight into the new free agency system. By holding all other variables constant, qualified free agents will, on average, make significantly more money annually than non-qualified free agents. Thus, MLB executives must properly value their players and prospective free agents in order to achieve the most economic value for their respective teams.

**The Effects of WAR on AAV**

Another piece of information that plays a significant role in establishing a player’s AAV is wins above replacement (WAR). WAR is a summarization of a single player’s total contributions in one statistic against the league and position average. WAR is split into two sections: position players and pitchers. In the case of position players, a player’s batting, running, and defensive performance are measured against the major league average, adjusted per position, and adjusted for park factor. For pitchers, WAR is calculated through fielding independent pitching (FIP) and measured against the league average for pitchers, and then adjusted for park factor (Fangraphs, n.d.).

On the Internet, there are many sets of WAR data available because there is no single exact interpretation for the measure. However, the different WAR databases available usually reach the same conclusions on MLB players. In this analysis, Fangraphs’ WAR was used because its data sets take into account advanced peripheral data for evaluating position player and pitcher performance.

Based on the data analysis, WAR’s relation to AAV increases exponentially, meaning that the rate of change of WAR is found by the formula, \(y = WAR + (2*WAR)\), holding all other variables constant. In the case of three years of free agency and extension data, MLB teams are currently willing to annually pay $2,356,526 for every additional point of WAR.

**2015 MLB Free Agency Case Study: Jon Lester**

Jon Lester was drafted in the second round of the 2002 MLB draft by the Red Sox. He made his debut with the team in 2006 and was considered a cornerstone ace in his eight-and-a-half-year tenure with the team. With the Red Sox in last place in the division nearing the trade deadline, the Red Sox made the decision to trade Lester to the Oakland Athletics for left fielder, Yoenis Cepedes (Browne, 2014). With Lester approaching free agency in the upcoming off-season, the trade had major implications on his free agent status. Because the trade occurred mid-season, the Athletics did not have the ability to extend a qualifying offer to the star pitcher, effectively eliminating them from having a chance at signing Lester. When the Athletics lost the wild card game against the World Series finalist Kansas City Royals, the sweepstakes for Lester effectively began.

After receiving competitive offers from the Boston Red Sox and San Francisco Giants, Jon Lester chose to sign with the
Chicago Cubs for six years for $155 million (“Lester Choses Cubs”, 2014). Based on the model provided above, the Cubs paid $8,506,658 more than the predicted value annually (see Figure 2). This means that over the course of the six years of the deal, the Cubs overpaid by nearly $51 million for Lester’s services. Although Lester was able to perform at a 6 WAR in 2014, he has never performed at a high enough level to justify a nearly $25 million per year contract. In defense of the Chicago Cubs, one huge factor was in play for their decision to overpay for Jon Lester. With no draft pick attached to Jon Lester in the form of a qualifying offer, teams such as the San Francisco Giants and the Boston Red Sox were more willing to get into a price war for Lester’s services.

In the case of the Cubs, Theo Epstein began his tenure as the president of baseball operations for the Cubs in 2011 and began to rebuild the foundation of the team’s minor league/major league system. The Lester signing signals the change from rebuilding to contending. Over the three-year tenure of Epstein, the Cubs have cultivated many promising players such as Javier Baez, Kris Bryant, and Jorge Soler (Keown, 2014). Thus, Epstein accepted the fact that he overpaid for Lester’s services, but that is clearly predicated on maintaining a 3–5 WAR per season, which is indicative of a top of the rotation starter (see Figure 3).

2015 MLB Free Agency Case Study: Pablo Sandoval
Pablo Sandoval has followed a career path that is far more unique than that of Jon Lester. As a 16-year old, he signed a minor league deal with the Giants as a catcher from Venezuela. During his minor league career, he switched between third base, catcher, and first base. However, after playing only a handful of games at catcher at the major league level in 2008, Sandoval has played predominantly at the third base position. Since his debut season in 2008, Sandoval has become known for three things: phenomenal contact percentages, clutch postseason play, and his weight. In a five-year span since 2010, Sandoval has had the highest outside contact rate per outside swing rate of any player in MLB by a wide margin. In other words, he is able to consistently open up his swing-zone and put the bat on the ball at a phenomenal rate compared to his peers. In terms of clutch postseason play, he has played a significant role in the Giants’ three championships in the past five years. After the Giants won the 2012 World Series, Pablo Sandoval was named MVP of the series. Specifically, he is most remembered for his three home run performance in Game 1 of the World Series, which is a record only shared by three MLB all-time greats: Babe Ruth, Reggie Jackson, and Albert Pujols (“Sandoval Hits Three,” 2012). In this past World Series victory, he replicated his prowess for clutch hits by generating a momentum-turning double in the late stages of Game 7, which ended up being the game-winning run. If any criticism could be parlayed onto Sandoval, it would be his weight. Although Sandoval was able to keep his weight below 240 pounds during this past season, many executives in the past have been concerned about his durability over a long 162-game season because of his inability to keep his weight in check.

After six years of arbitration control, Sandoval hit the free agency market this offseason. As duly noted by the model, Sandoval was projected to have an AAV of about $15.3 million per year. With Sandoval playing a full year in San Francisco in 2014, the Giants offered him the qualifying offer, valued at $15.3 million, and he quickly rejected the offer in search of a long-term deal. After fielding long-term offers from the Giants, Toronto Blue Jays, San Diego Padres, and Red Sox, he ultimately chose to sign with the Red Sox for five years at $95 million (“Sox to Sign Sandoval,” 2014). Based on the model, it seems that the Red Sox signed Sandoval for about $3.6 million annually more than the projected annual value (see Figure 4). Overall, the Red Sox overpaid Sandoval by about $18 million.

Although the Red Sox forfeit their highest pick (second-round pick), the price of an extra $18 million is reasonable. One important perspective to take into account for this signing is that the Red Sox in the 2015 draft have a protected top 10 pick. This presents a win-win situation for a top 10 protected team like the Red Sox, which is able to weigh the difference between a second-round pick (with a value of less than $500,000) against the qualifying offer (with a value of $4.3 million). In this case, it is a no-brainer for the Red Sox to pursue Sandoval’s services. When one takes a look at the moves the Red Sox have made this offseason in the form of trades and signings, it is apparent that the team is dedicated to putting a winning team on the field this 2015 season. After winning a World Series in 2013 and not even making the postseason in 2014, the Red Sox have put themselves in a win-now situation with David Ortiz and Dustin Pedroia being the core to hold it all together. Pablo Sandoval fits this perspective perfectly because he is still in the prime of his career at the age of 28 and has shown to be an above-average player at the third base position. The contract is predicated on Sandoval maintaining a 2.6 WAR per the course of the five-year deal, which is fairly reasonable for a player of his nature (see Figure 5). Obviously, the maintenance of a high-level of fitness and functional weight will be a concern for Sandoval going into the future.

Conclusion
This analysis shows that the new free agency system is simpler than the old Type A/Type B compensation system. Still, the intricacies of the qualifying offer system are rather difficult in action. As seen through this analysis, with performance constant in terms of WAR, qualifying
offered players make approximately $4.3 million more than non-qualifying offered players. In this case, teams must carefully weigh the value of impending free agents to the value of their team and the free agency market. If an impending free agent's past and future performance value does not justify the use of the qualifying offer, the team should not offer a qualifying offer or sign a qualifying offer attached player. In this case, the reason is that there are players of equal or better performance value available at a far lower price in the free agency market. As evidenced by Stephen Drew's qualifying offer situation in the 2013–2014 offseason, the impending free agent actually has an incentive to sign the offer based on the team's inflated perception of the free agent's value in comparison to the market.

Still, as a decision maker in the free agency market, it is more important not to look at a high AAV residual and immediately declare that a team overpaid for a free agent. The free agency market is run like any industry, where there is a fixed supply and a fluid demand. Thus, in the case of the model above, the most effective way to really gauge the quality of the contract is to look at the WAR (average WAR over three years) and then determine whether the player can maintain that WAR over the course of the contract based on factors such as age, potential, and make up in comparison to the contract value given. For example, Jon Lester's model predicts an AAV of about $17.3 million, but he is being paid at a premium AAV of about $25.3 million. If he can perform at a 3–5 WAR over at least four years of a six-year deal (when he will be age 31–35), he could possibly be delivering between $49 and $54 million in performance. Even though Lester would be paid about $101.6 million for the first four years of the deal, many pitchers in MLB cannot replicate the same dollar amount in performance.

Value in MLB free agency is determined by a team's own valuation of its own players and the free agency market. With the cost of a win increasing on an annual basis, the effects of the qualifying offer and WAR on player salary (AAV) will continue to play an important role in player valuations until the next CBA agreement.

References


http://espn.go.com/mlb


Thorough Robotic Exploration of Complex Environments with a Space-Based Potential Field

By Alina Kenealy, Nicholas Primiano, and Alex Keyes

Abstract:

Robotic exploration, for the purposes of search and rescue or explosive device detection, can be improved by using a team of robots. Potential field navigation methods offer natural and efficient distributed exploration algorithms in which team members are mutually repelled to spread out and cover the area. However, they also suffer from field minima issues. Liu and Lyons proposed a Space-Based Potential Field (SBPF) algorithm that disperses robots efficiently and also ensures they are driven in a distributed fashion to cover complex geometry.

In this paper, the approach is modified to handle two problems with the original SBPF method: fast exploration of enclosed spaces and fast navigation of convex obstacles. Firstly, a “gate-sensing” function was implemented. The function draws the robot to narrow openings, such as doors or corridors that it might otherwise pass by, to ensure every room can be explored. Secondly, an improved obstacle field “conveyor belt” function was developed, which allows the robot to avoid walls and barriers while using their surface as a motion guide to avoid being trapped.

Simulation results, where the modified SBPF program controls the MobileSim Pioneer 3-AT simulator program, are presented for a selection of maps that contain difficult geometries. Physical robot results are also presented, where a team of Pioneer 3-AT robots is controlled by the modified SBPF program. Data collected prior to the improvements, new simulation results, and robot experiments are presented as evidence of performance improvements.

Acknowledgments:

We would like to thank Dr. Damian Lyons for helping lead the team through the various problems we encountered. Without his instrumental assistance we would not have achieved nearly as much. Tsung Ming Liu was also tantamount to our success. His work in creating the original SBPF method gave us a foundation on which to build our work. The assistance he provided early on helped us get up to speed as swiftly as possible. Finally, we want to express gratitude to Adept Mobile Robotics for their interest and support in the ESBPF project.

Alina Kenealy, FCRH ’15, is from Maryland studying for a BS in computer science. She has worked in the Robot and Computer Vision Lab for the past year, and she is really glad to see the research put into the ESBPF program finally come to fruition. She hopes to apply her skills in programming to a career in software development in the future.

Nicholas Primiano, FCLC ’16, is from Rockwell Centre, New York, and is participating in the 3-2 engineering program to study computer science, biomedical engineering, and mathematics. He was inspired by the opportunity to participate in a project with the goal of mitigating life-threatening dangers encountered by first responders. In addition, this research has allowed him to pursue his interests in computer science with the potential to make a real contribution to knowledge in the field of robotics. After graduation, he plans to attend medical school.

Alex Keyes, FCLC’ 16, hails from Ridgefield, Connecticut. He is a Computer science major, and a music minor. Robotics is interesting to him because it is one of the few times code directly affects the real world (in a hopefully positive way). He is currently quite excited for a potential internship opportunity at Adept Mobile Robotics this summer.
1 Introduction

This paper addresses the problem of using a team of robots to quickly explore a large indoor area. Fast and effective exploration strategies would enable autonomous robot teams to assist in urban search and rescue, disaster recovery, area surveillance and other applications. The benefits include reducing the danger to first response personnel as well as allowing disaster victims to be treated more quickly. The Space-Based Potential Field (SBPF) algorithm developed by Liu and Lyons (2014) is a decentralized control strategy that uses the same straightforward control scheme for each team member, but nonetheless leverages each team member effectively. It allows team members and even sub-teams to become disconnected and reconnected during exploration as needed.

A potential field is a collection of vectors over an area that ideally produces a certain motion model for a robot at any given point. At any space, the robot will follow the direction of the vector at the point it currently occupies. The direction of each vector is determined by objects in the area, which can be either attractive or repulsive. Typically, a potential field to guide robot motion will consider obstacles and other robots repulsive. The Space-Based Potential Field also allows empty space to be repulsive or attractive, depending on whether the robot has mapped it or not. The SBPF approach allows a team of autonomous robots to quickly map the general structure of a large area. However, this speed comes with a drawback, as algorithms designed to explore the largest unknown spaces as quickly as possible may have difficulty navigating complex areas. Efficient large-area search dictates that enclosed areas, such as those accessible only by a hallway or narrow door, will be outweighed in exploration significance and may never be covered. Additionally, these concave building geometries provide a special danger to potential field based approaches since they admit the possibility of minima in the field, which will trap robot team members and stall exploration (Arkin 1998). Addressing the problem of more thorough building exploration therefore must also ensure that field minima are not inadvertently created.

This paper proposes an enhanced SBPF approach designed to more thoroughly explore a building while specifically avoiding issues of concave geometry. The neglect of narrow areas in complex environments is solved by adding two features to the method: a “gate-sensing” feature and a “vortex” feature. The first endows the robot team members with a “curiosity” drive by having them be drawn to narrow areas such as halls or doors ("gates") using the same field mechanisms by which they are drawn to unexplored areas. In this way, a robot is able to discover closed-off areas that are only accessible by narrow points. The second feature involves adding a constant “twist” to the repulsion generated by SBPF obstacle fields, so that robots do not simply turn away from obstacles they are near but are instead guided along them in a “conveyor belt” effect.

The remainder of the paper is organized as follows: Section 2 provides a review of prior work in this area. Section 3 reviews the SBPF method (3.1) and describes the two proposed enhancements: the drive to explore concave geometry (3.2) and the addressing of local minima due to concave geometry (3.3). Section 4 presents results that show the performance of these enhancements. Simulation results are shown that indicate that on average the “gate” mechanism improves both single-robot exploration and two-robot team performance for the same multiple-room map. To show that the “conveyor belt” mechanism is effective for avoiding the local minima due to concave geometry, simulation results are presented for a map with a C-shaped room. A robot using the original SBPF method fails to complete this map, becoming trapped in the field minimum created by the concave ‘C’ shape. However, with the enhanced method, one- and two-robot teams are conveyed around the obstacle and quickly complete the exploration. Finally, results are presented in Section 4 for the implementation of the enhancements on one- and two-robot teams of Pioneer 3-AT robots equipped with SICK laser sensors. Lastly, in Section 5, future work is discussed.

2 Literature Review

The potential field approach to motion planning for a single robot has a long history in robotics, e.g., Arkin (1998), and has gained prominence more recently for motion planning for a robot team, e.g., Baxter et al. (2007), Renzaglia and Martinelli (2010), and Julia et al. (2008). It is not the only approach to autonomous multi-robot exploration: Arkin (1998) proposed a behavior-based approach, but reported difficulty in synchronizing exploration status among team members. Novel topological approaches are proposed by Min and Papanikolopoulos (2011), Mi et al.(2011), and Schwager et al. (2011). Wu et al. (2009) proposed a new K-Means based global optimization strategy in order to efficiently distribute multiple robots for exploration. Using a frontier based approach for exploration, Pal et al. (2014) and Tiwari and Shukla (2013) developed a decentralized system for communicating sensor data between multiple robots. The potential field approach has the benefit of simplicity and speed when compared to other approaches. It only requires each team member to sample and record the field effects of each of the other robots and obstacles at its current position, and does not require significant maintenance of state between sampling times.

A well-recognized problem with potential field methods is the danger of unexpected field minima: locations where the contributions to the field by other robots and obstacles will sum to zero, leaving a team member trapped. A traditional approach to this problem is to add some random noise into the field summation (Arkin 1998). This is an effective strategy if the cumulative exploration time is not an issue. If time is an issue, then other approaches can be used. Renzaglia et al. (2010) and Julia et al. (2008) use a two control strategy approach: a simple and fast potential field strategy is used by default, but with frontiers based leader-follower behavior triggered to break the team out of local minima. The Space-Based Potential Field (SBPF) of Liu and Lyons (2014) is unique in having a single, simple control strategy per robot. It leverages a combination of a small amount of noise and Arkin’s Spin field (1998) to combat local minima. Liu and Lyons (2014) showed that this approach was at least as good as the leader-follower approach for a selection of rooms. They also addressed the addition and loss of team members mid-exploration, handled using an ad hoc network scheme (Pal et al., 2013). This aspect of the algorithm and problem will not be considered in the current paper, for simplicity and clarity.

However, the SBPF method can fail to thoroughly explore complex, concave spaces within a building, as might be caught by a topological or geometric analysis of the space, e.g., Schwager et al (2011). The challenge is to improve the thoroughness of SBPF search without complicating the method and hence losing the advantages of simplicity and speed. Furthermore, forcing team members into concave areas in order to map them increases the possibility of encountering potential minima, and the existing SBPF approach to this problem can be shown to be ineffective in that case.
3 Enhanced Space-Based Potential Field (ESBPF) Method

This section presents the proposed enhanced SBPF approach to the multi-robot dispersion and exploration. The first subsection reviews some of the relevant background information from Liu and Lyons (2014).

3.1 Space-Based Potential Field (SBPF) Approach

The SBPF approach assumes knowledge of the size of the area to be explored. First, the map of this area is divided into multiple grids/cells where each cell has a potential level, representing the level of exploration or scanning by sensors. Each time a robot sensor covers an area, the potential level increases. Adjustments to the potential level are also used for avoiding obstacles: if the sensor detects an obstacle, it will increase the potential level of the associated cell. As time increases, cells with low or zero potential levels will generate more attractive potential fields, and will pull the robots towards them, guiding the robots toward unexplored areas. The algorithm disperses the robots for the exploration mission and also drives the robots to unexplored areas. Keeping robots dispersed will ensure that they exhibit better coverage and are alive, as they explore the space and obstacles, or uncovered space and covered space, and only the desired regions remain attractive. This produces more directed and purposeful exploration of the space. The function \( r(x,y) \) inspects the field around the point \( q=(x,y) \) in two-dimensional space:

\[
\text{Applying the attractive force calculation to the map yields an attractive vector field } F_{at}(q). \text{ However, using this field directly in the calculation of resultant force on the robot produces noisy motion. For this reason, a filter is applied to } F_{at}(q) \text{ to emphasize edges between uncovered space and obstacles, or uncovered space and covered space, and only the desired regions remain attractive. This produces more directed and purposeful exploration of the space. The function } r(x,y) \text{ defines:}
\]

\[
\begin{align*}
& F_{at}(q) = \sum_{i,j} F_{at}(q_{i,j}) \\
& \text{where } x \text{ and } y \text{ is the robot location, } q \text{ is the potential level of each other cell in the map grid, } p_c \text{ is the maximum sensing distance of the robot, and } p(q)=|q-q_i|. \text{ The function, } h_{op}(c) \text{ gives us a repulsive variable factor for this specific time of coverage, } c, \text{ as } h_{op}(c)=ck^c. \text{ The use of the coverage factor in the equation causes the repulsive force to increase with smaller coverage and decrease as coverage grows. This gives a repulsive force, for each cell, equal to:}
\end{align*}
\]

\[
F_{rep}(q_{i,j}) = \frac{1}{2 R^2} \left( \frac{1}{|q_{i,j} - q|^c} - \frac{1}{|q_{i,j} - p_c|^c} \right) \leq p_i > p_j
\]

Lastly, the summation of the repulsive force from each other cell gives the robot at location \( q \) a repulsive force that drives it away from obstacles and previously visited areas:

\[
F_{rep}(q) = \sum_{i,j} F_{rep}(q_{i,j})
\]

3.1.1 Avoiding Explored Areas Using Repulsive Potential

Repulsive potential is generated by the obstacles—i.e., grid cells with obstacle potential level—and all such cells have the same magnitude of repulsion. The repulsive potential field is as follows:

\[
F_{rep}(q_{i,j}) = \frac{1}{2 R^2} \left( \frac{1}{|q_{i,j} - q|^c} - \frac{1}{|q_{i,j} - p_c|^c} \right) \leq p_i > p_j
\]

where \( q \) is the robot location, \( q_i \) is the potential level of each other cell in the map grid, \( p_c \) is the maximum sensing distance of the robot, and \( p(q)=|q-q_i| \). The function, \( h_{op}(c) \) gives us a repulsive variable factor for this specific time of coverage, \( c, \) as \( h_{op}(c)=ck^c. \) The use of the coverage factor in the equation causes the repulsive force to increase with smaller coverage and decrease as coverage grows. This gives a repulsive force, for each cell, equal to:

\[
F_{rep}(q_{i,j}) = \frac{1}{2 R^2} \left( \frac{1}{|q_{i,j} - q|^c} - \frac{1}{|q_{i,j} - p_c|^c} \right) \leq p_i > p_j
\]

3.1.2 Attraction to Unexplored Areas

When a cell in the map has zero potential, it indicates that this area has not been scanned nor visited by any robots and contributes an attractive potential to the potential field. The attractive potential is given by:

\[
h_{at}(c) \text{ gives an attractive variable factor for the specific time of coverage, } c \text{ as:}
\]

\[
F_{at}(q_{i,j}) = \frac{1}{2 R^2} \left( \frac{1}{|q_{i,j} - q|^c} - \frac{1}{|q_{i,j} - p_c|^c} \right) \leq p_i > p_j
\]

The attractive force is given by:

\[
F_{at}(q_{i,j}) = h_{at}(c)(q_{i,j} - q)
\]

and summing over all the attractive cells we can get the net attractive force applied to the specific robot:

\[
F_{at}(q) = \sum_{i,j} F_{at}(q_{i,j})
\]

This will be used to selectively enable edge regions by modifying the attractive field to be \( F_{at}(x,y) \times R(x,y) \), producing more directed and smoother motion.

3.2 Attraction to Concave Spaces

The SBPF approach treats cells that are closer to obstacles as less attractive because of the repulsion of the nearby obstacles. An example of an area that might need further exploration despite obstacles around it is a doorway. The doorway is generally repulsive, due to the two walls on either side, but often leads to more unexplored space. If a robot can overcome the repulsion of the walls, it will find a new, unexplored area behind them. A solution to this issue is the use of a “gate” function, which affords open cells that are close to obstacles more time to be defined as attractive. This gate function is a filter applied to \( F_{at}(q) \), similar to equations (7) and (8), to emphasize edges between uncovered space and obstacles or uncovered space and covered space, and only these regions remain attractive. This modification produces more directed and purposeful exploration of the space.

The function \( y(x,y) \) checks an area of the field to measure if there are obstacle cells enclosing it:

\[
y(x,y) = \sum_{i,j} \text{gap}(x,y,i,j)
\]

where \( \text{gap}(x,y,i,j)=1 \) if \( (x,y) \) is within an obstacle and so is the point directly across from this in the grid \( (e.g., i=0, j=1 \) and \( i=0, j=-1 \)) and 0 otherwise. \( G(x,y) \) is used to build a gate field that enhances the attractive field \( F_{at}(x,y) \) in the same manner as \( R(x,y) \) in equation (8):

\[
G(x,y) = \begin{cases} 1 & \text{if } y(x,y) > 1.0 \\ 0 & \text{otherwise} \end{cases}
\]

Figure 1(b) demonstrates the gate function at work. It shows one stage in the exploration of a map with a lot of concave geometry—a two-room map. Figure 1(a) shows the situation without the use of a gate function. Notice that the areas within the rooms are rendered less attractive due to the effect of the surrounding walls. In Figure 1(b), a
3.3 Avoiding Minima in Concave Spaces

Certain types of complex geometry result in local field minima (an area in the field where the vectors sum to zero). These halt the robot's navigation progress. For example, a building map with the central "C" shaped room, shown in Figure 2, will create a local minimum in the field related to the depth of the shape. Adding additional noise to jar the robot free of the minimum by sending it in a random direction will result in slower completion times, so that approach is avoided here. Instead, a vortex element is associated with obstacle fields to produce a "conveyor belt" effect in regions of concave geometry, pushing the robot through hallways and around enclosing obstacles that would otherwise produce local field minima.

The "conveyor belt" effect is designed to push the robot out of complex spaces such as the "C" shaped room in Figure 2. This is accomplished by modifying equation (2) effecting repulsion from obstacles. In order to twist the repulsive field, $q_i$ is replaced with a new expression, $(||q_i||, R(\alpha) \hat{u})$, where $\alpha$ is the angle of rotation, $R(\alpha)$ is the 2-dimensional rotation matrix for angle $\alpha$ and $\hat{u} = \mu(q_i)$ is the unit vector of $q_i$. The following formula describes the new calculation for only obstacle repulsion:

$$F_{\text{rep}}(q_i, q_j, \alpha) = \begin{cases} \frac{1}{2(||q_i||)} \frac{1}{p_i} \frac{1}{p_j} \frac{1}{||q_i||} ||q_j|| R(\alpha) \hat{u}, & p_i \geq p_j, \\ 0, & p_i < p_j. \end{cases}$$

The new expression shifts the field around obstacles so that, from the robot's point of view, the resulting field is shifted based on the position of the obstacle. As shown in Figures 2(a) and 2(b), the potentials of cells directly adjacent to obstacles no longer generate vectors that are directly opposed to the obstacle. The direction of the potential at these cells points away from the obstacle at an angle. In areas where the

Credits: Kenealy, Primiano & Keyes

Figure 1. (a) Two room map showing exploration by 1 robot with SBPF method; (b) enhanced SBPF method showing gate regions. Arrows in each grid cell show the field direction. Black cells indicate obstacles. The disk designates the location of robot and arc shaped region shows the field of view of robot sensor. Level of gray in grid cell indicates cumulative coverage. The gate function affects the cells with stipple pattern in (b).

Figure 2. (a) No conveyor belt function (caught in "C" shape); (b) Conveyor belt function (pushed around "C" shape). The arrows in each cell indicate the field direction, and black cells indicate obstacles. The disk and arc shape represent the robot and its field of view. The black line shows the trajectory taken by the robot up to location shown. Credit: Kenealy, Primiano & Keyes
A robot would otherwise get caught on a wall, the addition of the new expression forms a "conveyor belt" adjacent to the exterior of the "C" shape in the middle of the map. Experimentally, we determined that a 30° twist to the field performed best under most conditions. While the twist could be tuned specifically to perform better under certain conditions, such adjustments would not be feasible in real world situations.

The graphical results in Figure 2 show experiments using the 30° twist. Figure 2(a) shows the robot using the unenhanced SPBF approach being trapped in a local minimum. Figure 2(b) shows the enhanced SPBF behavior, where the emergent "conveyor belt" effect is shown under the lower obstacle wall. Additionally, since the robot should never enter an obstacle cell, we have set the potential levels in all obstacle cells to zero. This results in a more accurate representation of the field near obstacles. Note that this change appears in both the tests, with and without the "conveyor belt" function.

4 Results
This section presents the results of evaluating the enhanced SBPF approach (ESBPF) in simulation and on a team of two Pioneer 3-AT robots equipped with SICK laser sensors.

4.1 Results using the Gate Function
The ESBPF was evaluated in simulation, using the MobileSim simulation program for the Pioneer 3-AT robot, on the two-room map shown in Figure 1. This map is rich in concave geometry. Both SBPF and ESBPF algorithms were run on the same map ten times and the cumulative coverage of the area gathered for each time step. Both one-robot and two-robot cases were evaluated. For the two-robot case, the robots started beside each other. The results were averaged to produce average graphs for the one- and two-robot cases and compared.

Figure 3 shows the average cumulative graphs for all of these cases. The performance metrics defined by Liu and Lyons (2014) will be used: performance is defined as the reciprocal of the time taken to complete a target coverage, 90% in this case. The one-robot SBPF performance is $P_{1,SBPF} = 0$ (it never reaches target coverage), while $P_{1,ESBPF} = 0.0036$. The two-robot cases are: $P_{2,SBPF} = 0.007$, $P_{2,ESBPF} = 0.0078$. This demonstrates that the gate function is indeed enabling more thorough exploration. The metric of timesteps is used to time robot performance, where one timestep is one cycle of the ESBPF program. The length of a timestep is arbitrary and can change depending on the platform on which the program is run. Each set of results below (SBPF and enhanced SBPF) comes from tests run on the same platform, so comparisons are valid.

4.2 Results using the Conveyor Belt Function
The ESBPF method was evaluated on the "C" room map shown in Figure 2 because it is designed to invoke a local minimum. The average of 10 runs for SBPF and ESBPF and one- and two-robot cases are shown in Figure 4 (a) through (d).

Notice that in Figure 4(a), on average, the robot covers less than 60% of the space because it tends to get stuck in the local minimum ($P_{1,SBPF} = 0$). In comparison, Figure 4(b) satisfies the coverage goal (95%) in 250 timesteps ($P_{1,ESBPF} = 0.004$). Tests conducted with two robots produced significantly different results. When the conveyor belt function was disabled, the repulsion generated by robot 1 pushes robot 2 far enough from the "C" shape that it never enters a field minima produced by the shape. So robot 2 navigates the exterior of the area, while robot 1 remains in a field minimum in front of the "C" shape. Although both robots explore in the ESBPF case, the map is simple enough that the coverage time is about the same. The 2 robot cases are: $P_{2,SBPF} = 0.005$, $P_{2,ESBPF} = 0.005$.

4.3 Robot Experiments
To demonstrate the ESBPF algorithm on physical hardware, a map with a single partitioned space, similar to that used in Liu and Lyons (2014) was used. The room consisted of a 3.5 by 4 meter space, with
a small “wall” obstacle, about one meter long, dividing the space into two “rooms” connected by a larger corridor. The robots began in a starting room two meters wide. The one-robot starting point was approximately in the middle of the starting room, a half-meter from the back wall, facing outward. The two-robot starting points were spaced with each robot about a half-meter from the two closest walls. Cumulative coverage graphs were collected for five runs for the one- and two-robot cases. All five results are shown superimposed in Figure 5(a) for the one-robot case, and figure 5(b) for the two-robot case.

During testing, the robots successfully moved out of the starting room into the corridor, with the first robot to move out usually reaching the target room. In the two-robot case, the robots separated after leaving the starting room, with the slower robot staying behind to investigate the bottom corner. However, the robots often came into close proximity again when the first robot turned and proceeded back into the corridor after mapping the target room. The average performance for the one-robot case was $P_{1,ESBPF} = 0.012$, and for the two-robot case, $P_{2,ESBPF} = 0.035$. The factor $(P2/P1)$ by which the speed increased for the two-robot team is 2.9.

4.4 Multi-robot Results
Using three robots, the C-Shape map was explored in 228 timesteps, on average, with the ESBPF method and 314, on average, with the SBPF method, for a time improvement of 37%. The conveyor belt pulls two of the three robots around

![Figure 4. Averaged cumulative coverage graph for conveyor belt evaluation: (a) one robot and SBPF algorithm, (b) one robot and ESBPF algorithm, (c) two robots and SBPF, (d) two robots and ESBPF.](image)

![Figure 5. Five Cumulative coverage graphs for ESBPF on physical robot hardware: (a) one robot; (b) two robots.](image)
the shape, while the third explores the interior of the shape. The gate and conveyor functions also improve the speedup gained by adding additional robots to the map, as demonstrated by results from the previously used two-room map. Speedup, $S$, is defined as $S_{n,p} = P_{n,p} / P_{1,p}$ where $n$ is the number of robots and $p$ is the completion percentage. Several of the one-robot examples under both algorithms failed to explore the room to the desired threshold of 95%, so for these comparisons, a lower threshold of 75% was used.

For the ESBPF method, a single robot maps 75% of the two-room map in 204 time steps, for $P_{1,75}= 0.0049$. When another robot is added, however, it explores 75% of the room in 138 time steps, for $P_{2,75}= 0.0072$. This results in a speedup for ESBPF of $S_{2,75}= 1.469$. Likewise, using three robots results in a speedup over one robot, $S_{3,75}= 1.287$. This is in comparison to SBPF method which has speedups of $S_{2,75}=1.287$ and $S_{3,75}= 1.202$ respectively.

Since all of the two- and three-robot runs mapped the room to 95%, we can calculate the speedup from two to three robots ($S_{23,p} = P_{3,p} / P_{2,p}$) under both algorithms. For ESBPF, $S_{23,95}= 0.637$ and for SBPF, $S_{23,95} = 1.206$ respectively. When finding the speedup to 75% from two robots over one robot, the enhanced SBPF performs significantly better. However, the speedup to 75% from one, two, and three robots is about the same, and the speedup to 95% from two to three robots is less than one, meaning it takes longer for three robots to fully explore a room under the enhanced SBPF than does for two robots. Results are summarized in the table below.

<table>
<thead>
<tr>
<th>Number of Robots</th>
<th>Coverage Percentage</th>
<th>$S_{ESBPF}$</th>
<th>$S_{SBPF}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>75</td>
<td>1.478</td>
<td>1.287</td>
</tr>
<tr>
<td>3</td>
<td>95</td>
<td>1.244</td>
<td>1.202</td>
</tr>
</tbody>
</table>

In many cases on the two-room map, at least one of the robots ultimately became stuck near one of the walls. Without the gate and conveyor belt functions enabled, one robot will become stuck at the starting location while the other robot explores; while with the added functions, both robots will traverse the room but become disoriented at the top of the map.

Since the purpose of the conveyor belt function is to guide a robot around obstacles, this takes precedence over exploring new areas when the robot is near an obstacle until it comes to an open area. In the successful robot runs without the conveyor belt function, the robots explore to the top of the two-room map before backtracking to map the rooms and the bottom-right corner more thoroughly. Vector fields from maps with the conveyor belt function appear to be less able to allow the robot to go back. They instead want to guide the robot upwards around the rooms, until it inevitably hits one of the walls. Further work will include investigating how the conveyor belt effect works on different maps, and how to adapt it or the obstacle repulsions to the robot’s current readings.

**5 Conclusions**

This paper has addressed the problem of quickly but thoroughly exploring a complex map using a team of autonomous robots. The approach taken was based on the Space-Based Potential Field (SBPF) method of Liu and Lyons (2014). That approach fails to thoroughly explore corners and niches because of the repulsive effect of walls and obstacles. An Enhanced Space-based Potential Field (ESBPF) was developed to make concave areas of the map more attractive, using an existing mechanism within the SBPF method. To compensate for the increased risk of potential field minima in concave areas, the vortex field associated with walls and obstacles was configured to generate a conveyor belt effect that quickly moved robots out of minima and through corridors and narrow areas. Results were shown in simulation to demonstrate that the ESBPF can navigate maps that would otherwise defeat the SBPF method. Physical robot results were also shown to demonstrate that the method works in practice as well as in simulation.

Future work will proceed along two lines: the physical robot results shown here do not include a SLAM (Simultaneous Localization And Mapping) layer; currently, the robot determines how far it has traveled by the dead reckoning of its odometry, not accounting for friction or other factors that may influence its actual movement. This has led to problems with prior SBPF evaluations (Liu 2014). A SLAM module will be integrated with the ESBPF algorithm to avoid these problems. The other line of work will involve testing the ESBPF on a wider set of maps in simulation and physical experimentation.
References


The Greatest Generation: A Case Study
By John Caruso III

Abstract:
Remembering the Greatest Generation inspires images of patriotic, dedicated, duty-bound young men and women. Recent films such as Unbroken highlight the personal struggle of U.S. servicemen heroically laboring to fight the Axis powers of Japan, Germany, and Italy during World War II. They worked in deplorable conditions to defend America, their home, while separated from loved ones and family. While some stories showcase the intense experiences of soldiers entrenched in front-line warfare, others detail those of servicemen delivering food and munitions to the front lines and providing triage to wounded soldiers. In remembering the Greatest Generation for their sacrifice, such narratives inspire feelings of pride and inspiration. This essay investigates such thoughts and feelings through the photo-guided story of one member of the Greatest Generation.

That story is of John Caruso, my paternal grandfather, who fought in the Pacific theatre during World War II. He enlisted in the United States Marine Corps in 1943 upon turning eighteen and became a member of the Third Marine Air Wing infantry unit (MAW). He installed communication wire in trees and drove transport trucks bringing troops to the front lines. In his military career, Caruso also participated in taking back the Marshall Islands and the Philippines from the Japanese. In one experience, Caruso took part in re-capturing the Japanese airfield on the Zamboanga peninsula in the Philippines. I found the following selected photographs among many others in a box with my grandfather's other personal effects in the basement of my family's home. They tell his story in chronological order from adolescence to the end of his involvement in the war and return to life with his family in the United States.

Acknowledgements
I dedicate this piece to my grandfather, John Caruso, for his service to our country. I thank my father, John Caruso Jr., for his input and help in editing this article. I would also like to express gratitude to my family for preserving my grandfather's legacy through pictures, documents, and stories. Because he passed away while I was an infant, it is only through their memories that I know his life and character.

John Caruso III FCRH ’16 is a junior majoring in chemistry with a concentration in American Catholic studies. He is originally from Florham Park, NJ. In the fall of 2013, John received a Fordham Undergraduate Research Grant to research the chemical influences of cholesterol on the development of cardiovascular diseases. Over the past summer, John received a Summer Science Internship from the Fordham College Dean’s Office to work under Dr. Amy Balija of Fordham’s chemistry department on creating a new chemical to remove organic pollutants from water. Upon graduation, John is interested in pursuing a graduate degree in chemistry followed by an MBA.
Caruso at age fourteen working at a private home on the outskirts of his home city, Newark, New Jersey. His younger self gives an impression of innocence in contrast to his future role as a marine.

Caruso as a teenager with his sister, brother, and mother outside their home in Newark, New Jersey. For Caruso, nothing was more important than his family, and this value carried him through hard economic times in his youth.
Caruso in early 1944 shortly before shipping off to the South Pacific. His stern expression conveys a sense of duty and determination.

Caruso with two fellow marines posing in front of an American Corsair fighter plane shortly after arriving at an air base on the Marshall Islands in the Pacific. Caruso and the two marines convey an air of confidence in the American-made fighter plane behind them that provides them support from above.

Caruso (right) hanging communication wire in palm trees in the Philippines, 1944. Inspiringly, even when not in the midst of combat, he found the energy and motivation to put himself to work in service of his country.

In the midst of daily life in the Philippines, Caruso, kneeling front and center, took a picture with his unit in the Third Marine Air Wing, a branch of the United States Marine Corps. Though wearied, their appearances radiate with undaunted motivation to help end the war.
A letter to Caruso from his brother, Rocco, a serviceman stationed in New Guinea, dated November 10, 1944. Abating qualms over the worst and instilling joy, the letter brought a sigh of relief from Caruso as it was the first time he had heard from his brother in two years.

Caruso (left) and a fellow marine posing in front of a captured Japanese transport plane shortly after taking the Japanese airfield on Zamboanga, Philippines. Given Caruso's toil and that of his fellow marines, their poses convey a satisfied spirit, having successfully taken Zamboanga Airfield from the Japanese.

A letter written by a Japanese soldier, picked up by Caruso in one of the barracks from the captured Japanese airfield on Zamboanga. The letter elicits a sense of empathy for its author, because he may have used it to relay his condition to his family back in Japan much in the same way as Caruso would.
An air-dropped flyer addressed to Filipino civilians under Japanese occupation, picked up by Caruso after the capture of Zamboanga Airfield. For the Filipinos, the flyer represented impending liberation from Japanese occupation. Its ambitious language gave hope that the war in the Pacific would soon come to an end for Caruso.

Shortly after Allied victory in World War II, Caruso (far right) and his unit-members grabbed drinks at a bar in San Francisco before heading home to New Jersey. With the war’s end, Caruso and his fellow marines seem bewildered but elated to be home.

Reunited: Caruso and his wife, Anne, in 1947 shortly after moving into their new home in Belleville, New Jersey. Caruso’s smile expresses the long-awaited satisfaction of being home in the United States, ready to start a family of his own.
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With *Theology and the Kinesthetic Imagination*, Kathryn Reklis, assistant professor of theology at Fordham University, undertakes an exploration of the “bodily ecstasies” in Jonathan Edwards’s revivalist preaching and the process by which these ecstasies formed a unified, corporeal understanding of the modern self in response to the rationalist, disembodying “dichotomies of Western Enlightenment philosophy” (5). Borrowing from performance theory, Reklis contends that Edwards offered a “kinesthetic imagination that carried, through bodily gestures, alternative ways to understand and imagine oneself as a self” (14) and to transmit theological meaning and a divine sense of circum-Atlantic unity. This argument enables scholars to discern in the afterlife of Edwards’s theology a liberating, Christian transcendence of national and racial borders.

As one might gather from the above description, this volume is not for the theory-neophyte, the casual reader, or the reader who prefers a more traditional theological methodology. This book will most benefit scholars with interests in early modern Protestant theology, performance studies, or early American studies—given no acute distaste for some dense theory.

*Theology and the Kinesthetic Imagination* is arranged uniquely and effectively. Its three chapters function like concentric circles that contextualize and increasingly approximate Reklis’s central thesis as laid out in the introduction. This arrangement reflects the author’s methodological goal: to recontextualize Edwards’s sermons in their material and intellectual milieu and subsequently to draw on them as a source of embodied experience and unification in the circum-Atlantic world. Reklis’s first chapter explores the sermon event as a communal performance in relation to the material and economic conditions that shaped the modern, circum-Atlantic self. Primarily, Reklis attributes to an emerging capitalism the formation of an “ad hoc” (40) self whose relations did not “map onto older understandings of value, transparency, or accountability” (40). While Reklis maintains that Edwards’ universalizing sermons directly responded to the threat of this modern self, her argument here is a bit muddled. Scholars note that Edwards’ sermons legitimated the performance of this new “bourgeois individualism” (43), and Reklis does not sufficiently refute this argument. It therefore remains unclear how the sermons simultaneously reinforced and supplanted the same marketplace individualism against which he preached.

In the second chapter, Reklis traces Edwards’s theological/epistemological realization of divine sovereignty and beauty—“being swallowed up in God” (61)—through bodily affections. Using his sermons, she argues, Edwards countered rationalist epistemology with the “creation of inner dispositions…marked by strong emotional responses to the Word of God” (69). Reklis theorizes Edwardsian beauty as an “interconnectedness of all things” (71) that enables the universal communication of being. From this aesthetic ontology, it follows that the assent and inclination of the body to God is beautifying while the rejection of God is defined by terror and divine wrath.

Reklis’s final chapter examines the kinesthetic imaginary “Scenarios of Universality” (as the chapter is appropriately titled) that helped form alternative modes of being across circum-Atlantic communities. As used in this book, kinesthetic imagination refers to the means of conveying meaning and memory through bodily gesture, the work done by acts of bodily ecstasy. Reklis’s argument culminates in an exploration of how Edwards promoted the use of this kinesthetic imagination, particularly in “A Faithful Narrative,” as a universal “script” for conversion. The patterns of conversion supplied through this script allowed Christians to unite themselves by partaking “of the same repeatable, predictable patterns as in different places on the circum-Atlantic map” (97–98). From this climax, Reklis proceeds to explore the socio-political conflicts of revivalist ecstasy with the rationalist subjectivity of Edwards’s Arminian rivals. She also explores the way in which the kinesthetic imagination and its universalizing effect shaped the spiritually liberationist religions of slaves and Othered groups. Ambitious and clever, Reklis’s argument shines in the chapter’s concluding exploration of postcolonial slave religion, though I would have liked to read more on these new forms of Christianity and their inherent paradoxes.
After all, Reklis herself remarks that enslaved Africans, who were subject to the proselytizing of missionaries, often found the most freedom in Christ’s unity.

A self-described “theory minded” (8) systematic theologian, Reklis borrows heavily in her argument from the work of performance theorists, particularly from Diana Taylor’s *The Archive and the Repertoire*. She uses Taylor’s theory of the scenario to frame the work of the kin-aesthetic imagination. This requires an exploration of the cultural repertoire, the embodied memory of ephemeral performances (e.g., singing or dancing), rather than the archive, the set of static signifiers (e.g., maps, documents) used in traditional scholarship. With this novel methodological orientation, Reklis hopes to reinvigorate contemporary theology by constructing her argument around embodied performance and drawing attention to bodily mutability and immediacy in scholarship. Of course, this challenge is not easily surmountable, but Reklis admirably works toward her goal by placing her subjects not only in an appropriate theoretical context, but in their material contexts as well. Her skill in doing so proves most useful and exemplary in her final chapter, in which she reconstructs and analyzes the kinesthetic imaginary scenario of Awakening sermons by incorporating diverse primary accounts from parishioners across the geographic span of the Awakening.

Throughout the text, particularly in the final chapter, Reklis seems to suggest that Edwards consciously promoted the use of bodily ecstasy as a means of theological communication. While she succeeds in her goal of establishing a new theology of desire via Edwards’ preaching, the important theological communication she ascribes to bodily ecstasy is discordant with Edwards’ own theology. In fact, each time she introduces a major theoretical development, Reklis grants that Edwards himself classified bodily ecstasy as a “negative sign” (14, 96, 116) of awakening. For Edwards, bodily ecstasy was not a primary sign of the Spirit’s work through the body—while ecstasy could accompany the work of the Spirit, its ultimate meaning was neutral. As he writes in “Religious Affections” (1746), “It is no sign that affections have the nature of true religion, or that they have not, that they have great effects on the body […] consequently these effects are no signs, that the affections they arise from, are of one kind [spiritual] or the other [common].” Edwards never denied that bodily effects could accompany conversion, but since ecstasy is an inconclusive sign, readers are discouraged from using it to communicate theological knowledge. It is doubtful that Edwards would have, at least immediately, embraced the role ascribed to him by Reklis.

Despite some minor issues, Kathryn Reklis’ argument was successful in drawing attention to the place of bodily ecstasy and embodied memory in Edwardsian theology and in reinstating bodily desire as a principal device of theological scholarship. Readers of this book will find an intellectually challenging (and entertaining) alternative history of the modern self that, as Reklis demonstrates in her epilogue, inspires a reflective line of thinking about subjectivity, Protestantism, and social order in the modern world.

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Introduction
Yeasts that are commonly used to produce ethanol for alcohol consumption in beer and hard liquor can also be used to produce ethanol for energy. Wen et al. (2010) describe using simultaneous saccharification and fermentation, a method to directly convert cellulose and hemicellulose, major components of plants, into ethanol, with genetically modified Saccharomyces cerevisiae, a fungus. The authors give S. cerevisiae recombinant DNA to produce a scaffolding protein that can attach up to three enzymes, produced by S. cerevisiae. This allows the fungus to form a uni-, bi-, or tri-functional minicellulosome, a complex of scaffolding proteins and enzymes on its outer surface to break down cellulose and hemicellulose into glucose, galactose, and xylose. The authors found that bi- and tri-functional minicellulosomes have higher percent ethanol yields than uni-functional minicellulosomes. Given that S. cerevisiae is naturally capable of fermenting glucose, galactose, and xylose to ethanol, the authors report a net percent ethanol yield of 62% from cellulose and hemicellulose (Johnston 1987; McMillan 1993; Wen et al. 2010). The authors do form a compelling argument that a 62% yield is obtainable, but they do not adequately explain why their method achieves a 62% yield. If claims made in the paper are true, then cellulosic ethanol has the potential to become economically viable such that its production will be economically feasible on an industrial scale using common sources of cellulose and hemicellulose (Perlack et al. 2005). Should the authors’ claim that a 62% ethanol yield can be achieved, production of ethanol from cellulose and hemicellulose will be economically feasible on an industrial scale using common sources of cellulose. Particularly, a viable and abundant source of cellulose and hemicellulose is wood residue from hardwood and softwood trees which can be extracted through the cold soda process (Fengel and Wegener 1989; Perlack et al. 2005). Ground wood residue is subjected to pre-treatment with sodium hydroxide at 20–30°C, causing the cellulosic fibers to swell and become more accessible to reaction with cellulytic enzymes, resulting in a pulp yield of 85–92% (Fengel and Wegener 1989). Wood residues, a byproduct of harvesting, are a source of cellulose found in abundance in the United States (Perlack et al. 2005).

Scientific Analysis of Wen et al.
Wen et al. first show that S. cerevisiae can be augmented with recombinant DNA from C. thermocellum to produce cell surface scaffolding proteins that attach enzymes to the outer cell walls of the fungus. They were able to perform this augmentation and detect the resulting protein scaffold using flow cytometric analysis. Subsequently, endoglucanase, cellobiohydrolase, and β-glucosidase are produced by S. cerevisiae and become attached to these cell-surface proteins, forming a minicellulosome. Wen et al. show through flow cytometric analysis that both the scaffolding protein and attached enzyme are present among uni-functional minicellulosomes. Specifically, the authors show a change in signal with V5 epitope detection, indicating presence of the scaffolding protein and the attached enzyme. The authors also show that bi-functional and tri-functional minicellulosomes were constructed successfully through flow cytometry and multiantibody staining (Wen et al. 2010). However, Wen et al. do not adequately demonstrate that higher percent yields result from using bi- or tri-functional minicellulosomes due to synergy of those enzymes compared to uni-functional minicellulosomes. Given that S. cerevisiae is capable of synthesizing ethanol from cellulose in moderate yields using the enzymes endoglucanase, cellobiohydrolase, and β-glucosidase, Wen et al. claim that combinations of either two or three enzymes on the cell surface as opposed to one enzyme have a higher percent ethanol yield due to synergistic effects of the enzymes hydrolyzing the 1,4-glycosidic bonds with one another. Figure 1 shows that combinations of two and three enzymes such as CipA3-EGII-CBHIII-BGL1 have higher percent yields over both a 24 and 73 hour period. While the authors show that higher percent yields are obtained with combinations of two enzymes or more in Figure 1, they do not discount the possibility that strains with two or more types of enzymes have a higher percent yield because they have a larger concentration of enzyme compared to strains with just one type of enzyme. This is possible because of the non-constant concentration of enzymes present in each strain (Wen et al. 2010).

Fiscal Analysis of Cellulosic Ethanol Production
Should the authors’ claim that a 62% ethanol yield can be achieved, production of ethanol from cellulose and hemicellulose will be economically feasible on an industrial scale using common sources of cellulose. Particularly, a viable and abundant source of cellulose and hemicellulose is wood residue from hardwood and softwood trees which can be extracted through the cold soda process (Fengel and Wegener 1989; Perlack et al. 2005). Ground wood residue is subjected to pre-treatment with sodium hydroxide at 20–30°C, causing the cellulosic fibers to swell and become more accessible to reaction with cellulytic enzymes, resulting in a pulp yield of 85–92% (Fengel and Wegener 1989). Wood residues, a byproduct of harvesting, are a source of cellulose found in abundance in the United States (Perlack et al. 2005).
Numerical Analysis

Cellulose and hemicellulose represent 43–47% and 25–35% respectively of hardwood plants, while softwood plants contain 40–44% cellulose and 25–29% hemicellulose (Figueiredo et al. 2010). Consequently, wood residue consisting of equal parts hardwood and softwood on average contains 41.5–44.5% cellulose and 25–32% hemicellulose. 37.2 billion kilograms of wood residues suitable for biofuel production are generated each year from the logging industry (Perlack et al. 2005). Thus, a maximum of approximately 16.3 billion kilograms of cellulose and 11.8 billion kilograms of hemicellulose is available for ethanol production.

Given the cold soda process’s maximum yield of 92% (Fengel and Wegener 1989), approximately 14.996 billion kilograms of cellulose and 10.9 billion kilograms of hemicellulose can be extracted from wood residue in the form of pulp. Using the method described by Wen et al. with an ethanol yield of 62%, 7.97 billion kilograms of ethanol can be produced from wood residues. Based on a five month average of ethanol prices from August to December of 2014, $2.22 per gallon of ethanol (USDA 2015), approximately 8.0 billion kilograms of ethanol can be sold for approximately 5.9 billion U.S. dollars.

Table 1: Data Relating to Potential Ethanol that can be produced

<table>
<thead>
<tr>
<th>% from hardwood plants</th>
<th>% from softwood plants</th>
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<tr>
<td>44.7</td>
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<tr>
<td>45.4</td>
<td>45.4</td>
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<tr>
<td>43.1</td>
<td>43.1</td>
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<tr>
<td>33.2</td>
<td>33.2</td>
</tr>
<tr>
<td>Billions of Kilograms that can be used using cold soda pulping process</td>
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<tr>
<td>14.996</td>
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Table 2: Data Relating to Cost and Profit from Ethanol Production

Conclusion

Overall, conversion of cellulose to ethanol as described by Wen et al. utilizing S. cerevisiae represents a promising but costly solution to helping meet the world’s energy demands. While the authors sufficiently show that they can construct uni-, bi-, and tri-functional enzymatic minicellulosomes, they do not adequately prove that bi and tri-functional cellulosomes have a higher percent yield over uni-functional cellulosomes due to the synergy of the multiple enzymes acting together. Moreover, the analysis of the cost of conversion to ethanol including the expenses to consumer, manufacturers, distributors predicting a 2.03 billion dollar profit, should be carefully evaluated before further pursing cellulosic ethanol as a fuel source. If the authors’ claim is true that a 62% percent ethanol yield from cellulose and hemicellulose is possible, ethanol production will be feasible on an industrial scale allowing for ethanol to become a major competitor in the world’s energy markets, but only at the enormous expense of consumers and manufacturers of technology that currently use oil and gas.

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References


The Fordham Undergraduate Research Journal would like to thank the alumni donors whose generous support funds undergraduate research at Fordham.

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