OCULUS

Journal of Undergraduate Research at Ohio State

Letter From the Editor

Dear Reader,

The Journal of Undergraduate Research is proud to present to you our seventh print edition, Oculus. This volume contains quality research accomplished by our authors on The Ohio State University Campus. So much work has gone into the publication of this edition, not only on the part of our staff, but also our newly-published authors.

Ohio State is known worldwide as one of the top institutions for undergraduate research. This journal exhibits a portion of the astonishing research undergraduate students complete on and off campus in a variety of fields. We welcome and celebrate research in all fields of study completed by first year students all the way to graduating seniors. These authors have given us the privilege of reading their submissions and we are honored to showcase their hard work.

I am also proud and truly grateful for the commitment and dedication the JUROS staff members have displayed throughout the year. The JUROS staff members are the backbone behind this journal and all JUROS events held throughout the year. This publication would not have been possible without their hard work and love for research.

My hope is for this journal to inform you, inspire you, and enlighten you with new ideas and discoveries and to breed more innovation on and off The Ohio State University Campus. Please contact our staff with any questions, concerns, or new ideas at JUROS@osu.edu or visit our online edition at JUROS.osu.edu. I encourage you to read through this journal with an open mind and heart to entertain new ideas and take in knowledge.

Best Regards,

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2018 CONTENT

Articles

Abstract

Analytical Determination of Re-Epithelization of Porcine Wounds using Immunohistochemistry

By Carlie Francis, Nandini Ghosh, Sashwati Roy, and Chandan K. Sen

Introduction

Background: In United States, chronic wounds represent a major public health burden with 6.5 million yearly cases costing more than 50 billion dollars (Frykberg, 2015). This burden is further aggravated due a sharp rise in the incidence of diabetes and obesity, due to diabetic related ulcers and inhibited wound healing. It has been estimated that two-thirds of chronic wounds get infected by biofilms. These multi-species microbial biofilm infected chronic wounds pose a significant threat to the global population.

Objective: To study the re-epithelization, the ability of skin to heal itself, of a pig's back wounds using immunohistochemistry.

Method: Full thickness excisional wounds (2"x2") were created on the dorsum of pigs and followed up to 31 days post wounding. The wounds were either infected or not infected with a bacterial species mix consisting of Pseudomonas aeruginosa, Acinetobacter baumannii and Staphylococcus aureus. Wound biopsies were collected on day 31. To study re-epithelization of the wounds, formalin fixed paraffin embedded sections were deparaffinized and stained with eosin. Immunostaining with cytokeratin 14 (K14) antibody of the OCT (optimum cutting temperature) embedded frozen sections of 10 μm. For the blocking of the frozen sections, 10% normal goat serum (NGS) was used. Fluorescent tagged secondary antibody Alexa Flor 488 (green) was used for the K14. DAPI, a fluorescent stain to highlight cell nuclei, was used to visualize the nucleus. The stained sections were scanned with a Zeiss Axiovert 200 inverted fluorescence microscope supported by an AxioCam digital camera, a motorized stage, and guided by Axiovision software (Zeiss). The images were analyzed in image J or with the Zen software to determine the re-epithelization.

Results: The infected pig wounds showed impaired epithelization as compared to the non-infected pig wounds. Thus, it was concluded that Biofilm infection compromises the re-epithelization process. Current studies are ongoing to elucidate the mechanism for the impairment of the re-epithelization on biofilm infected wounds.

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Frykberg, R. G., & Banks, J. (2015). Challenges in the Treatment of Chronic Wounds. Advances in Wound Care, 4(9), 560–582.

Toeing the Line: Erick Hawkins in Cold War America

By Marissa Ajamian

After the horror and upheavals of World War II, there was a desire in the United States to return to a traditional, "normal" life. The national discourse of the return to normalcy created problems for anyone or anything that was outside the defined normative life: Western, white, and heterosexual. While many artists pushed against the normative culture, Erick Hawkins, a modern dance choreographer, rarely did. Through the creation of the Hawkins technique and his choreographic aesthetic, Hawkins upheld the normalcy policies of the Cold War era through the utilization of his ideals of beauty and "natural," kinesthetically-correct dance. While Hawkins was falling in line with these Cold War policies, he failed to receive the recognition of fellow choreographers. He was unwilling to stay within the artistic parameters that critics and the State Department created for the modern dance canon. However, he was not radical enough to break the legacy of universalism and transcendence. Due to these reasons, Hawkins has been marginalized from discussion in the modern dance canon; however, his contribution to the field should not be overlooked because of the lines he was attempting to walk during an era of both political and artistic tension.

Hawkins was a classicist who believed that the natural, which refers to Hawkins' understanding of kinesthetically correct movement, was the only way to survive modern society. He argued against technology and mechanization which he often associated with ballet. Hawkins viewed the dance of the four cygnets from Swan Lake as a representation of the machine-like qualities of ballet (Hawkins 1992, 30). He felt that ballet went against the natural movement aesthetic he championed, which was more closely related to the antiquity-inspired dancing of Isadora Duncan. Auguste Rodin, a French sculptor from the turn of the century, argued that "whatever is false, whatever is artificial […] all that is only a parade of beauty and grace; all, in short, that lies is ugliness in art" (Rodin 1971, 46-47). This argument was very similar to Hawkins' way of thinking. There was a desire for a return to a classical conception of the true, natural expression of the human body and not the artificial influence of the technological age. While Hawkins' movement was in line with normalcy policies, he rejected the artificiality of mechanization which was a part of the burgeoning consumer culture of the Cold War.

Hawkins rejected mechanization; however, he celebrated and exalted the new field of scientific study: kinesiology. Hawkins felt that "ugliness in the body and in movement is primarily ignorance of the deductively formulated, empirically verified, natural scientific laws of movement, now called the science of kinesiology" (Hawkins 1992, 76). Hawkins celebrated kinesiology because he believed it informed dancers on how they should move their body. While kinesiology was a new scientific field of study, in Hawkins' eyes, it provided confirmation for his movement aesthetics of beauty and natural dancing. Hawkins saw kinesiology as something the body innately understood and attempted to accomplish, but the de-

mands and pressures of Western culture had removed that natural understanding of the way bodies were supposed to move. This confirmation gave Hawkins scientific evidence and the reasoning that he used to continue to perpetuate his agenda of aligning with Cold War policies.

Hawkins participated in these normalcy policies through the creation of what he called the normative technique, or Hawkins technique. He aimed to create a movement technique that was the kinesthetically correct way, or normative way, of moving. Hawkins felt that "when it comes to skill or dance training, you can't base a training against what the nature of the body wants to be" (quoted in Tracy 1997, 66). As a principle, Hawkins was stating that if you were participating in a dance technique other than his own, then you were moving incorrectly. He aimed for "dance that eliminated unnecessary effort, rigidity, and tension" and instead utilized "a system of moving based on the body's natural flow of energy, avoiding all extremes" (Reynolds and McCormick 2003, 371). Through the creation of this technique, Hawkins intended to create a system that could and should be done by all bodies. This aligns with the return to normalcy during the Cold War. As World War II ended, Americans wanted to bring soldiers home and reintegrate them into familial life (Kowal 2010, 22). To reintegrate the soldiers, anything that was extreme was not considered to be a part of traditional lifestyles. In line with this cultural ideology, Hawkins sought to create a normalized way of dancing, which took out the extremes of movement.

Hawkins focused his efforts on creating beauty in both his technique and choreography with clear definitions of what constituted beauty. He defined this beauty as "the equivalent simplicity, clarity, directness, effortlessness, strippedness, in dance movement that I liked in everything else" (Hawkins 1992, 94). This meant that the dancers did not overwork muscles to make movement happen. This concept of finding beauty in moving the body with efficiency and ease created a distinct movement quality. This movement quality is showcased in The Erick Hawkins Modern Dance Technique: Volume 2: Movement Patterns & Aesthetic Applications, which displays standing and across-the-floor work in a Hawkins class. In one exercise, dancers move in a grapevine, a series of steps moving sideways with one foot crossing in front and then behind the other leg. This

movement pattern mimics the intertwining of grapevines. During this movement, the dancers float their pelvises across the floor by lifting their weight into their core, allowing the legs to glide. The float of the pelvis, an important aspect of the Hawkins technique, allows the movement to be done with ease, without overworking the muscles to forcefully make the intertwining leg-work occur. The float of the pelvis in Hawkins' grapevines is just one example of the way ease and efficiency are linked to beauty in Hawkins' work.

While there are many aspects of Hawkins' definition of beauty, at its heart is the concept of decontraction which is the opposite of the harsh and tension-filled contraction found in Martha Graham's technique. In 1950, Hawkins created his school and company. During the same year, he also separated, personally and artistically, from Martha Graham. This separation resulted in hostile rhetoric between the two artists. One of the ways that Hawkins separated himself from Graham was by creating a technique that focused on an effort quality that was the opposite of Graham's technique. Whereas Graham's technique is predicated on bound movement qualities with movement striking out from the abdominal core, the Hawkins technique emphasizes pulling weight into the center to allow for free-flow movement. In contrast to the Graham contraction, Hawkins' decontraction was not a relaxation of the working muscles, but a change in the effort used to move the muscles (Celichowska 2000, 44-51). The goal was to utilize the minimum amount of energy, to be efficient and to not overwork the muscles. This is the opposite of the tension that is required to complete contractions in the Graham technique. This change in effort resulted in the buoyant flow that characterizes the Hawkins technique and choreography. Even with creating a new effort quality for his technique, his movement was not new. Hawkins preached a new, natural, and universal technique, but in reality, was utilizing and manipulating the classwork of Graham to create his own technique.

The manipulation of the Graham technique caused the Hawkins technique class to mimic a Graham technique class. Although Hawkins preached anti-Graham rhetoric, his technique is structured similarly to the Graham technique. Both class sequences start seated on the floor with the legs crossed, though the Hawkins position is more relaxed than the Gra-

ham crossed-legged position. There are also similarities in the floor work of a Hawkins class and Graham class. One such exercise is contractions lying supine (Celichowska 2000, 105). The image of the contraction in The Erick Hawkins Modern Dance Technique is a mirror image of the "Graham contraction." The movement is initiated from the pelvis, the head is thrown backwards, and the arms and hands yearn, or plead, towards the sky. There is a clear connection between the two techniques even though the effort quality and emphasis may be different. This connection occurs because Hawkins is placing Graham on a pedestal of artistic creation, even though he is breaking away from her movement aesthetic, and Hawkins yearns to find a way to achieve this level of achievement (Frank 2012, 94). By utilizing movements reminiscent of Graham's work, he attempted to place himself in the larger conversation of dance modernism.

Graham was considered one of the standard-bearers of modern dance and created an image of universality in dance. In midcentury American concert dance, "universalism signified the idea that all human beings shared essential characteristics regardless of the particularities of their lives or geographic location" (Kowal 2010, 9). While this concept seems idealistic, in reality, it becomes a way to cover up anything or anyone who was deviant from the normative identities of society—what Kowal identifies as white, Western, and heterosexual. By destroying differences and compiling everything under Western ideals, Hawkins neglected the contributions of people and forms considered "Other." Hawkins himself utilized Native American dance to find credibility for the sacredness of the body (Hawkins 1992, 143). This appropriation of Native American culture was found acceptable during this period because Hawkins believed he was taking a "lower" form of art, anything that did not come from a Western tradition, and using that form to create high art. By covering up the contributions of non-Western cultures, Hawkins was continuing to perpetuate the idea of the Western artist as being singular, superior genius that invisibilized artists of other cultures. Hawkins was not the only artist who incorporated and appropriated Native American culture into modern dance to find credibility for artistic creation. The American government has a long history of systematically attempting to Westernize, Christianize, and

assimilate Native Americans into American culture (Shea Murphy 2007, 30). This attempt to assimilate Native Americans into the general American culture caused artists to assimilate Native American dance and culture into modern dance. Modern dancers felt that they had a "right to knowledge about Indian people and cultures" and that "they could draw freely [on Native American culture] for their own artistic dance production" (Shea Murphy 2007, 115 and 117). Hawkins, like many other modern dancers, felt it was his right to incorporate the Native American rhythms, male virility, and spirituality into his work. As Hawkins was incorporating Native American culture into his work, he was participating in the continued acculturation of Native American culture into American culture during the 1950s. While his later works such as Plains Daybreak (1979) and Black Lake (1969) evoke Native American culture through costumes, his impetus of using Native American culture to aid his artistic creation happened during the Cold War period.

The universal ideas that pervaded Hawkins' and other artists' work also recognized the transcendence of the white human body onstage. An editor for Dance Observer, Gertrude Lippincott, stated in 1946 that "art deals with timeless and universal themes, not local, transient ones" (quoted in Morris 2006, 6). Art, specifically dance, called for bodies onstage to transcend the everyday existence of man and to showcase a greater purpose for humanity. Hawkins believed that Western culture was "a transcending culture" which "Non-Western peoples" had the inability to experience since they "merely keep re-discovering their unchanging, unhistorical intuition of excellence" (Hawkins 2011, 40). By believing himself to be from a culture that had the ability to transcend the everyday existence of humanity, the dancers in his work did not stand for just one human. The bodies onstage had to be able to showcase the potential that humanity has once it transcends the confines of tradition and low culture. By being in conversation with universalism and transcendence, Hawkins was attempting to place himself in the same choreographic conversation as Graham and other choreographers who received prominent attention at the time.

As a choreographer, Hawkins upheld normative gender and sexual preferences. Parker Tyler, a poet and art critic, stated that "one finds natural manliness

in Hawkins' dancers, but also natural womanliness" (Norton 1973, 24). This can be seen in the partnering and weight sharing that occurs in much of Hawkins' work. In Early Floating (1961), the male dancer captures the woman around the waist, stopping her forward momentum. His grip around her waist brings the woman to standing as he slides his arms to cover her ears. At the same time, the male dancer leans in as if to whisper something in the woman's ear (Hawkins 2000b). The power in this situation is given to the male dancer which places him in control of his partner. His motions to cover her ears, yet also whisper to her, reflect an idea of the man influencing and manipulating the woman. This idea of gendered roles does not change in Hawkins' work, even as the dancers' costumes change. The theme arises if the dancers are in leotards, pants and dresses, or fully masked. While the costumes may seem to be equal-izing or eliminating differentiation, in reality, the dancers' movements do not allow for the removal of difference between man and woman.

While Hawkins upheld these normative ideals, he pursued a wider range of movement pos-sibilities and roles for male dancers. He sought to uphold the "authentic" male persona which was the opposite of the aggressive brute male or the balletic cavalier (Reynolds and McCormick 2003, 372). This authentic male was viewed by Hawkins to be able to express a wider range of human emotion. Hawkins began to create new and alternative roles for men in his earliest works such as Stephen Acrobat (1946). In this piece, Hawkins portrays a male Eve who "eats of the Tree of Knowledge" (Franco 2012, 82). This masculinized version of Eve is in contradiction to the feminized male heroes that Graham portrayed in her own work. Hawkins was emulating but also critiqu-ing this feminized version of human emotion. He sought to create a place for male dancers to experi-ence a wider range of human emotions on stage than had been available to him in Graham's company. By portraying himself as a male version of a well-known female character, Hawkins was able to portray those emotions and find acceptability for a man to portray such feelings onstage. The portrayal of men who were able to depict more than a heteronormatively masculine man was one of the few ways that Haw-kins challenged the normative ideas of society during the 1950s.

With this desire to find true masculine dance, Hawkins believed that man's transcendence was the key to woman's transcendence. He stated that "not until the men in our dance find not a copied passion, but their own flesh and blood passion, will our dance be good enough, and our women take their rightful place as awakened women" (Hawkins 1992, 58). Hawkins believed that men had to find their true male presence onstage, true human desire. While Hawkins' hope to create a new male persona was beneficial, he did it at the expense of women. He needed men to take women through transcendence and wom-en could not arrive there by themselves. This can be seen in a photo of Hawkins and Carol Conway from Of Love (1971). Hawkins presses his cheek to Conway's stomach which softens Conway's torso and chest towards Hawkins (Norton 1973, 33). By pressing his head into a vulnerable place, Conway's body reacts with feeling or as Hawkins referred to it, sensuousness. In Early Floating, a male dancer slides his hands down the side of the woman's body just inches from her skin. This movement prompts the woman to begin dancing and to arch backwards into her partner (Hawkins 2000a). These examples showcase how Hawkins required the actions of men to help and guide women towards sensuousness and feeling. While Hawkins was challenging the range of emotions for men, he forced women to inhabit the same social construct that society placed them in: the object of the heterosexual gaze.

Through the search of finding his beautiful and natural movement, Hawkins' work explores nor-mative values, positioning himself against the values of concert dance which valued non-normative ideals. In Hawkins' opinion, dancing was supposed to depict the ideals of society such as ideal love, ideal gender, and ideal expression of emotion. Hawkins believed that dance should not showcase ugliness, meaning the problems or hardships of modernity. Due to this belief, Hawkins upheld the normative policies of the Cold War. He choreographed dance that did not question heterosexual love or the transcendence of the human body. By upholding the normative values of Cold War America, Hawkins was contradicting the beliefs of many concert dance artists. Other artists, such as José Limón and Martha Graham, choreo-graphed non-normative values that consisted of homosexuality and masculinized femininity (Kowal 2010, 53). However, Hawkins firmly upheld the nor-mative values of general society, instead of the values of the modern dance culture. This was just the foun-

dation of Hawkins rejection of the values of concert dance and the modern dance canon.

The State Department and dance critics dictated the way modern dance was supposed to look and how modern dance was supposed to communicate with audiences. As Gay Morris argues in A Game for Dancers: Performing Modernism in the Postwar Years, 1945-1960, critics and the State Department created rules for what modern dance should be during the postwar era. Some of the rules for what modern dance should have were abstraction, experimentation, and innovation. With these tenets, Clare Croft asserts, "the state department claimed modern dance as quintessentially representative of and indigenous to the United States" (Croft 2015, 16). Artists were forced to either play into these rules to receive federal funding and critic approval or to break these rules and not receive these benefits. Choreographers such as Graham were the choreographers that critics and the State Department exalted as the quintessential modern dance, meaning quintessential American dance. Hawkins did not follow all of the rules for modern dance which stopped his work from achieving the label of quintessential American dance. Hawkins' notion of beauty rejected drama, sensationalism, and emotionalism which were valued in the modern dance canon. He felt that "art that is only sensation or entertainment is only serving an inadequately conceived function and cheating us of the spiritual food we need to live" (Hawkins 1992, 3). In Hawkins' opinion, dance should teach the audience about life and how to live it, not just for pure enjoyment or entertainment. This belief led to the lack of drama and emotion in many of Hawkins' earlier works. These works, such as Early Floating and Stephen Acrobat, consisted of sparse sets and backdrops, tight clothing and atonal music. These elements relate Hawkins to the early works of Merce Cunningham and Paul Taylor, both choreographers who focused on the form of dance as the function of their choreography. Many of Hawkins' early works also focused on dance being the main function of the choreography, not narrative. While Hawkins exalted the same principles of universalism and transcendence as Graham, he was creating choreography that functioned more similarly to the form as content approach of Cunningham's and Taylor's work. The sparseness of Hawkins' work can be found in how the movement functioned. In an image of Haw-

kins in Stephen Acrobat, his knees bend sharply towards the ground with his heels just barely escaping the floor. He looks upward, arms outstretched with an apple in one hand (Franco 2012, 83). While he holds the apple, the movement and shape of his body are what catches the eye, not his relation to the prop. The belief of dance as a functional element and the most important element of a choreographic work, not narrative or emotion, was fundamental to the creation of Hawkins' choreographic ideology. This belief also placed him in opposition to the ideologies of what modern dance was supposed to look like. By utilizing the form as the function of his choreography, Hawkins was labeled as the vanguard of modern dance. However, because of Hawkins normative beliefs, he did not fit neatly into the vanguard.

By breaking the predetermined rules of modern dance, Hawkins went against prominent dance critic John Martinm who was instrumental in defining the canon of modern dance and made Martha Graham the standard bearer of this canon. His writing carried weight in the dance world and he dictated which choreographers were called the pioneers of modern dance. After reviewing a new Hawkins work, John Brown (1945/1947), Martin stated that "the whole thing, as a matter of fact, comes close to the point of being embarrassing" (Martin 1945, 15). Five years later, Martin similarly stated that Hawkins' piece The Strangler (1948) "is a thoroughly embarrassing piece of ineptitude" (Martin 1950, 23). In both reviews, Martin describes Hawkins' work, which is appearing on the same program as Graham's work, as embarrassing. By describing the work as embarrassing, Martin is insinuating that the work is something Hawkins should be ashamed of or something that is not art. Martin's opinion continued to push Hawkins' work away from the modern dance canon. With Martin being vehemently anti-Hawkins, this made it difficult for Hawkins to be understood or well received by other critics and audiences. This sentiment also ensured that Hawkins would not be written into the modern dance record that Martin created.

While Martin strongly stated his distaste for Hawkins' choreography, many critics also disliked Hawkins' concerts. After watching Hawkins' evening-length work here and now, with watchers (1957), critic Allen Hughes stated that "conventional notions about acts and their consequences and log-

ical progression must be suspended for entry into its strangely detached world where movement is everything" (Hughes 1952, 19). Moreover, Clive Barnes stated, "yet here again there was little to engage the heart or mind. One watched with amiable detachment" after watching On Lord of Persia (1965) (Barnes 1965, 16). Again, these two critics use a similar lexicon. The critics describe Hawkins work as detached, not engaging the audience, and insinuating Hawkins' disregard for conventional standards of modern dance. Hughes, Barnes, and Martin wanted Hawkins work to fit seamlessly into the dramatic and emotional work they praised or the objectivist, form as function work they disliked. When Hawkins did not deliver dance that fit within the established mainstream modern dance rules or the rules of the vanguard, the critics openly dismissed his work. Critics were unable, or unwilling, to understand the movement-driven and normalcy values of the pieces that Hawkins was creating.

Hawkins beliefs place him at odds with the rules of modern dance and the requirements for being toured internationally by the State Department. The State Department exported the work of Martha Graham extensively even though her work went against the normalcy values of the United States. The sexuality, feminism, and "eroticism was acceptable when Graham did it" (Croft 2015, 114). Her work challenged values, which made her work anti-communist. Censoring material was linked to communism, which would have gone against the cultural diplomacy of this era which "became a tool of American domination" over other countries (Croft 2015, 12). Due to Hawkins' positioning outside the modern dance canon, Hawkins did not have the choreographic respect, as Graham did, that would have afforded him the ability to be independent with his choreography and still receive federal funding. Instead, Hawkins continued to make work that was outside the modern dance canon, which was not seen as the quintessential American dance that the State Department was looking for. This is one reason that Hawkins failed to receive funding from the State Department. Hawkins' dances would not portray American dominance and American artistic excellence abroad, and his transcendence was not recognizable as universal enough to support the efforts of American imperialism.

Hawkins' choreography and technique are recognizable as modern dance. The white, heterosexual, male body transcends modernity. However, Hawkins scraps the sensationalism and emotionalism that can be found in the work of Martha Graham and other choreographers. While the critics openly rejected Hawkins' earlier works, it cannot be denied that Hawkins was attempting to be a part of the larger modern dance canon. His desire to receive this recognition was drowned out by his unwillingness to play by the rules that modern dance critics demanded. By toeing the line of upholding normalcy policies but also rejecting dramatic elements in his work, Hawkins falls between the lines of mainstream and the vanguard of modern dance. This has caused Hawkins' work to be rejected by the concert dance canon because he disregarded the values of fellow artists, critics, and the State Department. Not having the recognition from any of these sources, when it was crucial to do so, has caused Hawkins' omission from many conversations of dance modernism. While Hawkins has been minimized in the modern dance canon, his influence and impact are significant to understanding that modern dance is not solely restricted to the historical definition of the canon or the vanguard.

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Motion Sickness Interactions with Spine Disorders

By Grace Klosterman

Abstract

The world of low back movement quantification has been revolutionized through the invention of the Clinical Lumbar Motion Monitor (cLMM) in the 1980s by Dr. W.S. Marras of the Spine Research Institute (SRI) at Ohio State. This wearable exoskeleton collects position, velocity, and acceleration data from a subject's back in the sagittal, lateral, and twisting planes, in order to create a three-dimensional kinematic trunk "motion signature." The cLMM is a validated tool capable of objectively measuring the functionality of the low back, including injury. Low back injury costs the Navy over $240 million, occurring in connection to motion sickness in 50-90% of aircrew, according to Sheard (1996) and Dobie (2000) from 'Aviation, Space and Environmental Medicine' and 'The Naval Medical Information Management Center,' respectively. Some aircrew members, however, have a high resistance to motion sickness (MS), which is not well understood. The goal of this experiment is to collect motion signatures from eight subjects of the military population at Wright-Patterson Air Force Base and compare these signatures between subjects. Following IRB consenting, subjects performed a pre-MS LMM screening, incurred MS-inducing stimulus in the Neuro-Otologic Test Center (NOTC) at a rate of 10 rpm for up to 30 minutes, and a post-MS LMM screening. Via comparison of the low tolerance group to the high tolerance group, objective data regarding the changes in an individual's motion signatures following motion sickness exposure can be obtained. In further studies, a database comprised of military members with healthy low back motion signatures who are prone to motion sickness and those who are not, could be developed. These data could then be used to predict which individuals are at risk of motion sickness. By analyzing the differences between the at-risk versus high threshold groups, training protocols could be developed to teach aircrew how to not only mitigate motion sickness, but also low back disorders.

Article

The Global Economic Crisis, Economic Distress, and Mental Health in Poland

By Taylor Cathcart

Abstract

Whereas it is well-established that socioeconomic conditions impact self-reported mental health in Central and Eastern Europe, it is less well-known how the Global Economic Crisis and changes to specific features of economic security influence mental health outcomes. I use the 2003, 2008, and 2013 waves of the Polish Panel Survey POLPAN to examine the relationship between economic distress, defined as being unable to provide basic necessities for one's self or family, as well as being unemployed, and two mental health outcomes. I find that, net of other factors, Poles under economic distress reported substantially worse emotional health and greater social isolation. I found that the Global Economic Crisis had a small but not profound effect on mental health, and unemployment had an effect only in 2008. In 2008 and 2013, being unable to provide basic necessities for one's self or family was strongly associated with worsened mental health, other things equal.

Introduction

It is well-established that socioeconomic conditions impact self-reported mental health (Cutler and Lleras-Muney 2006), even in Central and Eastern Europe (Alvarez-Galvez et al 2013; Kaleta et al 2008). In general, people living in Eastern European countries were more likely to self-report a poor state of health (see also Koziel et al 2010 and Kaleta et al 2008). Alvarez-Galvezet al (2013) found a positive association between socio-economic status and self-rated help using the European Social Survey. Yet, what is less well-known is how a sudden macro-level change in the economy – the Global Economic Crisis – and changes to specific features of economic security influence mental health outcomes in this region of the world. My contribution is to examine the concept of economic distress, defined as being unable

to provide basic necessities for one's self or family, as well as being unemployed, and the extent to which it affects peoples' wellbeing net of other factors. I focus on Poland and use panel survey data spanning the period 2008 -2013.

Theory and Hypotheses

Many studies have been conducted on the relationship between education and health. Cutler and Lleras-Muney (2006) evaluate the different theories and evidence that have surfaced from various studies to give their theory on the relationship between the two variables. From the data they analyzed they were able to draw conclusions. One conclusion being that individuals with higher education were less likely to die within five years from the time they were interviewed in surveys about self-reported health. Along with a lower mortality rate, they were less likely to suffer from common acute and chronic diseases like heart conditions, strokes, cholesterol, diabetes, etc. Another trend found was that those with a higher education were less likely to report poor health, anxiety, or depression. Furthermore, not only did the more educated seem to have better health statuses, it was found that those with more education were less likely to engage in unhealthy behavioral factors like smoking, drinking, obesity, or use of illegal drugs. Additionally, those with more education were more likely to take preventative steps to preserve good health, like getting vaccinated. Overall, Cutler and Lleras-Muney could conclude that more education ultimately correlated with better health status across all groups -men and women, blacks and whites, rich and poor- although sometimes these results varied, on average they were the same.

While there is a clear link between mental health and socioeconomic status (often measured as income and education) scholarship on the impact of economic distress on mental health is mixed. Schmitz (2010) analyzed the effects of unemployment on health using the German Socio-Economic Panel from 1991-2008 as the source of data. Using these panel data, they measured mental health with satisfaction with health, the Mental Component Summary Scale, and the number of hospital stays over the four years. Schmitz (2010) concluded that unemployment does not directly worsen mental health. Country specific effects may influence this relationship. He suggest-

ed that Germany has an unemployment insurance system in which those who become unemployed still have health insurance benefits and are better able to maintain a good health status.

The impact of economic distress may be influenced by global economic conditions. Drydakis (2014) analyzed the relationship between mental health and the rates of unemployment before (2008-2009) and during (2010-2013) the economic recession in Greece. Drydakis used the Longitudinal Labor Market Study to test two hypotheses; (1) that unemployment would result in a lower health status, and (2) that during the recession period unemployment would result in higher deterioration of mental health status compared to the time before the recession. Drydakis concluded that both hypotheses received empirical support, and that there is a correlation between unemployment and the unemployed having worse health statuses than those who were employed. Furthermore, Drydakis found that not only do the unemployed have a higher deterioration of mental health, but there was a gender effect: women are more likely to have greater mental health deterioration then men.

Paul and Moser (2009) analyzed how demographics and unemployment are associated with mental health. Paul and Moser (2009) included gender, socioeconomic status, ethnic minority vs. ethnic majority, marital status, age, duration of employment, economic development between different countries, unemployment protection, and labor market opportunities. Overall, they found that those who were unemployed were more likely to have worse mental health than those employed, but when the unemployed became reemployed, they experienced improved mental health.

Koziel, Lopusza´ñska, Szklarska, and Lipowicz (2010) analyzed how unemployment is related to the risk of cardiovascular disease in Poland after the change into a free-market economy. To analyze this relationship, they collected data from participants that included the following: a consultation with a cardiologist, a resting electrocardiogram, an assessment of vital signs, a measurement of body fat, standard laboratory tests (including fasting plasma levels of glucose, total cholesterol, LDL cholesterol, HDL cholesterol and triglycerides) and lastly participants filled out a questionnaire regarding education level, professional career, various actual life-style elements,

and the family's social status. After analyzing the data collected, the study found a relationship between unemployment and cardiovascular disease in which the risk of getting cardiovascular disease was elevated.

Validity of Self-Rated Health

Self-rated health has been shown to be a useful research method for looking into socio-epidemi-cological studies. Alvarez-Galvez, Rodero-Cosano, Motrico, Salinas-Perez, Garcia-Alonso, and Salvador-Carulla (2013) examined the association between socio-economic status and self-rated health using European Social Survey 2002-2008. Respondents were asked about their personal health and gave ratings on a scale from 1-5 (1 being very bad and 5 being very good). In general, Northern European countries were likely to self-report a better general state of health, and people living in East European countries were more likely to self-report a poor state of health. More specifically, the research indicated that income-related health inequalities had increased in Eastern, Northern and in Central European countries, where in Southern countries there was not a clear difference between people with high and low incomes. Furthermore, the study found that a higher education will ultimately positively impact the self-reported health of individuals in all countries in the earlier years of the survey; but the trend ultimately decreases as the years pass.

Kaleta, Makowiec-Dabrowska, and Jegier (2008) studied the surveys of 460 men and 508 women who self-rated their health on a scale of 0-100, where the higher the score, the better the heath. They also broke down the group into sub categories, including education levels, height, and habits like smoking and drinking. Poles were more likely to report bad health in comparison to citizens of other East European countries and the United States. Overall, the conclusion of the study was that those who were employed tended to be better off health wise as opposed to those who were unemployed.
Drawing on this literature, I pose the following research hypotheses:

Hypotheses

Hypothesis 1: Net of other factors, people under economic distress will report poorer emotional health.
Hypothesis 2: Net of other factors, people under economic distress will report higher social isolation, an indicator of mental health.

Data, Variables, and Methods

In this paper, I use data from the Polish Panel Survey, POLPAN, which was initiated in 1988 on a representative sample of residents of Poland aged 21 – 65 years. Respondents were re-interviewed every five years thereafter, with renewal samples of young Poles (aged 21-25 years) added since 1998 (Slomczynski et al 2015). The latest POLPAN wave is currently in the field. The POLPAN study focuses on changes in the social structure. It contains, among others, measures of socioeconomic status, economic distress, and mental health, along with demographics such as gender, age, marital status and family composition.

For analyses included in this paper, I use data from the 2003, 2008 and 2013 waves of POLPAN. This allows me to measure respondents characteristics prior to, during and after the 2008 Global Economic Crisis.
To measure mental health, I use two types of indicators. In 2003, POLPAN contains information on respondents' self-reported psychological mood. Respondents rated their own psychological mood on a scale of 1=very good, 2=rather good, 3=rather bad, and 4=very bad. Starting with 2008, POLPAN respondents completed the Nottingham Health Profile (NHP), which contains, among others, a battery of survey items evaluating respondents' mental health. I focus on those parts of the NHP scale that deal with two dimensions of mental health: "emotional problems" and "social isolation." Each of these two dimensions contains a set of binary items (response category of "yes," or "no").

Emotional health and social isolation variables for 2008 and 2013 respectively, are constructed such that the higher the score, the greater the reported problems in emotional health and the greater the social isolation. In other words, the higher the score, the worse the mental health. Some argue that items

within the NHP should be differentially weighted (Papsteri and Neagoe 2016: 42). For example, based on the weights reported in Papsteri and Neagoe (2016: 42), a "yes" to the item "I feel that life is not worth living" had a weighted value of 16.21 out of 100. To measure "emotional problems" I added all of the weighted NHP items of emotional health. A value of 0 indicates that an individual has no emotional health problems, and a value of 100 would indicate very bad emotional health. I constructed the indicator of "social isolation" in a similar way.

The main independent variable is economic distress measured at different times in respondents' lives. POLPAN contains the following set of questions related to financial difficulties: "In the last twelve months, were there financial problems in your household such that there was not enough money for: (a) food? (b) utilities – rent, electricity, and other?; (c) culture – press, books, cinema, theater?; (d) leisure time, including vacation?; (e) medical care, including medication?; (f) education?; (g) entertainment in your free time?" From among them, I selected the items dealing with food-related financial problems and financial difficulties in paying for utilities. I used these to construct, for 2003, 2008 and 2013 a new set of variables, 'basic economic distress' that measure whether respondents reported food-related financial problems and financial difficulties in paying for utilities. In addition, I created indicators of medical financial distress.

Next to basic economic distress and medical financial distress, I account for respondents' employment status, marital status, household income, education, gender, and age. The descriptive information for the Dependent Variables, the Independent Variables and Controls are provided in Table 1 and 2.
To examine the extent to which the data support my hypotheses, I use multivariate linear regression analyses. Since the same people are measured repeatedly through time, regression models are estimated with robust standard errors (using the vce(robust) option in STATA).

Results

The first set of analyses pertains to Hypothesis 1, which states that economic distress will lower peoples' emotional health, other things equal. I measured emotional health in two time points, 2008 and 2013, respectively. Results from the regression analy-

ses support the research hypothesis: generally, greater economic distress fosters higher mental health problems, even when other factors that would influence mental health outcomes are controlled for. It is worth remembering that, for any formulation of the dependent variable, its values range from 0 to 100, with higher scores indicating more serious health problems. Table 3 shows the results for the linear regression analysis of respondents' emotional health as they reported it in 2008. I present two regression models. In Model 1, I do not control for respondents' medical financial distress (measured for 2008), while in Model 2 I do. Overall, both models perform well and explain between 24% (Model 1) and 25% (Model 2) of variation in respondents' emotional health problems.

According to both model specifications, people who in 2003 reported being in bad psychological mood, compared to Poles who reported good mood, fared worse in terms of their emotional health five years down the line, other things equal (e.g., in Model 2 we see that bad psychological mood in 2003, as opposed to good mood, triggered an increase of 12.77 points on the emotional problems score in 2008).

The relationships between all economic indicators on one hand, and emotional health problems on the other, are statistically significant, although the strength of this relations vary. In both Models 1 and 2, more economic hardship is linked to greater emotional health problems. To illustrate, looking at Table 3, Model 2, we see that net of other factors, people who in 2003 faced economic distress, in comparison to those who did not, had a 4.20-point increase in their emotional health problems score in 2008. Being unemployed also mattered: respondents who were not working in 2008, in comparison to the employed, had more emotional health problems. People with higher household income (in 2003) scored lower on emotional health problems ($p<0.05$), while being in medical financial distress (as measured in 2008), in comparison to not being under distress, had a higher score on emotional health (b = 4.38 points of the scale).

Demographic characteristics of respondents are also important. As amply shown in the literature, people with higher education report significantly fewer emotional health problems, all else equal. Controlling for other factors, respondents who at the time

of the 2008 survey were married or in a long-term relation and living with their partner reported slightly better emotional health than the rest (divorced, never married and not cohabiting, and the widowed). This effect was statistically significant one-tailed, at an alpha level of 0.1. A similarly weak result is present for gender: compared to men, women reported slightly higher emotional health issues, other things equal. The effect of age (older people report more health problems, Model 1) washes out once I control for medical financial distress (Model 2).

Tables 4 and 5 present results for the regression of self-reported emotional health problems in 2013 on selected independent variables and controls. The set-up of the analyses is slightly different than for 2008: for one, I include medical financial distress in both regression models. Second, I take into account basic economic distress measured in 2008 (Table 4), and in 2013 (Table 5) as I control for peoples' emotional health in 2008. It should be pointed out that 2008 emotional health is a powerful predictor of health outcomes in 2013 (the beta coefficient for this variable is the largest in both regression models), and washes out the significance of many of the independent variables and controls (see Appendix 1 for the analyses without 2008 emotional health).

According to results in Table 4 and Table 5, one can see that the impact of gender is robust: net of other factors, women report more health problems then men do, and medical financial distress significantly worsens respondents' emotional health. From Table 5 we see that if basic economic distress is not lagged (i.e. it is measured in 2013, and not 5 years earlier), its detrimental impact for emotional health is present even if characteristics of the respondents, such as their earlier health status, gender, education, age or marital status accounted for.

Next, analyses engage with the second research hypothesis. Hypothesis 2 stated that persons under economic distress should face greater social isolation, other things, emotional health included, equal. I present results for social isolation in 2008 in Table 6, and for social isolation in 2013 in Table 7. Results only partially support this expectation. For the regression of social isolation in 2008 on the selected independent variables, only the impact of unemployment is statistically significant: net of other factors, being unemployed in 2008 increased social isolation by 4.50 points of the scale (see Table 6).

The strongest effect (cf. beta coefficients) is that of marital status, as married or cohabiting people report significantly lower social isolation.

For the 2013 model (Table 7), I added medical financial distress, while controlling for respondents' social isolation and emotional health in 2008. Everything else equal, people in medical financial distress in 2013 reported higher social isolation than those not in medical financial distress. The effect is substantial and statistically significant. In this model too, the strongest predictor remains marital status (cf. beta coefficients)..

Conclusion and Discussion

The purpose of this article was to investigate how economic distress is associated with peoples' reported mental health, as reflected in their emotional health and extent of social isolation. I focused on Poland around the time of the 2008 Global Economic Crisis and afterward. Drawing on the literature, I proposed two research hypotheses. The first hypothesis proposed that economic distress would negatively impact a respondent's emotional health, all else equal. There is empirical support for this hypothesis. Taking into consideration a person's economic distress characteristics from the previous wave onto their current emotional health state, gave the perspective of how the economic crisis in 2008 truly affected peoples mental health. Results of the regression of emotional health in 2008 show that people who were under basic economic distress in 2003 reported worse emotional health. Results from the 2013 regression - which took into consideration the respondents being under economic distress in 2008 during the crisis – are similar in this regard, although controlling for earlier emotional health problems clearly matters. Basically, we learn that economic distress operates both directly, and indirectly, though the effects on emotional health measured in 2008.

The second hypothesis, which stated that people under economic distress would have higher degrees of social isolation, net of other factors, received partial support. In 2013, respondents under medical financial distress were socially more isolated than those not under medical financial distress, other things equal.

I note that unemployment did not have a consistently significant association with mental health,

when controlling for other variables. It increased mental health problems only in 2008, but not in 2013.

We now know better how the Global Economic Crisis and changes to specific features of economic security are associated with mental health outcomes in Poland. The Crisis did not have a profound effect. Yet, it is clear that specific indicators of economic distress – food, utilities, and medical financial distresses in particular - do have profound effects on the mental health of Poles.

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Tables

Table 1. Major Independent and Dependent Variables

Variable (Year in POLPAN)	Mean	Standard Deviation	N
Emotional Health (2008)	13.84	20.29	1695
Social Isolation (2008)	5.25	13.21	1760
Emotional Health (2013)	15.50	21.40	1521
Social Isolation (2013)	5.76	14.92	1636
Self-Evaluation of psychological mood (2003)	2.00	0.62	1692
Basic Economic Distress (2003)	0.38	0.49	1699
Unemployment (2003)	0.16	0.37	1699
Basic Economic Distress (2008)	0.19	0.39	1805
Unemployment (2008)	0.05	0.21	1805
Basic Economic Distress (2013)	0.21	0.40	2581
Unemployment (2013)	0.10	0.30	1635

Table 2. Control Variables

Variable (year in POLPAN)	Mean	Standard Deviation	N
Age (2008)	46.76	16.80	1805
Martial Status (2008)	0.33	0.47	1805
Household income (2008)	1128.24	938.92	1460
Education (2008)	11.91	3.65	1805
Age (2013)	47.30	17.27	2581
Household income (2013)	4323.95	4810.91	2021

Table 3. OLS Multivariate Regression of Emotional Health in 2008 on Selected Independent Variables

Emotional Health, 2008 –Model 1			
Independent Variables	B	Robust SE	Beta
Psychological Mood, (1=bad, 0=other) 2003	13.35**	2.32	0.21
Basic Economic Distress, 2003 (yes = 1 else=0)	6.15**	1.40	0.14
Unemployment, 2008 (1=Not working, 0=else)	10.15**	4.00	0.09
Gender (woman=1)	2.08+	1.13	0.05
Age, 2008	0.39**	0.03	0.28
Marital status, 2008 (1=married/cohabit, 0=else)	-1.39+	0.73	-0.06
Education, 2003	-0.84**	0.20	-0.12
Household Income, 2003	-0.002*	0.00	-0.06
Constant	3.38	3.10	
Fit Statistics	F = 33.71 (df =8, 1095) R² = 0.241 Root MSE = 18.85		
Emotional Health, 2008 – Model 2			
	B	Robust SE	Beta
Psychological Mood, (1=bad, 0=other) 2003	12.77**	2.36	0.20
Basic Economic Distress, 2003 (yes = 1 else=0)	4.20**	1.60	0.09
Unemployment, 2008 (1=Not working, 0=else)	9.84**	4.01	0.09
Gender (woman=1)	2.02+	1.13	0.05
Age, 2008	0.37**	0.03	0.26
Marital status, 2008 (1=married/cohabit, 0=else)	-1.37+	0.73	-0.06
Education, 2003	-0.77**	0.20	-0.11
Household Income, 2003	-0.001*	0.00	-0.05
Medical Financial Distress, 2008	4.38**	1.61	0.10
Constant	2.69	3.06	
Fit statistics	F = 30.88 (df =9, 1094) R² = 0.247 Root MSE = 18.77		

N = 1104; ** p< 0.01; *p < 0.05 ; + p< 0.1

Table 4. OLS Regression of Emotional Health 2013 on Selected Independent Variables

Independent Variables	Emotional Health Problems, 2008		
	b	Robust SE	Beta
Emotional Health, 2008	0.49**	0.06	0.434
Basic Economic Distress, 2008 (yes = 1 else=0)	1.25	2.25	0.02
Unemployment, 2013 (1=Not working, 0=else)	0.75	3.91	0.01
Gender 2013(woman=1)	2.72+	1.56	0.06
Age, 2013	0.03	0.07	0.02
Marital status, 2013 (1=married/cohabiters, 0=else)	0.39	2.10	0.007
Education, 2008	-0.24	0.26	-0.04
Household Income, 2008	-0.00	0.00	-0.02
Medical Financial Distress 2013	13.34**	2.61	0.24
Constant	5.82	5.97	
Fit Statistics	F = 20.30 (df =9, 534) R² = 0.353 Root MSE = 17.31		

N = 547; ** p< 0.01; *p < 0.05 ; + p< 0.1

Table 5. OLS Regression of Emotional Health 2013 on Economic Distress and Selected Independent Variables

Independent Variables	Emotional Health Problems, 2013		
	b	Robust SE	Beta
Emotional Health, 2008	0.45**	0.06	0.42
Basic Economic Distress, 2013 (yes = 1 else=0)	6.86**	2.93	0.13
Unemployment, 2013 (1=Not working, 0=else)	-0.64	3.91	-0.01
Gender 2013(woman=1)	2.92+	1.56	0.07
Age, 2013	0.07	0.07	0.04
Marital status, 2013 (1=married/cohabit, 0=else)	0.82	2.12	0.02
Education, 2008	-0.21	0.26	-0.03
Household Income, 2008	-0.00	0.00	-0.01
Medical Financial Distress, 2013	10.48**	3.08	0.19
Constant	2.65	5.88	
Fit statistics	F =23.92 (df =9, 537) R² = 0.363 Root MSE =17.38		

N = 547; ** p< 0.01; *p < 0.05 ; + p< 0.1

Table 6. OLS Regression of Social Isolation 2008 on Economic Distress in 2003 and on Selected Independent Variables

Independent Variables	Social Isolation, 2008		
	b	Robust SE	Beta
Psychological Mood (1=bad), 2003	5.03**	1.48	0.12
Basic Economic Distress, 2003 (yes = 1 else=0)	1.20	0.85	0.04
Unemployment, 2008 (1=Not working, 0=else)	4.50+	2.43	0.06
Gender 2008 (woman=1)	-0.19	0.75	-0.01
Age, 2008	0.16**	0.03	0.17
Marital status, 2008 (1=married/cohabit, 0=else)	-5.68**	0.58	-0.35
Education, 2003	-0.36**	0.12	-0.08
House Hold Income, 2003	-0.0001	0.00	-0.02
Constant	9.31	2.18	
Fit statistics	F = 20.91(df =8, 1144) R² = 0.21 Root MSE = 12.508		

N = 1153; ** p< 0.01; *p < 0.05 ; + p< 0.1

Table 7. OLS Regression of Social Isolation 2013 on Economic Distress in 2008 and on Selected Independent Variables

Independent Variables	Social Isolation, 2013		
	b	Robust SE	Beta
Social Isolation 2008	0.27*	0.12	0.21
Emotional Health, 2008	0.15*	0.06	0.20
Basic Economic Distress, 2008 (yes = 1 else=0)	0.79	1.68	0.02
Unemployment, 2013 (1=Not working, 0=else)	-2.19	2.96	-0.04
Gender 2013 (woman=1)	0.70	1.18	0.02
Age, 2013	0.00	0.05	0.00
Marital status, 2013 (1=married/long-term cohabiting; 0=else)	-8.37**	2.15	-0.22
Education, 2008	0.04	0.18	0.01
House Hold Income, 2008	0.00	0.00	0.00
Medical Financial Distress, 2013	5.01*	2.07	0.13
Constant	7.11	4.45	
Fit statistics	F = 6.96 (df =10,548) R² = 0.26 Root MSE = 13.22		

N = 559; ** p< 0.01; *p < 0.05 ; + p< 0.1

Appendix 1:

OLS Regression of Emotional health 2013 on selected independent variables, without controlling for emotional health in 2008

Independent variables	b	Robust Std. Err.	p	Beta
economic_distress_basic08	7.347	2.399	0.002	0.138
unemployed13	2.108	4.061	0.604	0.024
gender13	4.285	1.688	0.011	0.100
age2013	0.185	0.078	0.018	0.095
marr_coh13	-0.905	2.338	0.699	-0.017
eduyrs13	-0.595	0.282	0.035	-0.093
hhincome08	-0.001	0.001	0.073	-0.058
financial_medical13	16.448	2.818	0.000	0.296
constant	8.443	6.625	0.203	.

N	=	559
F(8, 550)	=	12.98
R-squared	=	0.21
Root MSE	=	19.287

Pyrroloquinoline Quinone Treatment for Prevention of Mitochondrial Damage in Plants

By Torey Katzmeyer

1. ABSTRACT

Mitochondrial decay inflicted by oxidative stress in brain cells is the primary cause of neurodegenerative disorders such as Alzheimer's and strokes. Oxidative stress is an imbalance of oxygen caused by disproportional amounts of pro-oxidants and antioxidants, which regulate the consumption of radical oxygen species (ROS). Overproduction of ROS disrupts cell structure of lipids, membranes, proteins, DNA, and also attacks mitochondria. The naturally slow rate of mitochondrial genesis is harmful to cells undergoing oxidative stress, as mitochondria cannot reproduce fast enough to replenish the necessary mitochondria count in the cell, leading to cell death. Pyrroloquinoline quinone (PQQ) is a vitamin that reduces ROS while accelerating mitochondrial growth, therefore making it a factor in resisting damage from oxidative stress. This experiment introduced antioxidant PQQ into Wisconsin Fast Plants undergoing oxidative stress. Plants were grown in varying concentrations of PQQ solution and exposed to oxidative stress once mature. The 0.1% PQQ solution led to the best plant survival, decaying at a slower rate. However, all plants watered with the vitamin did not grow as tall as the control. Therefore, PQQ intake at 0.1 percent concentration allows an extended lifespan for Wisconsin Fast Plants when exposed to oxidative stress, but the organism will be compromised in overall height.

2. INTRODUCTION

Mitochondrial decay inflicted by oxidative stress in brain cells is the primary cause of all neurodegenerative disorders such as Alzheimer's and strokes (Kobayashi et al., 2006). According to recent estimates, stroke is the second most common global cause of mortality and the third most common cause of death in more developed countries (Sarti, Rastenyte, Cepaitis, & Tuomilehto, 2000). Case-fatality of total strokes varies little between populations, mostly between 20–30% (Feigin, Lawes, Bennett, & Anderson). 11.84% of global deaths were caused by neurological diseases in 2015 (World Health, 2006). Alzheimer's, Parkinson's, strokes, and other neurodegenerative diseases are caused by several factors, but all damage primarily stems from oxidative stress in the brain (Kobayashi et al., 2006).

The naturally slow rate of mitochondrial genesis is harmful to cells undergoing oxidative stress, as mitochondria cannot reproduce fast enough to replenish its numbers, eventually leading to irreversible damage and sometimes death (Friederich, Hansell, & Palm, 2009; Halliwell, 1992; Sena & Chandel, 2012). The overall mitochondria count of an organism further declines as an organism ages; existing mitochondria grow weaker and lose function while the rate of production of new mitochondria is insufficient to replenish mitochondrial loss (Kobayashi et al., 2006). These weaker mitochondria are even more likely to be damaged by ROS (Kobayashi

et al., 2006).

Recent work has shown that oxidative stress can be chemically induced in order to provide working models for studying oxidative stress (Li et al., 2003). Hydrogen peroxide (H2O2), a reactive oxygen species (ROS), was put in cerebral vascular smooth muscle cells to determine if this increase in free-radicals is a cause of strokes and neurodegeneration. Following H2O2 treatment, muscle cells underwent apoptosis, stimulated by the death of mitochondria. Mitochondria count continually declined until ATP (adenosine triphosphate) production did not reach sufficient levels to support survival (Deavall, Martin, Horner, & Roberts, 2012; Li et al., 2003). Similar research by Barry Halliwell confirms H2O2 as a reactive oxygen species capable of inducing apoptosis through oxidative stress (Halliwell, 1992).

Pyrroloquinoline quinone (PQQ) is a vitamin that reduces ROS while accelerating mitochondrial growth, and therefore has the potential to be used to treat or prevent oxidative stress. A PQQ-rich diet should positively impact the health of an organism as it ages (Chowanadisai et al.). Recent work has tested the effects of PQQ in vivo, with rat diet serving as the independent variable (Ohwada et al.). The experimental group, which was fed a PQQ-supplemented diet, resulted in better memory and information retention than the control groups (Ohwada et al.). A similar experiment tested the in vitro effects of PQQ in cardiac rat muscles, which provided similar results (Kobayashi et al., 2006). Heart cells treated with PQQ supplements experienced less cell death than untreated cells when exposed to H2O2 (Kobayashi et al., 2006). An article published by BioMed Research International extensively explains the mechanism behind PQQ by explaining how the natural interaction between pro-oxidants and antioxidants naturally fights oxidative stress (Rahal et al., 2014). This article concludes that antioxidants reduce an overabundance of ROS. Both of these rat experiments support the hypothesis that a PQQ-concentrated diet could potentially reduce risk of oxidation damage. However, if an excess of antioxidants are present, too many ROS may be consumed, which can also lead to negative effects (Rahal et al., 2014).

Similar to mammals, plants also experience oxidative stress (Bartosz, 1997). Although plants do not have neural or glial cells, an overabundance of ROS can have negative effects. An increase in anti-oxidants such as PQQ may help prevent this damage, as it has the potential to consume excess ROS and strengthen existing mitochondria. Oxidative stress is more significant in plants than animals because unlike other organisms, plants produce their own amino acids rather than obtaining them from ingestion. Therefore, all amino acids must be produced internally through protein synthesis. If synthesis is slowed or stopped due to oxidative stress, the plant will rapidly decline in health until it can no longer function (Mühlenbock, Karpinska, & Karpinski, 2001).

Herein, Wisconsin Fast Plant seeds were grown under a 24-hour light source and watered via a watering wick system. The plants were grown in the same conditions with the same soil for three weeks until mature. The solution taken up by the watering wick served as the independent variable as each plant had a specific concentration of PQQ dissolved in its water. The control group had a solution of pure water while the experimental groups were watered with varying concentrations of PQQ solution. After three weeks of growth, the plants were exposed to identical hydrogen peroxide solutions to induce oxidative stress. Observations were made following one week of over-oxidation with continued normal watering regimens. In this work, the preventative effects of PQQ on susceptibility to ROS-induced damage are investigated. We hypothesize that high levels of PQQ will prevent oxidative stress damage to a greater degree than an organism that ingests lower PQQ levels.

3. MATERIALS

Water bottles purchased at Kroger (Gahanna, OH), an X-Acto Knife (Home Depot, Gahanna OH), 4-inch watering wicks (Home Depot, Gahanna, OH), a hammer, nails, potting mix (Home Depot, Gahanna, OH), and Wisconsin Fast Plant seeds (Carolina.com), 10 mg PQQ capsules (Jarrow Formulas), distilled water, a 24-hour Agrobrite grow light, balance, soap, 35% hydrogen peroxide (Momentum98, Columbus, OH).

4. METHODS

4.1 Preparation of Pots and Watering Wick System

Water bottles were emptied and cleaned with soap and water. Each bottle was horizontally cut in half directly under the label. A hole was created in the center of the lid with a hammer and nail. A watering

wick was woven through the hole in all bottles. The top half of each bottle (the half containing the lid) was turned upside-down and placed inside the corresponding bottom half to create a pot (Figure 1).

Figure 1. The watering pots and watering wick system. The colored labels indicate a specific solution (blue=0.5% PQQ solution, pink=0.25% PQQ solution).

Each pot was filled to the top with potting mix. Three seeds were placed in the center of each pot.

4.2 Preparation of PQQ-Concentrated Watering Solutions

Equation 1 was used to determine the mass of PQQ needed for each solution.

Equation 1
(% desired as a decimal) x (500 mL) = grams of PQQ

Solutions (500 mL) containing 0.01%, 0.1%, 0.25%, and 0.5% PQQ concentration were made. 50 mL of each solution was placed into the bottom portion of the appropriately labeled pot (n=10). Untreated water served as a control (n=10).

4.3 Plant Growth

All plants were placed under the growth light for three weeks. Watering solutions were replenished as necessary. Yellow blossoms formed after about two and a half weeks (Figure 2). Plant height was measured with a ruler in mm. Stem color was measured on a 0-5 color scale, shown in section 4.4.

Figure 2. After two and a half weeks, all watering solutions yielded flowering plants. This picture shows the flowers grown in 0.25% PQQ solution.

4.4 Chemically Induced Oxidative Stress

Hydrogen peroxide was diluted to 20% concentration using the formula below:

Equation 2
$C_1V_1 = C_2V_2$

10 mL of diluted H_2O_2 solution was directly poured into the soil of each pot and observations were recorded after one and two days. Plant height was recorded with a ruler in mm. Stem color was also observed on a 0-5 color scale shown below by visual observation (Figure 3).
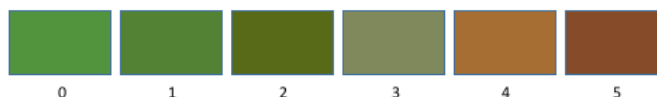
Figure 3. Color scale used for observation of stem color.

5. RESULTS

5.1 Plant Growth Prior to Over-Oxidation

After allowing the plants to grow for two and a half weeks until maturation, variation in plant height was recorded (Figure 4, Table 1). Plants grown in untreated watering solution (control group) showed the tallest average height amongst all groups. The 0.25% PQQ watering solution group yielded the second highest average height prior to hydrogen peroxide treatment, followed by the 0.01% PQQ solution, 0.1% PQQ solution, and the 0.5% PQQ solution,

respectively. The sample size for the 0.1% PQQ solution was reduced to 8 because 2 plants died prior to maturation. The sample size for the 0.5% PQQ watering solution was reduced to 6 because 4 plants died prior to maturation. Stem color was recorded based on the color scale in section 3.4 (Figure 3).

Figure 4. Average plant height before oxidative stress. The control group grew the tallest on average. The 0.01% PQQ solution and 0.5% PQQ solution plants were the shortest on average. (0.1% solution n=8, 0.5% n=6).

5.2 Effect of Hydrogen Peroxide on Growth and Survival

After chemically induced oxidative stress, the plant height was recorded (Figure 5, Table 1). 1 day after oxidative stress, the average plant height was measured for each experimental group and the control group. The 0.1% PQQ solution group was the tallest on average after treatment with concentrated hydrogen peroxide. After oxidative stress, visual observation concluded that all stems thinned and leaves became more fragile compared to initial growth. The color chart (Figure 3) was also used to observe stem color 1 day after hydrogen peroxide treatment and again 2 days after, shown in Table 1.
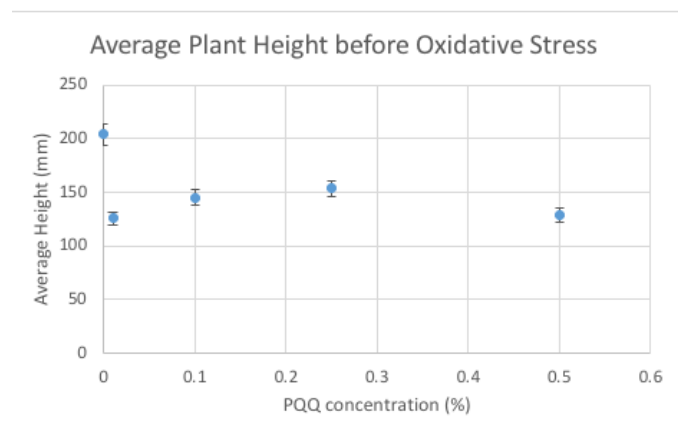

Figure 5. Average plant height after oxidative stress compared to initial growth. The 0.1% PQQ solution yielded the tallest plants on average after hydrogen peroxide treatment. The 0.01% PQQ solution plants were the shortest on average. (0.1% solution n=8, 0.5% solution n=6). Series 1=before oxidative stress, series 2= after oxidative stress.

Table 1. Average plant height before and after oxidative stress, and stem color changes. The control group had the tallest initial growth. After oxidative stress, the 0.1% PQQ concentration group was the tallest on average. The 0.1% group lived the longest, as it was the only group with a live plant 2 days after oxidative stress. Plant death was defined as stem color reaching 5.

PQQ Concentration (%)	Avg. height before (mm)	Avg. height after (mm)	Stem Color before	Stem color (Day 1)	Stem color (Day 2)
0	203.8	39.8	0	4	5
0.01	125.7	33.6	0	5	5
*0.1	145	43	0	2	3
0.25	153.5	37.7	0	5	5
**0.5	128.7	36.3	0	3	5

*Sample size=8
**Sample size=6

5.3 Comparative analysis before and after oxidative stress

The percent height differences were measured comparing average height before and after oxidative stress using equation 3.

Equation 3.

$$[(H_0-H_f)/H_0]\times100\%$$
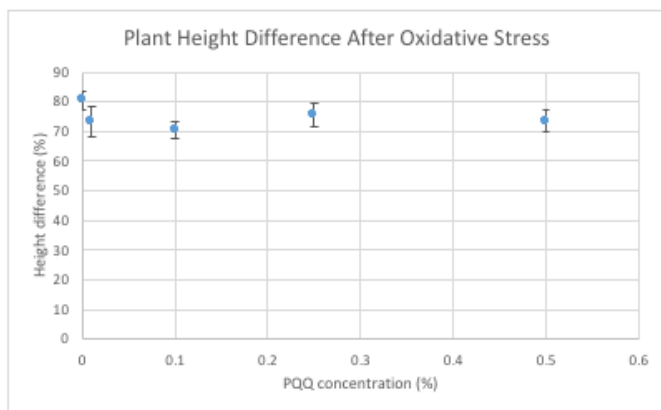
Figure 6. Average percent height difference after oxidative stress. The 0.1% PQQ solution group had the smallest percent height reduction on average. The control group had the highest percent height reduction on average. All of the PQQ experimental groups better maintained initial height compared to the control. (0.1% solution n=8, 0.5% solution n=6).

6. DISCUSSION

6.1 Initial Growth

All watering solutions yielded mature, flowering plants. However, the overall average height of the control group was the tallest, implying that PQQ solutions compromised plant growth (Figure 3). The mature plants of all watering solutions had the same initial stem color, suggesting that the vertically compromised plants were still healthy. Four of the ten plants watered with 0.5% PQQ solution died before reaching maturity, and two out of the ten plants watered with 0.1% PQQ solution also died upon initial growth. One of the 0.1% solution plants never grew, and the other 0.1% PQQ solution plant ran out of watering solution and was left untreated for two days, killing the plant. Therefore, the plant deaths in the 0.1% PQQ solution group may have been caused by operator error. Premature plant deaths in the 0.5% PQQ samples imply that PQQ has the potential to damage organisms when consumed in high concentrations. PQQ is an antioxidant, and a precise balance

of pro-oxidants and antioxidants are required in the body for proper consumption of ROS (Rahal et al., 2014). Therefore, by adding excess antioxidants, that balance is--at least temporarily--disproportionate. The PQQ concentration of the lower percentage solutions did not disrupt the interplay of pro-oxidants and antioxidants enough to cause significant damage to the organism as was seen in previous work (Rahal et al., 2014).

6.2 Consequences of Oxidative Stress

One day after hydrogen peroxide treatment, the average height of the 0.1% PQQ solution group was the tallest, followed by the control group, 0.25% group, 0.5% group, and 0.01% group, respectively (Table 1). The percent height difference was also calculated (Figure 4). The 0.1% PQQ solution group best maintained its initial height after over-oxidation, recording a percent height difference of 108.5%. The 0.5% PQQ solution killed 4 plants prematurely, possibly because of a sizeable excess of antioxidants (Rahal et al., 2014). The intermediate PQQ solution concentration performed the best in maintaining initial height after hydrogen peroxide treatment, and therefore the mid-range PQQ concentration is concluded to be the best concentration out of the experimental groups in resisting oxidation damage. Further experimentation should be performed with more PQQ concentrations closer to 0.1% to determine more specific resistant levels.

All experimental groups and the control group experienced 100% plant death, meaning that oxidative stress killed all 50 plants. However, the rate of death varied greatly. Stem color was observed one day following H2O2 treatment (Table 1). Plant death was defined as stem coloration ranking a 5 on the color scale (Figure 3). The 0.1% PQQ solution group most closely maintained its original color, followed by 0.5%. Two days following oxidative stress, living plants only existed in the 0.1% solution experimental group (Table 1). The remaining plants died within the next 24 hours. This observation supports the conclusion that 0.1% PQQ solution best resisted oxidative stress damage.

A more dilute solution of hydrogen peroxide, such as 10-15%, may lead to more accurate results in future experimentation because the plants may have reacted more slowly to the hydrogen peroxide solution. An error occurred because of the inability to adequately replenish water supply in one of the 0.1% plants,

causing its premature death. The plants were left under the growth light, and over a long weekend, the solution evaporated, leaving the plant an estimated two days without a water source and killing it. Therefore, sample size for this group was reduced. Larger sample size for all plant groups would better verify the results of this experiment.

7. CONCLUSION

From this work, we conclude that the plants grown in 0.1% PQQ solution were able to survive the longest after oxidative stress, and they recorded the most minimal stem color change and percent height difference. However, all PQQ solution experimental groups did not grow as tall as the control, meaning the addition of PQQ compromised initial growth. However, these compromised plants still appeared healthy, as their stem coloration was the same as the control. The plants watered with PQQ solutions were able to withstand and resist damage from hydrogen peroxide slightly better than the control because they better maintained their initial height throughout experimentation. The data also concludes that mid-range PQQ solutions are more effective in oxidative stress-induced damage resistance. Four out of the ten plants in the 0.5% solution died, most likely because of the high concentration of PQQ in the solution, which caused an imbalance of pro-oxidants and antioxidants to too great of an extent, leading to plant death (Rahal et al., 2014). The lower PQQ concentrations did not perform as well as the 0.1% PQQ solution, and therefore the PQQ may not have been present enough to significantly affect plant mitochondria. The mid-range concentration of 0.1% PQQ performed the best when undergoing over-oxidation, and therefore this PQQ concentration is presumed to help the plants resist oxidative stress by strengthening mitochondria, enhancing mitochondrial genesis, and providing antioxidants without overstimulating the organism (Chowanadisai et al.). Though the 0.1% PQQ solution group recorded the best resistance to height reduction, stem color change, and length of survival after oxidative stress, all plants eventually experienced 100% plant death, meaning that 20% H2O2 was too highly concentrated to allow cell damage without inducing cell death.

In conclusion, the results reported herein help to determine if PQQ has a significant influence on the prevention of oxidative stress and the speed of recovery following over-oxidation. Also, the best concentration of PQQ for optimum results can be determined based on the data collected. Plants watered with PQQ solution are hypothesized to respond better to oxidative stress, meaning they will have less lasting damage following H2O2 exposure and will recover at a faster pace compared to the control. Also, the mid-range concentration of PQQ solution is predicted to yield the best results because it will best balance the interplay between pro-oxidants and antioxidants. For future experiments, the mitochondrial death rate should be monitored and this experiment should be carried out in animal species such as mice. Stress can also be tested at different growth stages to determine the effect of oxidative stress on final height. Genetic predispositions for neurodegenerative diseases should also be taken into account in further research.

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Seabird Diversity Along a Latitudinal Gradient Within the Drake Passage

By Alec Sheets

Abstract

Though seabirds constitute only a small portion of all bird species, several studies have noted their relevance as indicators for the health of the marine habitats on which they rely. This is especially true of the seabirds that inhabit the Southern Ocean and Antarctic Peninsula. The seabird groups native to this area that were the focus of this study include penguins, gulls, petrels, and albatrosses. The study of indicator species such as these makes it feasible to track changes in ecosystems that are complex or otherwise difficult to study. Without data on these indicator species, ecologically vital but difficult to access ecosystems like those in the Southern Ocean cannot be studied easily. In order to collect data on current Antarctic seabird numbers and distributions, we sampled along a latitudinal transect from 60°S to 64°S, from just south of Cape Horn to the northern part of the Antarctic Peninsula. This was accomplished during travel across the Drake Passage by sighting and keying all seabirds visible from the bridge of the vessel four times each day, beginning at 0700, 1230, 1830 and 2200 for 15 minutes each. Observed seabirds and the latitude at which were they were sighted were recorded along with additional data such as wind speed, sea surface temperature and precipitation. Data were collected on 19 seabird species with varying distributions and abundances. In order to achieve a comprehensive analysis, we used a linear regression to determine the correlation between latitude and species diversity, calculated using the Simpson diversity index. The Simpson diversity index is regarded as the simplest measure of diversity and represents the probability that any sampled pair of individuals will be members the same species. This index was chosen over others for its independence from any specific theory on biodiversity. Although the result was not statistically significant, most likely due to a small sample size, these data still provide valuable reference points by which to track future changes in the marine ecosystems of the Southern Ocean.

Introduction:

Nat Turner and the Fear of African Spirituality

On the warm late summer night of August 21, 1831, Nat Turner embarked on a bloody crusade of insurrection and freedom which descended upon Southampton County, Virginia and the plantation owned by Joseph Travis. Turner was born into American enslavement in 1800 and had later been purchased by Mr. Travis, a craftsman who Nat Turner vehemently despised. Believing he had been directed to his mission through spiritual command and intervention, Turner proclaimed himself to be the savior of his people and proceeded to gather and recruit members of Mr. Travis' plantation as well as those adjacent to the Travis estate. As Nat Turner seethed with hatred for his owner, he regressed within himself in the weeks leading up to that fateful night, conjuring his determined mission through visions, omens, and signs. Inspired by a spiritual fervor which was imparted to him from his mother who was captured and brought to America from Africa, Nat Turner believed that he had been specifically ordained to obtain his freedom through the slaughtering of any white person who crossed his path.

Nat Turner's march through Southampton County began following an eclipse of the sun which was taken as a sign from God that his journey was divinely directed. Flanked by four others, Nat Turner approached the Travis family late into the night and murdered them all. With his mission not yet quenched or completed, over the next two days Turner and his small army went from plantation to plantation killing over sixty white men, women, and children. As his pursuit continued, Nat Turner was able to successfully recruit some sixteen others who were willing to follow the self-proclaimed Black Messiah in his bloodthirsty quest for freedom. Akin to a religious jihad, Nat Turner and his followers both shocked and impressively frightened the white community of Southampton County, Virginia placing the entire nation on edge. On August 23, the bloodshed ceased, and Nat Turner remained elusive from capture for the next six weeks.

After Nat Turner's apprehension, the country clamored for his swift execution as those who joined him in his mission were all tried and put to death. With the insurrection still firmly entrenched into the minds of the survivors, Nat Turner was placed on trial and executed on November 11, 1831. While the impact of the uprising penetrated deeply within the core of white America, it was the source of the rebellion, as expressed by John Wesley Cromwell which spoke to the primal fears that slaveholders carried with them during the afterward. In his account of the immediate aftermath Cromwell noted:

"A reign of terror followed in Virginia. Labor was paralyzed, plantations abandoned, women and children were driven from home and crowded in nooks and corners. The sufferings of many were intense. Retaliation began."

Slaveholders, overseers, and missionaries had dedicated nearly two centuries to the attempted conversion of enslaved Africans to Christianity. Yet, for as determined as their drive seemed to be, resistance to total conversion permeated throughout many of the plantations of colonial and eventually antebellum America. Christianity, it seemed, had failed to successfully push enslaved Africans into the area of compliance despite their status as being nothing more than chattel. For the first century and a half of the slave experience in America, there was but a small number of enslaved Africans who were converted to Christianity, let alone received a significant amount of Christian instruction and knowledge about the religion. Scores of Africans who were captured and placed aboard the many ships awaiting departure from the coast of West Africa were not allowed to carry any tangible item or relic during the Trans-Atlantic slave trade. With no physical items to remind them of the freedom they once shared on the continent, the African slaves managed still to carry the one item that could not be stolen or left behind: their spiritual identification.

Invariably, Nat Turner must have believed that Christianity in America was the white man's religion. Although his mother and countless other enslaved Africans might have had familiarity with Christianity, glaring hypocrisies still loomed. African spirituality represented a oneness of self, communion with the earth, the gods who nurtured the land and the peoples, and societies who converged to foster and populate their respective beliefs. Christianity was a European religion, perpetrated as a saving grace for a people who were identified as heathens in need of religious redemption. Nat Turner's insurrection underscored the difference between European religion and African spirituality and alerted the country to the reality that enslaved Africans were not willing to circumvent their spiritual identification, even as they faced the prospect of death in pursuit of freedom. Thus, African spirituality represented so much more to the enslaved African.

African Spirituality in Africa

Indeed, a wealth of scholarly literature has been produced which comprehensively examines diverse African societies and their separate religions. Works from historians William Ackah, Jualynne E. Dodson, and R. Drew Smith, co-editors of Religion, Culture and Spirituality in Africa and the African Diaspora (2017) and Elizabeth Isichei, A History of Christianity in Africa (1995), theologian Thomas C. Oden, How Africa Shaped the Christian Mind (2010), and historian Winthrop D. Jordan, White Over Black (1968), have been critical for understanding the heterogeneity of African and later African American religions. Historically, denial of Africa having had a religious and spiritual consciousness prior to a European presence in sub-Saharan Africa was championed by some of Europe's most esteemed scholars. German philosopher Georg Wihlem Friedrich Hegel sought to use anthology to dismiss African religious consciousness by asserting in his controversial work, The Philosophy of History that, "in Negro life the characteristic point is the fact that consciousness has not yet attained to the realization of any substantial objective existence." Hegel's incorrect conclusion that Africa was void of religious and spiritual identification continued with the erroneous claim that "[Africa] is no historical part of the World…Egypt will be considered but it does not belong to the African Spirit." Through the scholarly and anthropological works and writings by Hegel, among others, the extraction of a religious distinctiveness inside Africa allowed for what could only be surmised as unpardonable sins. Clearly, Hegel only helped to exasperate the racist and illogical belief that without European intervention, Africa was left without a conscious understanding of a "Higher Power."

Peculiar as it may be, the very concept of African spirituality and spiritual identification transcends beyond the continent of Africa as well as the range of immediate persons who have been influenced by its respective precepts. However, the idea of spirituality in Africa may not automatically register the same relationship that is associated with religion. Africans have shared in an approximation, a closeness to their respective faith and beliefs which often have moved past the conceptions of religion. For the sake of this essay, African spirituality will not be addressed in its entirety. The reasoning for this is

because the cultural, political, economic, and personal influences of African spirituality were incredibly diverse.

One way to frame African spirituality on the continent is through the examination of its overarching importance. Prior to the Trans-Atlantic slave trade, the spiritual connectedness which flourished through the various portions of African society was marked and counted through personal interactions. African spirituality would have been viewed as non-traditional, that is universally structured in the same manner as the Abrahamic religions of Christianity, Islam, or Judaism. In fact, each religion is unique to the people among whom it emerged. African spirituality addressed different concerns in life—health, wealth, security, etc., and the hereafter. In the Kongo, prior to the arrival of Catholic capuchins and missionaries, the intersecting of spirituality and life itself was highly visible. In outlining the elements of Congolese beliefs and practices, Aurelien Mokoko Gampiot explained the belief that God, or Nzambi a Mpungu, is the Almighty creator, was the first structural element to Congolese worship. This belief was not found exclusively in the Kongo, however, as other African religions had similar beliefs. In the Kongo, the ancestral spirits were believed to intercede on behalf of the living to Nzambi a Mpungu, much in the same way that modern day Christians believe that Jesus Christ was the intermediary between God and humankind. Certainly, this argues against the myth that African spirituality was nonexistent and nonstructural prior to a European presence in Africa, especially under the definitions of religious structure perpetuated by the Europeans. To suggest that Africans had no known understanding of spirituality— how it was viewed on the larger plane, and how it was incorporated into their overall lives, for example, ancestral protection from evil spirits or the healing and curing of the afflicted by spiritual leaders—is to neglect compelling evidence to the contrary. In fact, it is worth noting that any assertion of a spirit-less Africa is to deny that Catholicism has been deeply influenced by traditional African religions, especially as it relates to the association the Congolese had with Catholic missionaries during the reign of King Alfonso in the late 1490s and into the early 1500s. Some scholars have even claimed that Africa was the nurturing point of some world civilizations. At any rate, it is difficult to ignore Africa's place in the evolution of what would become known as universal civilizations. The centrality of African spirituality holds a value that should undoubtedly be recognized and appreciated in the same manner as Christianity, Judaism, and Islam. One of the most glaring complications in understanding the influence of African spirituality is the perception of Christianity. Christianity was viewed as the saving grace to a people who were considered sinful, backward heathens. Without the necessity of a protracted missionary sent by European powers to preach the gospel, Africans for millenniums had cultivated their own spiritual beliefs which one could argue certainly mirrored anything that was coming from Greece, Rome, Great Britain, or elsewhere. Africans were anything but sinful, backward heathens. Dominique Zahan noted that in the African religious universe, the Supreme Being was central. As the enslaved Africans were stolen from their homes, their families, and their literal sense of freedom, and sold into European-American slavery, the Supreme Being was virtually the only being on which they could truly rely. In the Americas, they would find a religion fundamentally opposing what they knew. Indeed, while some enslaved Africans were already converted to Christianity or had become familiar with some of the principals of Christianity, for a clear majority of enslaved Africans, their first introduction to what Nat Turner concluded was the "white man's religion" would be an inauspicious one at best, a brutal one at worse. And yet as the enslaved African arrived on the Atlantic coast of the New World, it would be their spiritual identification which would forge common bonds, become a beacon of hope in the most desperate and dismal of times, and above all, would set the foundation for the quest for liberation through rebellions, uprisings, and insurrections.

African Spirituality in America

"They know that if they would encourage their [slaves'] conversion they must allow them some reasonable time for their instruction; and this would consequently be a hindrance to their work and an abatement of the Master's. And this is not openly owned and avowed to be the cause of that…yet I may venture to say 'tis so at the bottom. Nor can some of them forbear to speak out their minds, though they endeavor to justify and excuse themselves by

pretending that the slaves (the Negroes especially) are a wicked stubborn race of men and can never be converted, tho to gull and deceive their Masters, they may put on the air and appearance of religion."
– South Carolina Clergy to Gideon Johnston, March 4, 1712.

In White Over Black, Winthrop D. Jordan sharply stated, "Despite their intimate contact with Negroes, the American colonists generally made little conscious effort to assess the nature of the people they enslaved and took to bed." Furthermore, "They felt no pressing need for assessment because both the Negro and slavery were, by and large, self-explanatory. Negroes were people from Africa bought for the purpose of performing labor." He finishes this thought with a profoundly simple question; "What fact could be more obvious and natural, less demanding of explanation?"

The fact that scores of American enslavers, colonists, and missionaries neglected to understand the very nature of the persons they enslaved related directly to the fundamental doctrines of Christianity in America, and thereby the insistence that "human unity was bound to be made in religious terms." To the practitioners of American slavery, Christianity was the definitive proof that God commissioned African peoples to be enslaved for life. The failure to appreciate the human nature of Africans provided substance for the spreading of Christianity, both in Africa and across the Americas. If Christianity was meant to save lost souls from their dark and wicked lives, who better to rescue than Africans? It was this illogical yet almost universally accepted belief that massaged the conscious of those who relentlessly asserted the authority of God while conveniently omitting redeeming grace of Jesus.

Contrary to beliefs shared by persons such as Georgia minister Charles Colcock Jones, Sr. (1804-1863), Christianity was not as influential to the slave experience in both colonial and later antebellum America as compared to African spirituality. The truth is that most enslaved Africans did not convert to Christianity in any abundant manner until the years directly proceeding the Civil War. This was because of a direct hypocrisy between what was preached and what was practiced by slaveholders and ministers. Recalling the rejection of preachers by the enslaved in the quarter community where he lived, Frederick Douglass noted,

"It was in vain that we had been taught from the pulpit at St. Michaels the duty of obedience to our masters—to recognize God as the author of our enslavement—to regard running away as an offense, alike against God and man—to deem our enslavement a merciful and beneficial arrangement—to esteem our condition in this country a paradise to that from which we have been snatched in Africa—to consider our hard hands and dark color as God's displeasure, and as pointing us out as the proper subjects of slavery."

Another reason for a lack of mass conversion was the uncertainty of what to do with Christian slaves. From a religious and moral point of view, the allowance for religious acceptance continuously posed a perplexing dilemma. While Christianity was most certainly used as a force to deepen the belief that enslavement was to be rationalized through Christian charge, the end result of Christian conversion was often left in question. Explaining that many slaveholders fretted over the reality that their slaves would eventually come to "dangerous conclusions" if they were given too much Christian instruction, James Russell Johnson, quoting William S. Plumer remarked, "All men will have some notions of religion, and if they will not be correct notions they will be erroneous. Wild. Fanatical. Superstitious, or in some other way dangerous." Additionally, as discussed below, enslaved Africans who refused Christian conversion did so in an effort to retain their own spiritual connections to their home, or as in the example of Nat Turner, was born into American enslavement but whose spiritual roots stretched back to Africa.

Missionaries throughout southern slaveholding states had a contentious relationship with enslaved Africans due in part to the prohibitions of religious teachings held by some slaveholders. As noted, this was because of the fear that Christian instruction might promote rebellion. Thus, efforts to "Christianize" Africans in South Carolina during the eighteenth century were primarily endeavored in Charleston and other settled plantation areas. If Christianity's role in the lives of enslaved Africans was not as prevalent as has been constructed, it is clear that, instead, African Spirituality's role was.
To understand the importance of African spirituality in respect to the slave experience in America,

one must recognize two significant points. The first is diversity. Evidently, not every African who was enslaved was taken from the same region or closely neighboring areas. As it has been well documented, slavers cared little about where slaves originated from. The end game was to acquire as many Africans as possible with the least resistance and loss. With that being the case, those who survived the Middle Passage were usually privy to their own language and religious beliefs, though at times a person may have known the language of another tribe and been familiar with the religious and spiritual practices or beliefs of others. The second point is a lack of familiarity. Indeed, as stated previously, some Africans on the continent were knowledgeable about Christianity. This is especially true as it concerns the Kongolese who were baptized and converted to Catholicism. Yet, a lack of familiarity is critical when attempting to convert a people who do not speak the language of the missionaries. Albert H. Stoddard relayed this point in saying the following:

"Taking such a conglomeration, totally ignorant by all our standards, and thrusting them into a sphere so different as to amount to almost another world, two principal things happened. In the first place, and in common with any immigrant, they had to learn to speak English. It was necessary to teach them as soon as possible so they could understand orders and instructions…When they had acquired a sufficient grasp of English to understand orders they were then left to themselves as to speech."

The "breaking period" of slave emigration was not resoundingly met with compliance or obedience. It must be understood that even though European slavers tapped into a preexisting slave network, the system of slavery operated differently in Africa as opposed to the Americas. For many free Africans, therefore, while they may have known of or even witnessed African enslavement, once they themselves were captured, the reality of enslavement was wildly different than anything experienced in Africa. To be captured, shackled, placed upon a ship, and after up to three months finally arrive on an unknown land and look upon the faces of persons who were so unfamiliar and wicked must have been the worst experience they would have had. To then be "broken" and forced to learn a language that was just as foreign as any other African language must have contributed to one's determination to rebel. In fact, forced emi-

gration was routinely met with African resistance at every turn.

As enslaved Africans resisted, rebelled, and refused, they began to turn inward to their spiritual connectedness and identities. By returning to their spiritual roots, they gained faith and protection. In some instances, certain African spiritual identities were shared among others, whether they belonged to the same group or a different group. There was a reverence within the confines of African spirituality which was difficult to maintain solely through traditional Christianity in America. Their shared experiences of slavery became a catalyst for a need to share religious and spiritual beliefs.

For many slavers, religion was the least of their concerns. So long as they retained the ability to purchase slaves and maintain a plantation, many planters were not interested in the religious lives of their slaves. The only time a slaver's ire could be heightened is if it was discovered that their slaves were using African religions or Christianity as a tool to rebel. Slaves early on identified this and began to formulate ways to use their spiritual beliefs to not only relieve some of the atrocities of slavery, but to also reformulate Christianity.

An interesting factor that both planters and missionaries failed to realize is that while in native lands, enslaved Africans, as author Jason Young puts it, "not only received a cultural and religious inheritance from Africa but also actively engaged in the process of putting Africa to use in their own lives." Maintaining a spiritual identity was one of the most important activities of enslaved Africans. However, more was required to navigate through living enslaved, considered property. The desideratum was to firmly place Africa into their lives to develop a means of transmitting and discovering salvation. As it would turn out, the enslaved African would create for themselves an elaborate structure built upon their various religious and spiritual beliefs and forged by their commitment to freedom. From their spiritual connectedness, the enslaved African formed a developed understanding of God, though the slave master and missionary both reported they had no knowledge of who God was.

African spirituality contributed to a connectedness that was not understood by slave master or missionary. In general, missionaries believed they were doing Africans a favor. When conversion

attempts were made, they were often empty gestures composed of demeaning consciousness. The enslaved Africans not only had personal relationships with God; in many aspects, their relationships were more deeply religiously rooted than some Christian missionaries. Missionaries, earlier on, decided that full-scale conversion was not successful because of the immeasurable devotion to their previous spiritual beliefs that Africans retained. The slaver's encouragement to Christian conversion and worship depended largely on his own pious behaviors. Within this paradigm, enslaved Africans created communities, and while not necessarily sharing the same cultural background or religion, were still connected within the compass of spirituality. As author Clifton Johnson pointedly explained, "The antebellum Negro was not converted to God. He converted god to himself."

Religion and Rebellion

"I finally got religion, and it was Aunt Jane's praying and singing them old Virginia hymns that helped me so much. Aunt Jane's marster would let her come to see me sometimes, but not often. Sometimes she would slip away from her place at night and come to see me anyhow. She would hold prayer-meeting in my house whenever she would come to see me…if old marster heard us singing and praying he would come out and make us stop. One time, I remember, we all were having a prayer-meeting in my cabin, and marster came up to the door and hollered out, 'You, Charlotte, what's all that fuss in there?' We all had to hush up for that night. I was so afraid old marster would see Aunt Jane. I knew Aunt Jane would have to suffer if her white people knew she was off at night. Marster used to say God was tired of us all hollering to him at night."

In Roll, Jordan, Roll, Eugene Genovese analyzed the institution of Christianity and how its relationship with the enslaved African affected their consciousness and ideologies. Suggesting that the Christian religion produced a spirit of passivity and submissiveness, Genovese surmised that the Christian religion "softened the slaves by drawing the hatred from their souls, and without hatred there could be no revolt." Indeed, there were enslaved Africans who saw Christianity as the religion of the redeemed and who believed that the only way to live a righ-

teous life was through the conversion, belief, and practice of the slave master's religion. Yet, for just as many enslaved Africans who subscribed to this ideology, there were just as many, if not more, who either turned to Christianity for manipulative and exploitative purposes, or refused to accept Christianity altogether.

Importantly, for the enslaved African, familiarity with Christian faith may have varied from slave owner or plantation. Depending largely upon whether or not the slave owner was a pious individual, the enslaved African may have received religious instruction or may have been prohibited from any Christian training up to attending church services. On its own, the Bible was a conspicuous entity in the relationship between the enslaved and Christianity. Fearing that the Bible may incite their slaves into resistance, many planters directly forbade the Bible from being present on their plantations. In the right hands, it could manipulate and exacerbate the institution of slavery. It could even promote the idea that, as William Wells Brown mentioned in his narrative My Southern Home when speaking about pastor Mason, "if you bear it patiently, and leave your cause in the hands of God, he will reward you for it in heaven, and the punishment you suffer."

This ideology was neither foreign to nor controversial among almost all of the southern planters or missionaries who used Christianity and, specifically, verses from the Bible to foster a defense for the creation and implementation of slavery. Many slave narratives spoke to the idea that Christianity was ordained to release the enslaved African from a life of spiritual bondage despite remaining in physical serfdom. The hypocrisy was to be covered through elaborate mixed messages masqueraded as sermons to sustain docility and keep the prospect of rebellions and insurrections held in check. Former slave Lunsford Lane, writing in his own narrative, illustrated the manipulation of Christianity as practiced by ministers who cherry-picked particular scriptures. In his narration, Lane said the following,

"I often heard select portions of the scriptures read…There was one very kind-hearted Episcopal minister whom I often used to hear; he was very popular with the colored people. But after he had preached a sermon to us in which he argued from the Bible that it was the will of heaven from all eternity we should be slaves, and our masters be our owners,

most of us left him; for like some of the faint-hearted disciples in early times we said, 'This is a hard saying, who can bear it?'"

The deliberate and perverted manipulation of the Bible, scriptures, and Christianity by all parties involved to subjugate millions of enslaved Africans is a stark testament to the orchestration of religious control.

"Faithfulness, obedience, and integrity would become rules of living for the negro, and so would substitute moral obligation for fear in his relationship to his master."

As enslaved African were brought to American shores, Christian beliefs stood in contrast to their spiritual identities. One of the most effective modes to break a person's will, to extract their obedience, is to displace their spiritual foundations. Once broken, rhetoric such as the abovementioned quotes become easily digestible. The "breaking" of the slave's will existed in two forms: physical and psychological. Repeated teachings that it was the intention of God that Black people were to be enslaved attempted to place the blame of slavery on an obviously unjust God and the misfortune of being born Black. While certainly the theoretical expressions of American slavery were derived from the unconscious manifestation of white supremacist ideals vis-à-vis the "God curse," it registered only for a small contingent of enslaved Africans. These instances depended on using a manipulated version of Christianity; here, in Western ethnocentrism. In the hands of the slaves, African spirituality could not only pierce but invade the tenants of Christianity for the benefit of the enslaved African.

African spirituality's influence not only on the slave experience in America but also Christianity is one of the most neglected narratives in this country's history. For the enslaved African, conversion to Christianity presented several challenges which needed to be addressed, yet seldom were. For starters, many were not permitted to hold their own services. If a newly converted slave wanted to learn more about Christianity, his or her only means of receiving the teachings might have been to attend church services with whites who forbade them to sit together. Some plantations were more lenient, yet routinely, enslaved Africans were only permitted to obtain Christian religion under strict provisions. Ac-

quiescing to these rules only increased the necessity to forge a common bond between respective African religion and Christianity.

If Christianity was to be accepted by the enslaved African, it first needed to attend to pressing concerns. First, Christianity needed to address the concept of slavery. In his own narrative, Friday Jones remembered a promise he made to God as a young boy: "I promised God I would seek my soul's salvation when I got to be a man." The pretense of this Christianity was one could acquire true salvation only through acceptance of Jesus Christ. Yet this stood in contrast to the condition of the enslaved, as these enslaved persons were aware of their fate. Accepting Jesus Christ did not end their physical bondage. Personal salvation for many enslaved Africans only came through death. Christianity's great paradox therefore became the difference between white Christians and enslaved Christians. To summarize the hypocrisy that blurred the line between the two, Frederick Douglass wrote,

"Between the Christianity of this land, and the Christianity of Christ, I recognize the widest possible difference…We have men-stealers for ministers, women-whippers for missionaries, and cradle-plunderers for church members. The man who wields the blood-clotted cow skin during the week fills the pulpit on Sunday, and claims to be a minister of the meek and lowly Jesus…He sells my sister, for purposes of prostitution, stands forth as the pious advocate of purity…We have men sold to build churches, women sold to support the gospel, and babes sold to purchase Bibles for the poor heathen! All for the glory of God and the good of the souls!"

Here, Frederick Douglass magnificently articulated the asymmetry between white and enslaved Christianity. As enslaved Africans began to explore Christianity, they had to understand that the religion for whites was inherent disparate from theirs. And it would be through this understanding that they could formulate their own interpretations while maneuvering through Christianity.

One of the most fascinating ways in which the enslaved Africans incorporated their respective spiritual identities into European-American Christianity was the "invisible institution." The enslaved Africans became very resourceful in ensuring they had opportunities to worship without impediment or punishment. For this purpose, they waited until night-

fall and slipped away deep into the woods to pray, sing, and preach. What developed from the souls of enslaved Africans during their late-night worship services was the ritual.

Rituals were known for their worship through song and dance as enslaved Africans expressed themselves in ways that were forbidden on the plantation. In the Journal of Negro History, John B. Cade gave voice to the perils which befell enslaved Africans seeking to steal away in order to worship. One account was given by M. J. Jones of Minden, Louisiana who was quoting Hannah Lowery: "When they wanted to sing and pray, they would steal off into the woods. During that time, most of the masters were cruel. If they would hear them (slaves) singing, they would get their whips and whip them all the way home."

Yet, as a Mrs. Channel gave her account of another plantation in Louisiana, enslaved Africans would not be stopped in their mission to worship: "…religious services among the slaves were strictly forbidden. But the slaves would steal away into the woods at night and hold services. They would form a circle on their knees around the speaker who would also be on his knees. He would bend forward and speak into or over a vessel of water to drown the sound. If anyone became animated and cried out, the others would quickly stop the noise by placing their hands over the offender's mouth."

Enslaved Africans faced a clear danger by assembling to worship and seek the guidance of the one whom they believed was more powerful than the slaveholder. The "ring shout," as these praise and worship services would be known, were often more than just a gathering of bodies to seek comfort and a few moments of relief from their otherwise base lives of enslavement. It further offered a valuable component to the enslaved Africans' lives, and an even greater danger if discovered by the slaveholder: the rebellion plot.

From historical works to slave narratives, it has been depicted that for many enslaved Africans, communications were given not only through day-to-day conversations, but also through song and worship. Though ignored or mocked by most slaveholders, the creation of the ring shout was less of a creation than an incorporation of Central and West African indigenous dance. As Sterling Stuckey wrote, "the dancing and singing were directed to the ances-

tors and gods, the tempo and revolution of the circle quickened during the course of the movement." Ring shouts served many purposes for the enslaved, which was primarily that of a hidden form of communication.

For those who toiled on large plantations, those holding dozens of slaves, communication was of the most vital importance. Communication provided through ring shouts varied, depending upon the necessity of its performance. It offered an opportunity to commune with God without the interference, prohibitions, or restrictions of Christian worship or slaveholder objection. Ring shouts allowed for the expression oneself creatively through music and dance which included rhythmic clapping and movement. Furthermore, ring shouts were used as a decoy for possible uprisings. While slaveholders who happened to witness a ring shout naively assumed it was nothing more than a "peculiar service" where "a dozen or twenty jog slowly round a circle behind each other with a peculiar shuffle of the feet and shake of arms," most were unaware of its ability to camouflage rebellion. Enslaved Africans had a deep understanding of how plantation life worked, and more so, how to properly manipulate the version Christianity disseminated by missionaries and slaveholders. The rebellion plot began to germinate almost as soon as the first enslaved African was brought in chains to American shores. Modes of discovering how to run away or how to create an insurrection figured into the daily lives of most enslaved Africans, though many might have never acted upon it or divulged their internal desires. The ring shout furnished, if even for a short while, the security in self-reflecting and communion with God. That enslaved Africans were ingenious enough to take a religion set against the backdrop of God-ordained slavery and manipulate it to help facilitate their spiritual necessities and to give birth to plots of uprisings, rebellions, and insurrections speak volumes to the character of every enslaved person who took these measures. Many rebellions, whether carried out, cancelled, or in some tragic instances, exposed, covertly used Christianity in concert with the aspirations of the enslaved. However, insomuch as enslaved Africans looked to domestic acts of rebellion as inspiration, it is plausible to speculate they were inspired by insurrections elsewhere.

Indeed, enslaved Africans on American

plantations might have been indirectly influenced by slave uprisings such as the Haitian Revolution. Indeed, no commentary on African slave rebellion can take place without recognizing the self-liberating tactics enacted by the Haitians in Saint-Domingue from 1791 to 1804. The Haitian Revolution and its independence from French colonial rule was the only insurrection in history to lead to the founding of an independent state for the formerly enslaved. As an American ally during the Revolutionary War, the French defeat by Toussaint L'Ouverture and the Haitian army was cause for great consternation. For the then-nation's capital Philadelphia, as mentioned in the book Dangerous Neighbors, news of the war for liberation in Haiti was extremely important. Questions of whether the same could occur in America concerned French sympathizers and pro-slavery Americans. In fact, while most Americans decried the violence of the war, author James Alexander Dun remarked that the Haitian Revolution only served to intensify pro-slavery rhetoric by what he defined as proto-Republican commentators.

While there is no historical evidence to support that the Haitian Revolution directly influenced any rebellion in America, it should be noted that the Haitian religion of Voudou (Voodoo) was believed to have been a spiritual guide. During the Bois Caïman ceremony, through which the Haitian Revolution began, a maroon leader and voodoo priest by the name of Boukman was said to have offered animal sacrifices to voodoo deities. Boukman would later credit voodoo as the source of victory:

"Despite rigid prohibitions, voodoo was indeed one of the few areas of totally autonomous activity for the African slaves. As a religion and a vital spiritual force, it was a source of psychological liberation in that it enabled them to express and reaffirm that self-existence they objectively recognized through their own labor…Voodoo further enabled the slaves to break away psychologically form the very real and concrete chains of slavery and to see themselves as independent beings; in short it gave them a sense of human dignity and enabled them to survive." A little over three decades later, Nat Turner, also divinely inspired by traditional African religions, would wage his insurrection upon the very system of slavery through the massacre of his slave master and neighboring plantation owners.

One of the less fantastical slave revolts in American history was planned for Easter Sunday, 1802 in Virginia, a mere year and a half after the infamous Prosser slave revolts of late 1800. The Easter Sunday insurrection commenced as reportedly "80 slaves met in a field near Norfolk and planned to fire the city and kill the white people." The conspirator of the plot was a man by the name of Ben who, according to records, was owned by Mr. Philemon Bird of King and Queen County. Ben was captured the next day and was subsequently hanged on June 1, 1802. While documents ascertained afterward fail to clarify whether the plot was conspired upon during a religious service, the argument can be made that Ben and the other eighty co-conspirators may have come to this plot by way of a religious gathering.

Slave revolts, plots, insurrections, and uprisings were to varying degrees fixtures in religious services, as services were one of the few times slaves were able to gather and fully question their positions in life. The hybrid of Christianity and African spirituality awakened the spirits of the ancestors and sparked the sense of freedom that was taken as the slaves were shackled and forced into ships bound for the Americas. While white planters, missionaries, and the like all gathered on Sunday mornings in a display of self-gratifying European chauvinism, as essayist Caryl Phillips denoted, enslaved Africans slipped away to the recesses of fields and woods to create a sense of hope.

African spirituality's influence on the slave experience in America challenged Christianity's power in ways that the master class could not conceptualize. The "pious" slaveholder and the "charitable" missionary were only as well-meaning and Godly as their imaginations would dictate. To invoke the spirit of God upon a race of people who were to be in bondage for life was one of the most blatant examples of hypocrisy in the American religious tradition. The enslaved African recognized this and either converted from an appreciation of Christianity that even the slave master themselves could never obtain, or in many instances completely dismissed it. The full influence of African spirituality on the slave experience lies nestled within the want for freedom and the prospect of death. Both concepts were the constant reminders that for the enslaved Africans, their only possessions were their spiritual identities. The fact that from integration of Christianity with their respective spiritual connectedness evolved

hope and a desired sense of liberation is a testament to the persevering spirit of every enslaved African. Thus, African spirituality continued to develop as it cemented itself into the lives of enslaved Africans, resulting in the rise of conjuring and Hoodoo.

Conjuring, Hoodoo, and the Counter to Christianity

The Latin word for conjure is conjurare, which is defined as "banning together by an oath or to conspire." In Old French the word is represented as conjurer which means "to plot or exorcize." In African spirituality in America, the composition of conjuring was a banning together by an unspoken oath, and in many respects, was a plot to usurp the powers held by Christian slavers. Europeans, and later Americans, were both ignorant to the complexities of African spirituality. They routinely mocked and were dismissive to what they considered to be mere superstitions. Georgia Presbyterian minister Charles Colcock Jones, Sr. apprised the participants of conjuring with a conclusion that, "they believe in second-sight, in apparitions, charms, witchcraft, and in a kind of irresistible Satanic influence. The superstitions brought from Africa have not been wholly laid aside." Noted traveler Frederick Law Olmsted shared in the same misunderstanding of spiritual practices when he wrote in his narrative, "A goodly portion of them, I am told, 'profess religion,' and are received into the fellowship of the churches; but it is evident, of the greater part even of these, that their idea of religion, and the standard of morality which they deem consistent with a 'profession' is of it, is very degraded." He further states, "they are subject to intense excitements, often really maniacal…I cannot see that they indicate anything but a miserable system of superstition, the more painful that it employs some forms and words ordinarily connected with true Christianity."

Indeed, slave conjure was neither absurd nor contemptible in the spirits of those who believed in its powers to perform various functions for certain desired outcomes. Planters, missionaries, and travelers often neglected to comprehend the history and culture of slave conjure, insomuch as not cultivating a perspective as to how and why it was retained and maintained from the continent of Africa to the plantations of America. To the enslaved African who was familiar with conjuring, the significance was to be understood and respected. The conjure doctor, as W.E.B. DuBois eloquently described, was the "healer of the sick, the interpreter of the unknown, the comforter of the sorrow, the supernatural avenger of wrong, and the one who rudely but picturesquely expressed the longing, disappointment, and resentment of a stolen and oppressed people." Clearly, the central importance of the conjurer in the enslaved African's life could not in any rudimentary sense be shared or appreciated by the master class because they were the oppressors, never the oppressed. The master class believed that true Christian values and beliefs were threatened by witchcraft, superstition, and paganism. Yet for the enslaved African, as DuBois pointed out, conjurers were the opposite: the healers, the interpreters, and the protectors.

The most important elements and persons of slave conjuring were the conjure bags and the conjure doctors. Jason R. Young, professor and author, explained that the conjure doctor's primary functions was to, "heal the sick, harm enemies, reveal the unknown, protect themselves [enslaved Africans] from the brutalities of slavery, and achieve countless other aims." The conjure bag, which could also be known as tricks, charms, tobys, and hands were responsible for storing ritual objects. Root doctors who used medicines to heal the sick or perform special functions were known to either wrap or bind their medicines inside the bag or in some cases seal their medicines inside glass bottles. A conjure bag could consist of roots from the ground, pins, rusty nails, and dirt, with other contents being added depending upon the specializations of the conjure doctor. In Notes on Negro Folk-Lore and Witchcraft in the South, late nineteenth-century author Louis Pendleton recorded that in Louisiana enslaved Africans constructed small human models, covered with blood, and pierced through the heart. In a more contemporary definition these "models" are otherwise known as "voodoo" dolls. The conjure bag might have also contained fingernails and hair that could be used to bring about harm or possibly even death upon the conjured.

On the plantations where there was a known conjure or root doctor, many slave masters maintained a distant relationship, which translated into a sense of status and power within the minds of other slaves. Indeed, not every root doctor practiced the

same way, and not everyone specialized in the same areas. However, as it pertained to the ever-teetering balance between African spirituality and European-American Christianity, the influence and power of the conjurer, as with others like herbalists, was embossed upon the sensibilities of the enslaved Africans. The relationship between planter and root doctor, herbalist, or fortune teller was a contentious one, yet there are many accounts where the conjurer was so mesmerizing that he or she could avoid physical labor or even punishment. In his narrative, Henry Bibb spoke to this by saying:

"There is much superstition among the slaves. Many of them believe in what they call 'conjuration,' tricking, and witchcraft; and some of them pretend to understand the art and say that by it they can prevent their masters from exercising their will over their slaves. Such are often applied to by others, to give them power to prevent their masters from flogging them."

In relation to religion, those who had or had not converted to Christianity sought the protection and assistance of root doctors with no certain hesitation. The overall impact that conjuring had upon the slave experience in America was that it stood as a formidable opponent to the structure of Christianity. Because the origins of conjuring derived from West and West-Central Africa, the enslaved African might have been more familiar with the ritual practice of conjuring as opposed to Christianity. Yet as African spirituality, due in part to conjuring, remained preeminent in the slave community, it would be Hoodoo which would be claimed by both Christian convert and minsters, as well as non-convert alike.

Both Zora Neale Hurston's Hoodoo in America and Katrina Hazzard-Donald's recently released work Mojo Workin': The Old African-American Hoodoo System are two of the most detailed and comprehensive writings on the religion that helped to transcend the Lowcountry (southern) region of the United States. Touching upon a litany of subjects, terms, and persons, Hurston's description of Hoodoo articulated its nuances and was one of the first major works which examined its rich history. Hurston emphasized, "Veaudeau is the European term for African magic practices and beliefs, but it is unknown to the American Negro. His own name for his practices is Hoodoo, both terms being related to the West African term juju. 'Conjure' is also freely used by the American Negro for these practices." Quite like the enslaved Africans from the areas in which it originated, Hoodoo is one of the most complex and transformative religions that survived the era of slavery. Despite the historical and cultural misunderstandings of West African religions in the United States, misinterpretations of African spirituality have continued by historians and students of American religion.

In Mojo Workin,' Hazzard-Donald describes the reason for Hoodoo's emergence as a "dynamic spiritual form functioning at the boundaries of slavery's power" due to the enslaved African's unwillingness to abandon all of the "traditional spiritual and worship practices" they carried with them from Africa. The tenacity of the enslaved Africans to hold onto their spiritual identification was paramount to their daily lives and the circumambient efforts to protect their spirituality was one of the most reflective driving forces which birthed Hoodoo in America.

Hoodoo's presence and influence could be felt as it grew and manifested itself in the lives of enslaved Africans in the Lowcountry region. Hazzard-Donald explains that there were three southern regional Hoodoo traditions which were established somewhere between the late-eighteenth century and the early-nineteenth century. These areas were, the Southwest (Gulf Coast; New Orleans; Mobile, AL), Southeast (Sea Island, Coastal Georgia, and Florida; the Carolinas), and the Northeast (Maryland; Virginia; eastern Tennessee; North Carolina). Within this large geographic area, enslaved Africans developed and fortified Hoodoo despite the presence of Christianity. Indeed, Hoodoo emerged over time and through time, Hoodoo's influence on the enslaved African expanded.

As opposed to Christianity, Hoodoo was not viewed as a contradictory, oppressive religion that was designed to impress upon the enslaved African that their bondage had been preordained. Additionally, Christianity stood opposite Hoodoo, as well as other traditional African religions because it was regulated by the slave master who decided when, where, and how enslaved Africans could worship. Finally, Christianity offered no realistic opportunity for liberation. If an enslaved African, who concluded in his or her mind that he or she would be in perpetual bondage for life, then it would be more than plausible that they would at the very least be morally obligated to worship the way in which they could in Africa. For

this, Christianity prohibited enslaved Africans where religions like Hoodoo did not. Hoodoo provided many of the tenants of spiritual worship that had been utilized in Africa which included spirit possession, sacred circle dancing, sacrifice, ritual water immersion, and divination.

African spiritual connectedness transformed the Black southern plantation church where Hoodoonized Christianity flourished among the congregation that fused Christianity with Hoodoo rituals. Many of the same practices of enslaved Africans who sought the depths of the woods to hold services through "invisible institutions" were also conducted inside the Hoodoo church. Dancing, prayer, healing, call and response, and spirit possessions were present within slave worship. The influence that African spirituality carried inside the Hoodoo church was so impactful that in some instances, Black ministers of Christian churches left their positions to further develop Hoodoonized Christianity.

Conclusion

More can be said, and has been said, about the influence that African spirituality had on the slave experience in America and thereby, the traditional religions of enslaved Africans. That enslaved Africans had the ingenuity, the resourcefulness, and the determination to preserve their spiritual beliefs and practices and created ways to connect their African spiritual heritage with Christian doctrine is truly remarkable. Indeed, the fundamental teachings of Jesus was to love one's neighbor and to remember that in true Christian worship, none were slave, and all were free. However, Jesus' commission was tragically ignored in a slave system designed, in part, to use religion to oppress rather than liberate. It was preached as a vessel from the same persons who, as Frederick Douglass conveyed, "sell my sister, for purposes of prostitution." In short, Christianity on the Southern plantations in America was a means to justify a unilateral approach to a universal religion based solely on the premise that Christians were correct, and the rest of the world was heathen.

Yet forged from the fires of despair, anger, sorrow, and grief, an enslaved people brought forth their spiritual and religious beliefs, worshipped under the ever-present threat of death itself and created for themselves a community within a community man-

aged by the common bond that all men were indeed created equal by God. African spirituality meant much more to the enslaved Africans than Christianity could have standing on its own. Despite the efforts of enslavers and missioners to insist the slave's lot in life was God-ordained servitude to the white Christian, the hypocrisy in that assertion was hardly ever missed. In fact, efforts to eradicate what enslavers and missionaries decried as pagan worship from the slave community and the slave specifically could not survive in the long run, and African spirituality was never compromised.

As generations have passed and ancestors have returned to their spiritual homes, the remnants of African spirituality live on through the songs, praise, worship, prayers, and services held at Black churches every Sunday. From being forbidden to worship God as was divinely ordained, to risking one's life, to manipulating and influencing Christianity for the purposes of supplied hope and prospective rebellion, to finally being free to worship as one chooses, indeed, African spirituality will never have an extinguished soul.

Outcomes and Explanations for Global Health Initiative Funding Trends in Relation to Maternal Health and Child Malnourishment in India

By Eileen Saunders

Introduction

Globalization has brought dramatic changes to the way the world views health. Increased interdependency and interaction between nations has exemplified how quickly emerging diseases can spread across the globe, affecting world trade and diplomacy as much as the health of vulnerable populations. "Global health" as a term has only recently evolved to encompass more than just the linear relationships of international health issues, moving beyond social and development agendas and into the realms of foreign policy and security[1]. As globalization has essentially dissolved many distinctions between domestic and foreign health issues, the study and response to health crises has transformed to extend beyond national boundaries and past an exclusive focus on traditional methodologies and perspectives[2]. What has developed in response to this newly globalized world of health issues is a fragmented network of institutions, initiatives, funds, and organizations to tackle diseases on an international scale. Generally, these have taken on the name of "Global Health Initiatives" (GHIs), most of which have been established after the year 2000 and will be defined more clearly later on. Since the creation of many of these GHIs and the shift international donors and governments have taken towards assisting public health in developing countries, there has been much debate over the effectiveness of these funding methods[3]. Most international funding for health aid is for service delivery for specific diseases, and usually diseases that pose a great short-term threat to countries, such as HIV/AIDs[4].

There is a host of positive outcomes from these types of funding initiatives, sometimes referred to as "mass campaigns", as they can bring attention, funding, and services to disease prevention very quickly[5]. However, there has been argument for quite some time that international funding for health is not focusing enough on strengthening health systems overall, but rather targeting single-purpose issues[6]. In addition, there is also a large body of evidence supporting the argument that GHI style funding has created a wide array of negative outcomes for the populations they are trying to serve[7].

In most cases, it is clear that the underlying cultural and social determinants of health in developing countries are neglected by GHIs and governments, leading to little investment in long-term changes[8]. There are several theories, explanations, and accounts of convincing evidence as to why this is and has been the case for over fifty years. Especially in the last few decades, the international political system and the global economy undoubtedly play a major role in deciding where and to which health issues donor funds are invested[9]. Unsurprisingly, the true needs of the populations receiving this "care" are often not acknowledged or met, and some developing nations are still left in crippling conditions without a stronger healthcare sys-

tem[10]. For example, rates of malnourishment among children and women in India remain at extremely high rates, despite their booming economic growth. There are a multitude of contributing factors at play in this particular case, but the research available generally seems to point toward a two-fold dilemma: the asymmetrical approach the international community has taken toward global health funding coupled with the domestic intersections between gender discrimination and poorly targeted spending programs, resulting in the stagnating rates of child and maternal malnourishment in India.

This paper aims to shed light on how and why international health funding trends can create debilitating outcomes for developing nations. It also explores the reasons why this trend exists in the context of international relations. First, the history surrounding the evolution of GHIs will be examined, along with a discussion of the extensive variables that are involved in global health research. Additionally, the financing trends will be assessed, along with an overview of the positive and negative effects of those trends. And lastly, the explanations and theories surrounding the trends and effects of GHI funding will be discussed and examined further in the case for malnourishment in India.

The Rise of GHIs

The era of neoliberal globalization in the late 1980s, gaining speed in the 1990s, gave rise to the weakening position of the state in international affairs and the growing position of other international actors[11]. The state's position shifted in the political hierarchy vis-a-vis other actors for various reasons, such as more establishments of decentralized partnerships with non-governmental organizations (NGOs), increased power of finance and trade agencies, and the elevated authority of international organizations. International authority disaggregated, resulting in powerful businesses, institutions, NGOs, and multinational companies involved and very influential in international debates and decisions[12]. This change in agency had heavy implications for debates and decisions on issues of international health. Globalization essentially gave way for "the new global health architecture" where new voices, other than states, were at the table[13].

The World Health Organization (WHO),

established in 1948 as a specialized agency of the United Nations, retained the clear authority up until the late 1980s- early 1990s on directing and coordinating issues of international public health[14]. However, the new architecture shifted this authority, or divided it, among public-private partnerships, private foundations, and NGOs involved in healthcare[15]. These partnerships, foundations, and organizations have now come to be known under the term "Global Health Initiatives" (GHIs) because they are characterized by the WHO as having a general set of common features including, "a focus on specific diseases or selected interventions, commodities, or services; relevance to several countries; ability to generate substantial funding; inputs linked to performance; and their direct investment in countries, including partnerships with NGOs and civil society"[16]. A few of the major GHIs are The Global Fund to Fight HIV/AIDS, Malaria, and Tuberculosis (Global Fund), The US President's Emergency Plan for AIDS Relief (PEPFAR), The Global Alliance for Vaccines and Immunizations (GAVI), the World Bank Multi-Country AIDS Program (MAP), and the Bill & Melinda Gates Foundation (BMGF). The US Agency for International Development (USAID) and the UNAIDS program have also been included in the overall GHI grouping because of their similar funding and delivery techniques.

Most GHIs started popping up after the year 2000, largely in response to the United Nations establishment of the Millennium Development Goals (MDGs)[17]. The MDGs essentially arose in response to how the HIV/AIDS epidemic grew as a consequence of, and then further damaged, already weak and overstretched health systems in the developing world. These weak healthcare systems struggled in large part due to the 1980s economic crises, debt repayment, poor governance, civil unrest, and structural adjustment policies that ended up, in many cases, cutting funds for public health spending in the name of improving fragile economies. The globalization of labor markets also incited health workers to leave their native developing countries for jobs abroad, further weakening their healthcare systems[18]. Following the period of international financial structural adjustment policies, global health was viewed more as a new global market, largely by the World Bank, rather than a global right for all people[19].

A new voluntary funding approach for these

GHIs emerged, whereas funding from governments to the WHO is both mandatory and voluntary[20]. The WHO began to receive less funding from developed nations as these governments started to funnel more money into GHIs, primarily the Global Fund[21]. For example, as of 2006 the United States, which is the largest donor country for health aid, donates on average three times more to the Global Fund than to the WHO. In 2010 alone, the US donated $387 million to the WHO and $1,050 million to the Global Fund[22]. The Global Fund and other major GHIs have kept the primary focus of their efforts on diseases and health issues of most interest to the international community, and largely the wealthy international community. International donors have been giving money to health issues gaining the most press and attention and usually opt for very direct, or "vertical", service delivery methods[23]. These methods of funding and intervention have sparked recent curiosity, research, and debate among scholars, doctors, healthcare workers and just about everyone involved in health systems over whether or not these "vertical" approaches are the most effective. These major GHIs have massive sums of money that are all going toward immediate and important health issues. Yet, for many developing countries some of these targeted issues continue to resurface and extreme levels of poverty and health disparity still exist[24]. This dilemma begs numerous questions; to where and to whom are these funds going? How are they being used? How effective are these methods? Why are the funds being granted or allotted in this way? The next several sections explore these questions further, before providing a more in depth look at a specific case of maternal health and child malnourishment in India.

Variables

Before beginning further discussion on the effects of GHIs, it is necessary to acknowledge the countless variables involved. Health systems are very complex and there are endless factors that contribute to and affect health systems differently from community to community, state to state. There are social, cultural, economic, geographical, political, etc. determinants of health that vary depending on every disease, issue, or aspect of healthcare delivery in every area of the world. It is very difficult to generalize findings for global health studies for this

reason. For example, there are certain approaches to funding and care that work well for a disease in one country, but terribly for that same disease in another[25]. Thus, arguments for ruling out a method of care or funding completely are rather difficult to substantiate. It is also important to remember that the largest GHIs have only been around for a little over ten years, making it difficult to show considerable effects just yet. In addition, most of these GHIs did not establish arrangements for prospective assessment of their effects on countries, and the scientific community has been slow to formulate research methods for these complex interactions[26].

Compounding these problems is the fact that even the most comprehensive and thorough research studies on healthcare and health systems admit to weak and inconclusive findings in the data or trends. This is due to several reasons, a few being the lack of a commonly agreed upon analytical framework, absence of empirical evidence, and the ambiguity associated with what exactly defines a positive or negative outcome of a health intervention or funding mechanism[27]. For example, it is often difficult to link a single health intervention to the increasing rate of healthy people/decreasing rate of people with a particular disease. There could be a handful of other contributing factors at play that are underlying reasons for why an intervention is "working", such as improved economic status, housing, nutrition, a healthier work environment, etc. Almost every source examined for this paper mentioned these barriers and variables, and called for more robust studies to be done. There is unquestionably a shortage of epidemiologists and researchers, both native and foreign, working in developing countries[28]. Thus, it is important to acknowledge that the nature of the data on health in the developing world may not always be entirely accurate.

The same can be said for GHIs and governments of the developed world, who have not always provided the most transparent data concerning their financial movements[29]. Overall, little attention has been given to analysis of global health financing, and systematically tracking money flows for health initiatives has proven difficult across the board[30]. For example, some GHIs and donors make detailed breakdowns of which organizations receive their funding publicly available, while others do not. There are often large information gaps between the rhetoric of

transparency and actual accountability[31]. Countless other factors exist that make it extremely difficult to follow money flows, including the very basic notion of what exactly counts as "health dollars", or money towards health-related issues[32].

It is important to keep all these things in mind when moving forward into the paper. Not every factor, variable, reference, or data account that I researched is included in this paper, nor did every variable present itself in the research I covered. However, I did cover a substantial amount and wide variety of reputable sources that I feel confident in drawing certain trends from. I cannot safely make sweeping generalizations about the findings; the hard data just does not exist yet. But I can confidently point to the explanations and trends I believe are most compelling based on the evidence and research I have done.

Financing

In order to evaluate trends of GHI funding, I have read through research studies on the nature of GHIs and international funding for health, along with numerous reports and data provided by the WHO, the Global Fund, Partners in Health, and the BMGF. Many of the research studies and reports I examined were by collaborative groups of epidemiologists, economists, health professionals, paid researchers, and a variety of academics. These groups took the painstaking process of gathering, analyzing, and compiling the credible health and finance data available. By examining numerous of these reports and studies, I was able to get a good sense of some overall findings in international financing trends toward global health issues.

Of the reports I examined, the most comprehensive one that serves as a foundation for this specific research focus is the WHO Maximizing Positive Synergies Collaborative Group's initial study on GHI effects in 2009 titled, "An assessment of the interactions between global health initiatives and country health systems". This study looks at the overall relationship between GHIs and country health systems by examining five key points of interaction that contribute to the success or failure of the delivery of health services. These five key points are governance, finance, health workforce, health information systems, and supply management systems[33]. The WHO acknowledges that a country's health

system is not just an assessment of its health service delivery, but "all organizations, people, and actions whose primary intent is to promote, restore, or maintain health"[34]. However, because GHIs are primarily concerned with the effort to "finance the delivery of specific types of services for priority health problems that arise in many low-income countries", it is best to look for how those efforts interact with the WHO defined key functions of a health system for the ultimate purpose of health service delivery. This approach serves as a solid framework for which to compare and analyze other findings.

Overall, this report along with several others by the WHO generally conclude that GHIs need to turn their focus more toward strengthening health systems rather than single-purpose interventions[35]. It has been unanimously agreed upon that although funding for many single-purpose interventions has brought significant positive outcomes for global health issues, they are not without their negative ramifications due to a lack of supplemental funding to strengthen the health systems.

Since the early 1990s, funds for health and development assistance have dramatically increased, setting unprecedented records. From 1990-2007 alone, funding quadrupled globally from $5.6 billion to $21.8 billion[36]. Particularly following 2001, the US Government became the largest donor of public health assistance[37]. Reports that track the financing of GHIs and health related government spending from major developed countries reveal that a vast majority of funds go to single-purpose "mass campaigns" for service delivery[38]. Single-purpose interventions, or "mass campaigns", are generally large-scale operations where money is funneled for a service that prevents or treats a specific disease[39]. This can manifest in a variety of ways. For example, funding can go solely to providing a vaccine or immunization, mosquito bed nets for protection against Malaria, or antiretroviral drugs (ARVs) for HIV/AIDS[40].

Two assessments of financial tracking in particular, one created by Oxford University and granted by the BMGF, the other by Harvard University and University of Washington, reveal the most useful data and analysis. These reports both found that a very small portion of funding from large donors, particularly the World Bank, the Global Fund, and the US Government-PEPFAR, go towards investing in gen-

eral health-sector support and strengthening for developing countries[41]. As of 2008, these three donors together issued more than 98 percent of their funds to service delivery (immediate preventative measure or treatment, such as vaccines, mosquito nets, ARVs, etc.)[42]. This is not to say that these donors and GHIs are not discussing the importance of and investing large sums of money in health systems, but compared to the amounts invested in service delivery, it is very minimal[43]. These reports indicate that each donor and GHI is unique in its areas of focus, and some place higher priority than others on funding healthcare infrastructure development as well as the health issues that stem from poor healthcare infrastructure, such as malnourishment, maternal health, primary care, etc.[44]. However, between all donated health aid collectively there is unequal funding for direct health service delivery over health systems strengthening[45].

The services required for treatment and prevention of HIV/AIDS, malaria, and tuberculosis account for most of the international development assistance, HIV/AIDS in particular[46]. Although these three diseases are given the most funding, it is important to note that funding for other heath issues has also generally increased since the 1990s-early 2000s, and resources established for those issues have not been reallocated for HIV/AIDS, malaria, and tuberculosis[47]. However, the proportional differences in funding for these three diseases over health concerns such as tropical diseases, communicable and parasitic infections, maternal health care, and child nutrition seem to suggest that there is a considerable amount of neglect[48]. This notion is also reinforced by the fact that there has been call for more investment in primary care and diseases that are pervasive in developing countries for over fifty years, yet circumstances have not significantly changed[49].

To further explain the argument for more investment in these "neglected diseases" and overall health systems, it is necessary to explain the common outcomes and effects of recent funding trends by GHIs and international donors. By examining a handful of studies and examples of where, to whom, and to what the funding goes to, the reasons why these trends are in need of a shift become clear.

Effects of GHI Funding: Positives and Negatives

The bulk of the studies and reports I examined not only discuss the changes in international health financing from a little over a decade ago, but also why these changes are problematic. The majority of the studies are primary source research accounts, case reports, and both cross-sectional and longitudinal studies that help to extrapolate broader findings. The overwhelming majority suggests a general agreement that there are both positive and negative outcomes from international health aid.

How funding is provided, the amount of funding donated, the interactions with domestic budget allocations, the aid effectiveness, and out-of-pocket payments from the population or service users are just a handful of the major factors that affect performance of health aid and health systems[50]. There is evidence of an initial concern that many of the large GHIs and international donors do not align their efforts with countries' national interests[51]. It appears that each donor and GHI choose their own health aid priorities without explicitly incorporating domestic needs and demands by governments and citizens of benefitting countries[52]. There is little account of country "ownership", where a country will exercise their own effective leadership to coordinate aid delivery strategies[53]. Although some GHIs have stated mechanisms to help incorporate domestic ownership throughout the process of their donations or grants, it is very unclear how much priority these mechanisms take and little is known about their follow-through[54]. Developing countries often stress the need for most donated funds to go toward a particular area of focus in their national strategic development plans, and in practice a majority of donor funds go alternatively to service delivery for a specific disease[55]. For example, Cambodia's national health priorities in 2003-2005 stressed a need for resources to go to primary health care, but over 60% of donor funding was allocated for HIV/AIDS and other infectious diseases[56]. This is reported to happen frequently, one reason being that donor funding tends to have restrictions on what the funds can go towards. In addition, governments and health ministries receiving donor funds often have limited awareness of these restrictions and what certain funds are allowed for, creating confusion between local and national healthcare providers[57].

Because GHIs and international donors primarily set their own priorities of spending, regulation, and implementation, they often create uncoordinated parallel funding structures[58]. The Global Fund, GAVI, and the World Bank MAP alone all have different mechanisms for health system engagement with other countries, and because coordination is rare between these GHIs, there ends up being multiple funding streams and applications for the same services[59]. The poor alignment of these engagement mechanisms creates a weakened supply management system for services in many developing countries[60]. For example, there are several studies following the distribution of medications in a few African countries that show the downfalls of a lack of coordination among multiple GHIs. The effects include commodities being under-stocked or over-stocked in regions, poor storage management due to lack of space/infrastructure, waste of products through expiry, and a shortage of human resources to manage and deliver the drugs and commodities[61]. The supply management systems often undermine the already existing supply and delivery systems the country has in place. Instead of strengthening the existing systems, the GHIs weaken them with too many of their own systems and their own labor force. If no supplemental investment exists in the governance of health systems, the delivery and distribution of donated resources to local communities will undoubtedly suffer[62].

An example of this can be seen in Angola between 2002 and 2007, where there was expressed concern with the ability to cope with the complexity of the countless funding structures. The Ministry of Health reported that, "MAP (World Bank) channeled funds through the Ministry of Planning rather than the Ministry of Health, the usual channel, and the Global Fund donated through the United Nations Development Programme, UNDP. PEPFAR, on the other hand, chose to channel its funds outside the public sector, mainly through international (often US-based) NGOs,"[63].

The WHO Commission on Social Determinants of Health in 2008 defined the problem well by saying, "there is... a danger that large new funding lines, running parallel to national budgeting, continue to distort national priorities for allocation of expenditure and action... While Global Health Initiatives have brought enormous new levels of funding to health-care systems within low and middle-income countries, there is a concern that their vertically managed programs have the potential to undermine the population health orientation of health-care systems and as a result exacerbate health inequity"[64]. The commission also raised concerns about the growing dependence that some developing countries were showing toward external funding[65]. There is reason to suggest some countries, mainly in Sub-Saharan Africa, have lowered their domestic health funding due to the increase in external resources for health[66]. In addition, health ministries in Kenya, Tanzania, and Uganda to name a few, have reported that around 40-60% of their budgets come from external donors[67]. The increased role of civil society is another noteworthy discussion, particularly GHI funded NGOs in developing countries as new actors of health care delivery. GHIs have been quick to fund the emergence of now hundreds of NGOs for health and humanitarian aid[68]. Although there are propitious outcomes from the rise of some strong, influential NGOs, there are also negative outcomes for domestic capacity building, or the overall strengthening of human and societal resources. For example, NGOs are now added to the mix of agencies, GHIs, and recipient governments who are competing for donor funds[69]. It is arguable that the new competitive nature of healthcare financing draws attention away from health systems strengthening. NGOs and GHIs also tend to miss the mark when it comes to providing free commodities and services by using their own workforce. Instead of helping the domestic economy and workforce, NGOs and GHIs often provide services that run domestic business out and neglect the capable native workforce[70].

Now even though GHIs can have damaging effects, they have still made substantial positive strides forward. GHIs and the NGOs they fund have proven to increase involvement of civil society in partnership with government programs, advocate for better governance, bring much needed vaccines and immunizations to marginalized groups, lower the cost of ARVs for HIV/AIDS, and bring attention to global diseases and health that has never been seen before[71].

GHIs have contributed to the tackling of diseases previously thought to be "untreatable", prompted more scholarly work and research on global health, and supported advancement in academic medicine, science, and innovative technologies[72]. It is clear that when epidemics hit countries, there is

a need for immediate mobilization of resources to address the disease. This is when GHIs are most efficient, using vertical delivery strategies to get needed services to the suffering populations fast. GHIs have, in a large part, been responsible for major reductions in the spread of epidemic diseases, especially HIV/AIDS, SARS, and Ebola[73].

The points and examples discussed above are some of the major outcomes of GHI funding. There are undoubtedly more examples of beneficial and detrimental outcomes and factors to consider. However, the overall point is that GHI funding is only addressing half of the problem. The international community largely discounts the underlying determinants of health disparities. Without attention, the diseases GHIs are targeting have the potential to resurface, and the diseases they are neglecting will continue to eat away at the fabric of developing nations[74]. Education, health information systems, community health worker training and retention, cultural stigma, maternal and primary health care, sanitation, regulatory frameworks, and gender equality are just some examples of the neglected areas of focus from the international community[75]. Investing in these equates to investing in the long-term sustainability of a health system that can hopefully one day handle domestic health problems on its own. The goal is never to endlessly fund developing countries, something many NGOs and donor agencies seem to forget when their livelihoods depend, in part, on people remaining sick and oppressed[76]. In order to see funds for health aid decrease and positive results increase, a more sustainable financing trend is needed.

Explanations and Theories

So why do GHIs and the international community fund healthcare this way? Why is attention given to short-term service delivery for threatening epidemic diseases and not for long-term health systems investment? There are a few possible explanations and theories to help answer this question. However, what is interesting to note first is that the plea for more funding to health systems strengthening, or more "horizontal" approaches, is not a new plea, but one that has existed for over fifty years. Yet, there seems to be little incentive for the international community to balance out their funding methods.

For at least the lifetime of the WHO, since 1948, there has been debate over "vertical" and "horizontal" programs for healthcare. The Director General of the WHO stated in the Annual Report for 1951 that, "more authorities are becoming aware that many campaigns for the eradication of diseases will have only temporary effects if they are not followed by the establishment of permanent health services in those areas, to deal with day-to-day work in the control and prevention of disease and the promotion of health"[77]. In 1965, C.L. Gonzalez provided one of the first comprehensive studies on this debate that was published as a Public Health Paper by the WHO. He argued that horizontal approaches and mass campaigns, or vertical approaches to tackling a disease, should not be mutually exclusive, but be implemented simultaneously[78]. His findings and suggestions have been replicated time and again over the next fifty years yet little has been done for long-term health systems strengthening to help maintain the achievements of the vertical approaches[79].

There have been a couple clear changes in the nature of the debate over the past fifty years. One of them surfaced in the 1980s when trends in services for general health turned to focus on, "a limited set or package of cost-effective interventions"[80]. Macroeconomics became a more central focus of heath intervention programs, with more stress put on the economic benefits of disease control. Thus, vertical approaches of disease "eradication" were prioritized for their cost-effectiveness, as this was also more attractive to donors[81]. Short-term vertical programs promise more economic benefits of disease eradication with a time-limited commitment[82]. Horizontal approaches, or the investment in general health services, require considerable financial, logistical, and organizational support because of the complex nature of the system. Investing in the countless areas that contribute to an improved health sector appears less attractive and risky to donors, and is also difficult to implement in an already weak health system[83]. However, this view is also a result of programs being designed with poor and inadequate descriptions of cost implications. Many vertical programs chosen 20 years ago had little evidence of relative costs for different strategies of health interventions; the epidemiological data was not strong enough. Looking in retrospect, many horizontal programs that could have been integrated were not actually that much more expensive than their vertical counterparts[83].

Global markets and macroeconomics undeniably play a role in healthcare funding decisions from international donors. This explanation takes a more Marxist approach, where dependency theory and the world economy are argued to be the ultimate reasons for why there is health disparity. Dependency theory, in short, is the idea that resources flow from a "periphery" of poor, underdeveloped states to a "core" of wealthy, developed states. The poor, underdeveloped states remain weak and at a disadvantage as they continue to modernize, with developed states unfairly integrating them into the global economy. However, you do not need to be a dependency theorist to point out the major critiques surrounding the way global markets view demand for health services and commodities[85]. Paul Farmer, physician and American anthropologist, expresses long-standing qualms with the inequities of global healthcare and the relationship with markets. He frequently states that, "above all, we fail to bring new deliverables to people who need them most because demand is constructed largely around the notion of markets. There are too few equity plans to link demand to burden of disease. When treatments are easily administered, convenient, and likely to result in cure or excellent clinical response, there will be great demand for them,"[86]. The problem for Farmer is that there has not been enough investment in "robust delivery platforms" for developing countries to meet the demand of new therapeutic agents[87]. Without these delivery mechanisms, international donors do not legitimize the demand. For dependency theorists, the problem of needing better delivery systems stems from the way the developed world has constructed the global economy. With resources from their spheres of influence, the developed world was able to build strong health systems and eradicate the diseases within their borders that are sadly still afflicting the developing world. The vast health disparity we see today originates from the global north's exploitation of resources in developing countries, crippling those economies and consequentially their health systems and abilities to fight off diseases. Therefore, dependency theorists will argue to invest in the growth of economies, and better health outcomes for developing countries will be seen as a result. Although this claim holds considerable merit, there are convincing counterarguments to this theory.

Along similar lines as Farmer and calling for a change in current investments in development and aid is Jeffrey Sachs, an American economist and world expert on economic development. He makes compelling arguments for an increased focus on economic growth for poverty reduction in his report for the WHO titled Macroeconomics and Health: Investing in Health for Economic Development. Sachs discusses the powerful linkages to improved health and longevity that result from allowing developing countries a stronger foothold into global markets, investment in poverty reduction, and long-term economic development[88]. In many cases, international donors, who align more with dependency theory perhaps, allocate funds under the assumption that health problems will take care of themselves if economic growth improves. Sachs believes this to be false, saying that, "the disease burden itself will slow the economic growth that is presumed to solve the health problems; second, economic growth is indeed important, but is very far from enough. Health indicators vary widely for the same income level,"[89]. He also makes the case against donors who refuse to invest in strengthening health systems where government corruption exists. Although corruption is indeed a reason why some interventions do not meet the world's poor, the more basic problem is that, "the poor lack the financial resources to obtain coverage of these essential interventions, as do their governments,"[90]. Along with Farmer, he stresses the need for modifying health service delivery and the access the world's poorest areas have to helpful interventions.

Fluctuating donor priorities and donor funds is another reason why it is difficult for developing countries and NGOs to pin down long-term health systems funding. Fluctuations are driven by a number of factors, some having to do with global economic markets, but most related to geo-politics and national strategic considerations[91]. For example, a more open political environment has often led to increases in civil-society investment from foreign donors and governments. After the fall of the Marcos regime in the Philippines in 1986, the country saw a dramatic rise of foreign investment in NGOs as democratic world leaders sought to embrace the shift in Pilipino governance[92]. These considerations bring us to another clear change in the nature of vertical versus horizontal health program debates; the shifts

in foreign policy and securitization.

Globalization has not only altered the landscape of international health actors, but it has also contributed to the shift in roles foreign policy and securitization play in regards to global health aid and funding decisions. The rise of liberal institutionalism as a theory for international relations, and an alternative to realism, gives an interesting context to this altered landscape. Liberal institutionalism is founded upon the idea that international institutions and organizations can aid in cooperation between states and directly impact and influence world politics. It rejects the realist view that international politics is a continuous struggle for power and security issues are always a top priority. Liberal institutionalism can offer explanations for the positive outcomes of the explosion of international health actors and donors, as well as the strong influence these actors have had on fighting global diseases. For example, the Global Fund was born from the idea that states do not have to be the only arbiters of global health issues, and international organizations may be able to facilitate aid better[93]. They have shown to be a rival of the WHO, representing the shift in approaches from sovereignty and rights-based solutions to ownership and merit-based solutions[94]. Although liberal institutionalism can offer an explanation for the positive coordination strategies by the international donors, it fails to offer a strong explanation for the influence of security and foreign policy on global health outcomes that I will continue to discuss next.

Since the late 1980s, it has become clearer that international factors have just as much influence on deliveries of health care as local and national factors[95]. When there are very different trends of the same disease in countries with similar health care structures, it begs questioning how international relations might be responsible for these effects. To explore this situation further, it is important to first discuss the evolution of health as a security issue.

Securitization of health is rooted as far back as 430 BC, as plagues and epidemics have aided in the collapse of great empires and societies[96]. Thucydides's account of the fall of Athens from plague during the Peloponnesian War, the collapse of the Byzantine Roman Empire from the "plague of Justinian", or the bubonic plague of Europe in the fourteenth and fifteenth centuries are just a few examples of how disease has altered the course of human soci-

eties for centuries[97]. The ability diseases and pathogens have to dismantle a society has been proven throughout history, but strategies and approaches in light of this knowledge have fluctuated and evolved to some extent.

In the era of globalization, securitizing health gained new speed. The new global network expedites the spread of disease from country to country, instilling fear in the developed world of the difficulties in preventing a disease invasion. Endemic diseases of a state along with epidemics have the ability to keep states in the troughs of poverty, unravel the fabrics of a secure society, and make states vulnerable to foreign invasion[98]. HIV/AIDS sparked heightened fears of this vulnerability becoming a reality in the US, but the ultimate turning point came from the terrorist attacks of September 11th, 2001[99]. These two events in particular led the developed world to make global health issues a higher priority in discussions of national security. Funding trends and intervention programs from the international community, especially the US, have since followed priorities of foreign policy over the provision of healthcare as a human right[100].

The more "globalist" view, or view that health is a human right and should be prioritized that way, is concerned with the seemingly more prominent "statist" view where health and security are the first and foremost considerations at the state level[101]. Globalists will argue that, "emphasizing securitization as a solution to health crises can potentially divert attention away from the most deadly diseases and their causes by drawing attention to only those problems that have 'headline-grabbing' quality"[102]. It is fair to say that increased focused has been placed on selected infections that have potential to move from the developing to the developed world, such as SARS, West Nile virus, Ebola, and monkey pox[103]. It is therefore unlikely that securitization will be a "vehicle for promoting a focus on long-term prevention and capacity-building" because securitization inherently assumes an imminent threat or sense of emergency[104]. This, in turn, has historically shown to have implications for international donor, GHI, and US Government funding and the areas they choose to focus on.

The rhetoric around global health, especially coming from the US Government in the late 1990s, started to change and encompass more aspects than

simply tackling disease in developing countries. For example, the Bush Administration in 2002 began to include health as a necessity for the infrastructure of democracies, claiming health to be a "bridge for peace"[105]. Since the Cold War, the US has maintained a democratization agenda for states of strategic importance, with internal instability and failed states remaining high on the agenda well into the 1990s[106]. Although these are still vital concerns for US foreign policy, the "war on terror" following 9/11 and rhetoric from the Bush Administration's 2002 National Security Strategy make it clear that involvement in insecure states is much more connected to potential terrorist links within that state than it is with improving the states' health care systems[107]. The fear that weak states with ungoverned regions provide possible havens for terrorist groups brings more attention to developing nations in Africa and South Asia. Using this rationale, if these nations are aided in development and governance strengthening, the fear of security threats manifesting in these areas will lessen.

Development aid, and health aid especially, has become more politicized by developed countries as being central to state strengthening. There is a growing body of evidence that suggests recent health initiatives in certain countries are also initiatives for building state stability[108]. For example, USAID's closer connection to the State Department and increased incorporation of short-term state security objectives in development plans has raised suspicions of becoming more of a quasi-security agency in some places[109]. In Kenya specifically, USAID has offered training programs to bolster the police force and counter-terrorism units in the name of country development[110]. In a 2005 report on African missions, USAID commented that, "the overarching goals of US policy in Africa seek to enhance African capacity to fight terrorism and create favorable conditions for US and African trade and business opportunities, while developing the foundation for sustained growth…"[111]. USAID has been referenced to have similar objectives in other countries of strategic importance, raising concerns that the agency is blurring the boundaries between security and development. The outcomes of these initiatives have put them and the US Government under more suspicion and scrutiny when it comes to long-term development goals, which are arguably being sacrificed for short-term

state security objectives[112].

There are other similar examples of the US Government, other developed nations, bilateral and multilateral donors, and private foundations switching funding and initiative priorities between countries for reasons suggesting strategic importance. In Asia, many donors following 2001 increased funding to Muslim countries, such as Indonesia, which led to declines in funding for other countries, such as India[113]. Other compelling examples include international sanctions denying medical aid as well as evidence suggesting financial aid being used to keep certain corrupt leaders in power for the sake of security[114]. Overall, it is clear that when it comes to international relations and questions of security, health and human rights of less developed countries remain a lower priority.

Framing health as a security issue has been a major concern in the field of global health because of its potential for negative outcomes in struggling developing countries. It is worth considering realism as an explanation to why international funding for health has neglected endemic diseases and underlying determinants of health in favor of diseases of high attention and alert to the developed world. The evidence in reports and articles surrounding these questions seems to suggest a realist theory, where developed countries, GHIs, and international donors generally allot more attention and money to diseases that pose a greater risk to the populations and economies of the global rich[115]. By framing certain health issues as threats to the wellbeing and economic status of developed countries, it is not surprising to assume that those issues would take the most funding given the priorities the international community has always created for domestic economic growth and security.

To shed more light on the competing perspectives on how economic forces and the interests of the international community shape global health funding and outcomes for the developing world, it is useful to examine a particular case. In the next section, I will use child and maternal malnourishment in India to demonstrate how international funding trends play a role in the progress India has made to address a basic but endemic health problem. Applying the knowledge and explanations discussed above to this situation truly illuminates the drastic disparities in global health and the neglect from international and national funding mechanisms. Looking at this problem in

the context of Marxist dependency theory, liberal institutionalism, and realism also helps to explicate why this issue exists and the complex interactions between the multiple perspectives.

The Case for Malnourishment in India

India has often been referred to as an enigma when it comes to child and maternal nutrition. With all the economic growth the country has experienced in two decades, India still has one of, if not the, worst rates of child and maternal malnourishment in the world[116]. In the past two decades, India has experienced a growth rate of approximately 7%, and is now classified as a newly industrialized country in the G-20 with a continually developing economy. India's rapidly growing economy and integration into global markets has made it the "bright spot" in the global landscape, as it has surpassed growth predictions and still maintains positive future outlooks. However, despite the fact that the country has a thriving economy and the quality of living for the middle class has risen, 42% of children under the age of five are underweight[117].

Good nutrition is an extremely important foundation for overall development and health, allowing for healthy brain development and immune system resilience. Without good nutrition and essential micronutrients from infancy, children are at high risk for contracting diseases and infections even into adulthood, and cannot thrive and perform at their highest potentials[118]. Micronutrient deficiencies and malnourishment take shape in many forms and can exist in countries, such as several in South Asia, where the food supply is adequate when it comes to meeting daily energy needs but severely lacking in one or more essential nutrients[119]. There is no doubt that good nutrition and strong child development is essential to cultivating a healthy population, workforce, and society.

Health researchers and medical professionals who have studied child nutrition and poverty in India over the past thirty years state that conditions generally have not changed for the country's poor and malnourished children and mothers, and they do not look to be changing anytime soon[120]. The New York Times has been covering healthcare and nutrition in India for several decades, and one particular article reveals that although India has moved to a "lower middle income" country from a "low income" one, activists point out that, "it continues to be a country of rampant poverty and vast inequities121. Despite two decades of growth, over 400 million people in India live on less than $1.25 a day, and the country's malnutrition figures are among the worst in the world. India has had some success with its welfare programs, but it spends only 0.9 percent of gross domestic product on health care, among the lowest in the world, and 3 percent on education,"[122].

South Asia and Sub-Saharan Africa account for the highest rates of child stunting, wasting, and malnourishment. South Asia also has the highest records of maternal undernutrition, which recent evidence strongly suggests has a correlation to child mortality[123]. Statistically speaking, South Asia and particularly children of South Asia should be better off than Sub Saharan Africa according to Millennium Development Goal indicators, the International Food Policy Research Institute, and other global research reports[124]. Despite being ahead of Sub Saharan Africa in other determinants of nutritional status, such as national income, democracy, food supplies, health services, and education, South Asia still remains the leader in nutritional deficiencies[125]. India in particular has the worst rates, where nearly a third of its people suffer from hunger and malnutrition[126].

Amartya Sen, a prominent Indian economist, has made countless contributions to maternal and child health research, as well as studies on welfare economics of India at large, for which he won a Nobel Memorial Prize. In various studies and articles, Sen draws a link between gender inequality in India and childhood malnourishment in one causal chain[127]. In short, the chain starts with gender inequality, which then leads to maternal undernutrition. Mothers who are undernourished are more likely to give birth to babies of low weight, which is associated with a high rate of child malnutrition and later in life, adult ailments either directly or indirectly related to malnutrition[128].

Gender inequality and maternal health has been a concern in India for a very long time, where the country is responsible for nearly a quarter of global maternal deaths[129]. Women in India make up "the most deprived and long neglected segment of the society, despite the constitutional guarantee for equal rights and privileges for men and women"[130]. Women are victims of socio-economic, political, and

cultural discrimination as a result of colonial domination and societal conditions[131]. They have rights and freedoms constitutionally, yet are still fighting against structural barriers such as, "dowry, female infanticide, sex selective abortions, trafficking, sexual harassment, domestic violence, and gender, health, and education disparities"[132]. Poor, rural women in India are particularly marginalized, especially when it comes to healthcare. The Indian Government as well as international donors has neglected direct investment in maternal health for decades. However, even investments in service improvement and availability are often offset by countless social and cultural obstacles such as lack of information about care, high direct and indirect costs, transportation to care facilities, impacts of status and caste, allocation of familial resources for women's health and decision making, and cultural norms favoring home births[133]. Primary and comprehensive health care has been shown to be particularly beneficial for women and mothers, yet is underfunded over disease control[134].

Additionally, funding agencies tend to unintentionally create competition between maternal and infant child health and between skilled facility-based care and community care[135]. Hospitals and facility-based care are commonly starved of resources in India, generating a large number of problems for women and children in particular[136]. Health professionals are often underpaid and in order to manage public facilities and stay afloat financially, tend to introduce a commercial rationale to service delivery that will hopefully maximize income[137]. Public-private partnerships for healthcare may have good intentions for contracting out better care, but have had limited impact on maternal health outcomes in India. There is a trend of well-funded, private hospitals popping up in more urban settings in India that are too expensive for large populations and will reject care outright. The poorly funded public hospitals that exist in more rural and suburban settings, or "peripheral" hospitals, lack the equipment and expertise to handle certain issues of maternal and primary health care, and tend to be flooded with disease control resources[138]. They are also too far away from better hospitals, and the travel time it takes to access better care is the cause of many child deaths in India[139].

There is also a problem with the training of health professionals that exists not only in India but also across the entire developing world. Health professional training initiatives in developing countries have historically been focused on a small set of diseases with poor alignment to local priorities[140]. Community health workers are often very capable of being trained in comprehensive primary care and possess the skills to manage a range of health issues. However, the approach remains on fast, efficient training initiatives for specific diseases rather than arming health workers with a broad scope of healthcare knowledge[141]. Additionally, donor-funding restrictions often prohibit the expansion of expertise to primary care[142]. There are limited resources for training health workers on issues in maternal and child health, greatly impacting the availability of care with a short supply of health workers in the first place[143].

The effects of the chain between gender discrimination and childhood malnourishment are pervasive and damaging. Not only does gender bias represent social failures and start the malnourishment chain, but it also increases the mortality rates of women and children, contributes to high fertility rates, and limits economic growth and political participation[144]. In sum, the neglect and disrespect of women has widespread deleterious effects on everyone in India. Until women are considered equal and given a higher sociocultural status, Sen argues India will continually struggle to improve its major health problems[145]. It is obvious that the issue of maternal health and child nutrition in India is definitely a result of gender discrimination and poor funding within India. However, the research also suggests that neglect in investment from the international community of health donors is a contributing factor.

GHIs and international donors unsurprisingly do not have the best track record when it comes to investments in maternal and child health and nutrition[146]. A report series published in the Lancet in 2008 on maternal and child undernutrition takes a comprehensive look at effective international action on the issue and the difficulties encountered so far. Primarily funded by the BMGF, the Study Group on Maternal and Child Undernutrition reveals in the series that, "the funding provided by international donors to combat undernutrition is grossly insufficient and poorly targeted, and is inappropriately dominated by food aid and supply-led technical assistance,"[147]. I have already discussed earlier in the paper how GHIs and international donors have focused their funding

toward short-term disease control programs. In India, support for long-term health systems strengthening remains low, where in lies the problem of maternal and child malnourishment[148].

GHIs and international donors have, at best, been able to mobilize resources that support country-level initiatives for nutrition. However, there is once again the problem of uncoordinated action with multiple organizations and programs striving toward similar goals but competing for the same scarce financial and human resources[149]. Humanitarian food aid and emergency food aid have been a principal outlet for nutrition funding from the international community, yet have not made significant progress towards stabilizing sustainable food availability for recipient countries[150]. In addition, food aid has been seen to facilitate poorly targeted consumer food subsidies once in the recipient economy[151].

Additionally, British aid to India has been dropping dramatically in recent years. This, in part, is due to the fact that India has become a middle-income economy that is able to and has been donating aid funds to lower-income countries[152]. Because India, by sheer numbers, should have the money to take care of its undernutrition issue, larger donor countries have been less willing to give aid in the past 5-10 years[153]. When India decides to spend millions building one hundred new ships for its navy over the next decade, it is difficult to rationalize giving the country health aid donations[154]. This relates to the domestic issues of spending and funding that, similar to international trends, have neglected health systems development and investment in child and maternal care.

India has the largest child-feeding program in the world, with a budget of $1.3 billion a year[155]. However, the problem does not exist with the funds but in distribution, allocation, and overall weak health systems. The programs, particularly India's primary one called the Integrated Child Development Services program, are essentially a network of soup kitchens in urban and rural slums[156]. Experts who have studied the government feeding programs agree that they are "inadequately designed" and have done next to nothing for children in the last ten years[157]. India does not like to market this failure, which is an explanation for poor funding allocations internationally and domestically[158]. India's focus on its positive economic growth and quality of living for its middle class has overshadowed the denial the coun-

try has shown towards its vast population still living in extreme poverty[159]. India's approach and rhetoric surrounding its problem of malnourished children seems to suggest the strong belief that its booming economy is and will continue to address its endemic health problems[160]. However, with more money flowing into the same bad programs, progress is not being made. This also discourages international donors to fund aid for nutrition if India is not accepting it as a dire need. Additionally, there is no evidence that has linked India's economic growth to reductions in malnutrition among children[161]. A comprehensive study done in 2011 by scientists from Harvard and the University of Michigan broke down malnutrition in India by region, concluding that there is, "little correlation between a state's economic growth and how much food most children got,"[162].

India is often compared to China in regards to development, but it is also interesting to compare the child malnutrition rates of both countries. China, as oppose to India, was able to greatly reduce its child malnutrition rates when it became an economic powerhouse. Between 1990 and 2002, they were able to cut the rates by two-thirds, where now only 7 percent of Chinese children under five are underweight[163]. There is often question as to why India has not been able to do the same, given similar trends in economic growth. The most common answer seems to suggest a difference in governance, and the recognition that the problem is, in fact, an emergency[164]. Unsurprisingly, when an issue is considered an emergency to a state, there tends to be more attention, resources, and dedication given to resolve it. This dedication was witnessed not only in China with child malnourishment, but also in Brazil and Thailand in the 1980s[165]. While the governments of these countries were/are less democratic than India, and there was a certain level of heavy handedness from these governments, the fact remains that they confronted child malnourishment with great urgency[166]. This is an important factor to consider when questioning why India still remains so far behind in tackling this issue that in many respects should be deemed an emergency.

What is also interesting to ruminate is the changing relationship between the geography of the global poor and economic growth. Economist Andy Sumner at the Institute of Development Studies published a study in 2010 titled, The New Bottom Billion. This study found that, "two decades ago, 93

percent of the world's poorest lived in low-income countries. Now, nearly three-quarters of them, or one billion people, live in middle-income economies,"[167]. Economic growth does not simply translate into poverty eradication. It is about how the growth is distributed and clearly there is a problem with the distribution.

When applying theories of international relations to this case, it appears to be a mixed and confusing blend of perhaps several different explanations. Marxist dependency theory does not offer a fully rational explanation on an international scale. The fact that India has grown so drastically in wealth and power over the last couple decades but has yet to distribute that wealth to issues of child malnourishment makes dependency theory less compelling. India is now more on the end of exploiting rather than being exploited by international actors, which is true for several other middle-income countries. Other developing nations that have enjoyed considerable economic growth and elevated status have not necessarily had the same problems aiding domestic nutritional problems. Entry into global markets and increased economic growth for developing countries does not always equate to the betterment of health. The global economy may influence decisions newly industrialized countries make, but it cannot be generalized as the cause for the health problems of the world's poor. When it comes to using liberal institutionalism as a lens for India's case of malnourishment, there exists only an explanation for the positive outcomes. The wide array of new international health actors has definitely presented its share of benefits. For example, there have been a few strong NGO movements for women's rights and advancement in India that have formed partnerships and made impressive strides in a number of areas, including health[168]. There are also movements and developments being made for women in parliament, in large part because of India's democratic republic . The democratic nature of India has definitely brought advancements for women and health in many ways, however it is not necessarily the solution to everything, as liberal institutionalism might have one believe. There are a fair amount of corrupt officials in India's government making budget and financial decisions that would suggest a greater desire to gain power than to alleviate its populations in poverty[170].

Liberal institutions have also shown to be uncoordinated in their efforts and detract from their recipient populations in India in unintended ways, discrediting the argument that they can perform better than the government programs. The motives behind health financing in India or any state for that matter are definitely ambiguous, and do not often suggest a rights-based approach. Because of this, it is easy to turn to realism for an explanation, which has its merits especially on the international scale. Links can be drawn between issues of national security and economic growth to decisions on healthcare funding in India, as well as countless other countries. The links have proven strong enough to incite questions about the true motives behind big GHIs and government funding agencies.

Conclusion

From the examples and studies discussed throughout the paper, as well as the case for child malnourishment in India, it is clear that a large body of evidence exists following the positive and negative outcomes of international health funding. This body has existed for quite some time now, even before globalization brought a myriad of international health actors, institutions, and organizations to the global health scene. There has been an acknowledgement for over fifty years, particularly from the WHO, that there is asymmetrical funding preferentially for vertical versus horizontal health programs. There has also been acknowledgement that this asymmetrical funding trend is not beneficial for countries in the long-term, as the underlying determinants of health are often neglected with vertical health programs. Yet, little has been done to rectify these funding trends from large GHIs and developed countries. Strengthening health systems in the developing world is still not as much a priority as funding for short-term service delivery and mass health campaigns. Additionally, it is service delivery for diseases that pose either a greater economic payoff or a higher security risk to the developed world that take the most attention on the international funding scene. The diseases and health issues endemic to struggling nations are often ignored and continue to flourish, such as maternal and child malnourishment in India. Although there are countless contributing factors and variables involved in health systems along with the research and data collection of health information,

the body of evidence still seems to suggest a broad trend when it comes to GHI funding. It is clear that explaining this trend does not lend itself to easy generalizations about funding approaches or theories of international relations. However, a few suggestions and arguments can be made with the data that is available, acknowledging that these suggestions and arguments are rarely universally true when it comes to healthcare.

The argument I have attempted to make in this paper is certainly not a new one and in some respects can be explained by mere common sense if using a realist context. By showcasing India, it is arguable that international funding for health is greatly influenced by issues of global economics and security threats and often neglects health systems strengthening and domestic health priorities. The stagnating rates of child undernutrition and poor maternal health in India, despite its booming economy, suggest deeper structural problems, such as gender discrimination, that are not being addressed by governments or international institutions.

Similar issues exist in other developing countries, some of which continually struggle with issues neglected by GHIs and international donors. Although these countries are often flooded with support for high attention diseases such as HIV/AIDS, malaria, and tuberculosis, support for issues such as primary health care, health education, communicable infections, and nutrition is significantly lacking. The situation I have painted for global health is rather grim, especially if viewed through a realist lens. There is reason to believe states will always place security issues of the developed world as the top priority, where anything and everything to retain power will be done, even when it comes to health and humanitarian aid. However, there is also reason to believe global health can escape the negative ramifications that come with an over-securitized view from the international community. With GHIs and international donors becoming increasingly critical and self-reflective, along with substantial critiques from researchers and scholars, there is hope funding can balance out to support health systems as much as service deliveries. It will take time to see the effects of the proposed changes in funding some GHIs have recently made. What to believe is ambiguous and depends on endless variables, yet the handful of examples of significant positive strides and improvements in global health are enough to keep the hopes of a more equitable global health system alive.

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Changing Campus Culture: A Policy Scan of Campus Sexual Violence Prevention and Response Procedures on Ohio's Campuses

By Sarah Hudacek

Abstract

Estimates of the prevalence of campus sexual violence suggest that 1 in 5 college females and 1 in 16 males will be sexually assaulted. However, only about 20 percent of campus sexual assaults are reported to authorities. In 2015, the Ohio Department of Higher Education (ODHE) released the "Changing Campus Culture" Report, with recommendations for preventing and responding to sexual violence. The purpose of this research is to determine the extent of compliance with Report recommendations among Ohio's universities. A policy scan of 14 public and 14 private institutions in Ohio was conducted in Spring 2016, before ODHE's compliance deadline, and again in Fall 2016, after the deadline. Each institution's Sexual Misconduct policies were analyzed to measure compliance with the five recommendations.

The results show that while most institutional policies met the recommendations that focused on response after sexual violence occurred, only a few institutional policies included information about prevention and education, such as utilizing a campus climate survey, comprehensive training programs, or awareness campaigns. Many policies contained negligent errors, were vague, or were not easily accessible. Given these results, there is an unequivocal need for substantial improvement in the incorporation of ODHE's recommendations into policies of Ohio's higher education institutions.

Introduction

Sexual violence on college campuses has been the focus of many studies for more than two decades, but researchers still have an incomplete sense of the rates of sexual assault on campuses, with discrepancies between many studies' statistics and much work left to do to eradicate this crime. Despite federal and state laws governing institutional prevention and response efforts, sexual violence continues to pervade college campuses across the country.

A study commissioned by the United States Department of Justice in 1996 found that three percent of college women are victims of sexual assault in any given year (DeMatteo, Galloway, Arnold & Patel, 2015). However, a more recent study conducted by the National Institute of Justice found that 19 percent of undergraduate women have been the victims of attempted or completed sexual assault since entering college (DeMatteo et al., 2015). A study conducted by the U.S. Department of Justice's Bureau of Justice Statistics in January 2016 supported this number, finding that 1 in 5 undergraduate females will be sexually assaulted while in college (Krebs et al., 2016).

Despite campus sexual violence having been in the public eye for decades, only recently have studies begun to look at the victimization of men and LGBTQ

students. A report prepared for the National Institute of Justice found that approximately 6.1 percent of men, or 1 in 16, are victims of completed or attempted sexual assault during college (United States, Department of Education, Office for Civil Rights, 2011). The median estimate of lifetime sexual assault for gay or bisexual men was 30 percent, while the median estimate of lifetime sexual assault for lesbian or bisexual women was 43 percent (Rothman, Exner and Baughman, 2011). Additionally, almost 50 percent of transgender people are sexually assaulted in their lifetime (Wooten & Mitchell, 2016). Because it appears that victimization rates for LGBTQ men and women are greater than those for heterosexual men and women, the risk for LGBTQ individuals may be much higher (Rothman et al., 2011).

Reporting numbers do not mirror these prevalence estimates, though. According to the National Crime Victimization Survey, collected from 2005-2013, only an estimated 20 percent of campus sexual assaults are reported to authorities, compared with 32 percent of assaults reported among nonstudent victims. A much higher percentage of sexual assaults, about 70 percent, are disclosed to friends, family members, roommates, or others close to the victim (DeMatteo et al., 2015).

A portion of the assaults that remain unreported have been attributed to possible uncertainty whether the assault constituted a crime. Only a meager 27 percent of women who reported experiencing sexual assault believed that the assault met the legal criteria for rape (DeMatteo et al., 2015). This phenomenon has been attributed to the rarity with which rape is committed with weapons, alcohol and/or physical injury, all of which are stereotypically attributed to occur in sexual assaults (Fisher & Sloan, 2007).

A U.S. Department of Justice National Institute of Justice research report from 2000 revealed additional reasons that victims may not have reported their victimization to authorities. Victims indicated that they did not view the incident as harmful enough to report, they did not want friends or family to know about their victimization, or they did not have proof that the assault occurred. Victims also feared the response police may have to their report or they anticipated the authorities would not believe the severity of their victimization or would not want to be bothered with their report (Fisher, Cullen & Turner, 2000).

Contrary to the belief held by many incoming college students, date or acquaintance rape accounts for 80-90 percent of sexual assaults, while stranger rape occurs only 10-20 percent of the time. Data suggests that 31 percent of rapes are perpetrated by steady dating partners (Yeater & O'Donohue, 1999). In one study, 12.8 percent of completed rapes, 35 percent of attempted rapes, and 22.9 percent of threatened rapes took place on a date (Cantalupo, 2010).

In the face of such a complicated, often invisible crime, campus sexual misconduct policies are indispensable in the fight against sexual violence. Policies are developed to respond to problems affecting a community, shape the issue, and serve as a strategy for an institution's role and planned actions to address a concern. Policies represent a university's interests or priorities in a certain matter and are a vessel for ensuring accountability, promoting awareness, and increasing transparency among students, staff and faculty. Because policies are frequently up for negotiation and re-negotiation, policy analyses are imperative in bringing attention to hidden assumptions or policy silences and the unintended consequences of policy practices (Wooten & Mitchell, 2016).

For more than two decades, institutional response to sexual violence has been overseen by the federal government. The Jeanne Clery Disclosure of Campus Security Policy and Campus Crime Statistics Act of 1990 requires institutions to disclose information about campus crime, while other laws like the Campus Sexual Assault Victims' Bill of Rights of 1992 and the Violence Against Women Act of 1994 preserve the rights of victims and perpetrators, and expanded the definition of sexual assault crimes, respectively.

The Ohio Department of Higher Education's 2015 "Changing Campus Culture" Report (the Report) expanded upon these federal policies and asked institutions in Ohio to implement more robust prevention, education and response programs and policies to protect students and work to end campus sexual violence.

This paper will address the following research question: To what extent have Ohio colleges and universities complied with the recommendations set forth in the Ohio Department of Higher Education's "Changing Campus Culture" Report, as codified in university policy? To measure these potential policy

improvements, a policy scan was conducted analyzing sexual violence prevention and response policies from Ohio's 14 public universities and 14 of Ohio's private universities. First, this paper will address federal and state policy regarding sexual violence on college campuses. This paper will then review the literature that supports the recommendations laid out in the "Changing Campus Culture" Report. The results of the scan will be reviewed and the implications of the results on institutional sexual misconduct policies will be discussed.

Literature Review

Federal Statutes Governing Sexual Violence on College Campuses in the U.S.
One of the first and arguably most important federal actions to respond to sexual violence was the Jeanne Clery Disclosure of Campus Security Policy and Campus Crime Statistics Act of 1990 (Clery Act). Jeanne Clery, for whom the law is named, was a freshman at Lehigh University when she was murdered. The Clery family later found that there were serious lapses in the university's security protocols, most notably that there was nothing governing campus crime response and prevention (Wooten & Mitchell, 2016). In 1990, President George H.W. Bush signed the Student Right-to-Know and Campus Security Act of 1990, which was renamed in memory of Jeanne Clery in 1998 (Fisher & Sloan, 2007). The Clery Act requires colleges and universities receiving federal financial aid to collect, retain, and disclose information about crime on or near their campus in a timely manner, with universities subject to fines for noncompliance (Lang, 2015).

The Campus Sexual Assault Victims' Bill of Rights was passed in 1992 as part of the Higher Education Amendments of 1992 and was enacted to ensure that victims and offenders are afforded the same rights throughout the reporting and disciplinary process (Wooten & Mitchell, 2016). More broadly, the law mandates institutions to create and communicate sexual violence response policies and procedures to students (Cantalupo, 2010).

The Violence Against Women Act amendments to the Clery Act were signed into law in March 2013 and are informally known as the Campus Sexual Violence Elimination Act (SaVE Act). The amendments altered the Clery Act definitions to include

dating violence, domestic violence and stalking, in order to require colleges and universities to educate, respond to, and prevent multiple forms of sexual violence (Wooten & Mitchell, 2016).

In April 2011, the U.S. Department of Education's Office for Civil Rights (OCR) issued a "Dear Colleague Letter" highlighting the epidemic of sexual violence on college campuses. The Letter reminded institutions that sexual violence and sexual harassment are forms of sex-based discrimination that institutions must address under the Title IX Education Amendments of 1972, the statute that prohibits sex-based discrimination at educational institutions receiving federal funding (Koss, Wilgus & Williamsen, 2014). The Letter describes how institutions should respond once a report of sexual misconduct is received and further details OCR's expectations and enforcement obligations under Title IX. If institutions failed to align their practices with the Letter's requirements, they risked the loss of federal financial support, including student grants, student loans and research funding (Koss et al., 2014).

With the complex culture surrounding sexual assault on college campuses, it's unsurprising that previous studies have found many weaknesses in institutions' response to campus sexual violence. In 2014, Senator Claire McCaskill (D-MO) commissioned a study of 440 four-year colleges and universities and found that only 50 percent of the institutions provided a hotline for victims, only 44 percent had an online reporting option, and only 8 percent offered a confidential reporting option. Furthermore, more than 20 percent failed to provide response training to faculty and staff, 30 percent failed to provide training for students, and 30 percent of the schools provided no training to those who adjudicate sexual assault reports. More than 20 percent gave the athletic department oversight of sexual assault cases involving student athletes, while more than 70 percent of schools did not have protocols regarding how law enforcement and the academic institution should collaborate in response to a report of campus sexual assault (DeMatteo, et al., 2015).

State of Ohio's Policy Environment

As of Autumn 2016, two institutions in Ohio have been found in violation of the Clery Act. In October 2004, Miami University was fined $27,500

for a combination of underreporting various crimes, including sex offenses, and other violations related to sexual violence (Cantalupo, 2010; Miami University, 2005). At the Ohio State University, allegations arose that one male student sexually assaulted two female students within weeks of each other in February 2002. Later, in February 2004, the survivor of the second assault sued the university, alleging violations of Title IX. In September 2006, the university was granted a summary judgment in the university's favor, but on December 20, 2006, the Department of Education found the university in violation of Clery for underreporting, incomplete and untimely reporting, and failure to issue timely warnings of campus crime (Cantalupo, 2010).

In February 2014, a University of Akron graduate filed a federal complaint that the university coerced rape victims into dropping disciplinary charges against perpetrators and failed to accurately report assaults and provide victims with accommodations. The student, while reviewing the university's policy to file her federal complaint, also found that the university's policies resembled, or even aligned exactly, with the policies at other schools in Ohio, and even presumed to offer resources that weren't available on Akron's campus (Baker, 2015). The student's assaulter was later sentenced to 180 days in prison, but served only three (Vaidyanathan, 2016).

On May 1, 2014, OCR released the names of 55 higher education institutions that are under investigation for possible violations of Title IX over their handling of sexual violence and harassment complaints. In Ohio, three institutions were placed under investigation: Denison University, the Ohio State University, and Wittenberg University (U.S. Department of Education, Office for Civil Rights, 2016). At the state level, Ohio's most recent initiative to fight sexual violence was set in motion in 2013, when over 100 sexual assaults were reported on Ohio's public campuses – a number that the state acknowledged was likely much lower than the actual number of assaults due to the tendency to underreport this crime. After a number of national studies found inconsistencies in how different colleges and universities investigate and respond to campus sexual violence, the Ohio Department of Higher Education (ODHE) conducted a review of Ohio's institutions and reported similar findings ("Changing Campus Culture: Background," 2016).

Later, in 2015, ODHE was allocated $2 million to develop best practices for preventing and responding to campus sexual assault. A working group composed of campus presidents, advocacy groups, and campus and community experts statewide was convened, and the group's findings were released in an October 2015 report entitled "Changing Campus Culture: Preventing & Responding to Campus Sexual Violence" ("Changing Campus Culture: Background," 2016). The Report was intended for and meant to aid all colleges and universities in Ohio – public, private, two-year and four-year institutions alike – in preventing and responding to sexual violence on campus (Ohio Department of Higher Education, 2015). ODHE released the Report with the goal that 100 percent of Ohio campuses would adopt 100 percent of the recommendations by the beginning of the 2016-2017 academic year, in August 2016 ("Changing Campus Culture: Background," 2016). The Report was released, along with robust accompanying resources to aid colleges and universities in adopting these recommendations, including sample campus climate survey questions, timelines, checklists, top sheets, guides, and FAQs ("Changing Campus Culture: Background," 2016).

The five recommendations outlined in the Report are as follows:

1.   Use data to guide action. Specifically, campuses are asked to administer an annual campus climate survey to inform prevention and response strategies, and to track trends over time.
2.   Empower staff, faculty, campus law enforcement and students to prevent and re¬spond to sexual violence through evidence-based training. Using feedback from the campus climate survey and/or other data sources to help select the most appropriate pro¬gram, campuses should implement a comprehensive training program for their institution. Programs focused on bystander intervention are particularly encouraged.
3.   Communicate a culture of shared respect and responsibility. Campuses should utilize a widespread awareness and communication campaign in conjunction with trainings and other initiatives to help encourage a safer culture.
4.   Develop a comprehensive response policy. Campuses are encouraged to engage a vari¬ety of stakeholders in developing and adopting a compre-

hensive policy to address sexual violence on campus. This comprehensive policy will be both survivor-centered and respect the rights of the accused.

5.   Adopt a survivor-centered response. By developing a response centered on survivors' needs, such as providing confidential advisors, campuses can strengthen student trust in campus systems and processes (Ohio Department of Higher Education, 2015, p.3).

The second recommendation from the Report asked institutions to utilize evidence-based training programs and awareness campaigns to educate students on campus – an important part of campus sexual violence prevention. Research has shown that the victim's ability to define their victimization as sexual violence is dependent upon the reactions of those to whom he or she first discloses the assault, and students who are sexually assaulted are most likely to tell their friends first (Fisher & Sloan, 2007). For this reason, it is beneficial for schools to train students and staff in what to do if someone discloses that he or she has been sexually assaulted and not to reserve response training solely for resident advisors, student security officers, or student employees. Furthermore, a study by Anderson and Whiston (2005) showed that students who participated in a sexual violence education program showed greater factual knowledge about rape than those who did not attend a program. Such results are encouraging because, as previously mentioned, 27 percent of sexual assault victims do not identify the behavior that was inflicted upon them as a crime (DeMatteo et al., 2015).

Increasing awareness is a vital part of changing attitudes and behaviors, an outcome that was seen beginning in the 1960s when the dangers of cigarettes and tobacco were widely disseminated. The per capita number of cigarettes smoked per year declined beginning in 1964, with the Surgeon General's report on smoking and health, with the Fairness Doctrine in the late 1960s, and the broadcast ad ban in the early 1970s. Per capita number of cigarettes smoked further declined with the nonsmokers' rights movement and when the federal cigarette tax doubled. Whereas in 1960, Americans smoked 4,000 cigarettes per capita each year, in 2012, American adults smoked slightly more than 1,000 cigarettes per capita each year, a decline that can be attributed to five decades of awareness-raising public policies (The Health

Consequences of Smoking: 50 Years of Progress, 2014). Applying these results to sexual violence, it is possible that raising awareness of sexual violence on college campuses could result in similar changes in attitudes and behaviors, and perhaps significantly contribute to the conclusion of this crime.

The third recommendation from the Report asked institutions to communicate a culture of shared respect and responsibility, including offering bystander intervention training. Much national attention for sexual violence has been focused on bystander intervention, particularly after the launch of President Obama's It's On Us campaign in September 2014. However, a study conducted by Rutgers University researcher Sarah McMahon suggested that beliefs in rape myths are negatively related to students' intentions to intervene as bystanders. Given this information, it's important that education about rape myths accompany bystander intervention in order for the training to be effective (McMahon, 2010). Having said this, McMahon also notes that bystander intervention training has been supported by the Centers for Disease Control and Prevention's call for a shift in sexual violence prevention and training that would emphasize primary prevention and the responsibility of the community to help end sexual violence. Bystanders are often present before an assault occurs, and if trained correctly, could interrupt dangerous situations (McMahon, 2010).

In addition to offering training opportunities as a method of increasing awareness and encouraging reporting, researchers have found that other actions, such as offering services for victims of sexual violence, having written law enforcement response protocols, establishing coordination between the campus and the surrounding community, and including training at new student orientations are all actions seen by administrators to facilitate reporting (Karjane, Fisher & Cullen, 2005). Many of these methods are also found in ODHE's Report recommendations. Further recommendations from research supported by the U.S. Department of Justice to alleviate barriers to reporting include offering confidential and anonymous reporting options, utilizing inclusive language for definitions of various forms of sexual violence in policies, and including contact information in policies for on-campus alternatives to police, such as victim advocates (Krivoshey et al., 2013). Furthermore, in 96 percent of sexual assaults, the offender is

an acquaintance, classmate, significant other, friend or other known relation to the victim. Because more than 30 percent of victims cite that fear of retaliation was a reason they did not report their assault, emphasizing confidential reporting and support resources can overcome a major barrier to reporting (Krivoshey et al., 2013).

However, it's also important to be deliberate in the reporting and support resources offered to survivors. Even though many campuses offer several possible outlets for reporting, including campus security, campus police, city police, residential life staff, a dean of students, student health services, and student counseling center professionals, among others, few victims report to the police or to campus authorities whose role on campus is not primarily related to safety or security, such as academic deans (Krivoshey, Adkins, Hayes, Nemeth & Klein, 2013).

Data and Methodology

In order to analyze the levels of compliance among public and private colleges and universities in Ohio, two sets of policy scans were completed. The first scan, completed in April 2016, measured initial compliance of colleges and universities in Ohio before the compliance deadline of August 2016. The second scan, completed in September 2016, measured improvements and changes made after the compliance deadline set by the Report as the beginning of the 2016-2017 school year. Spring 2016 policies were obtained on February 1, 2016, and Fall 2016 policies were obtained on September 1, 2016. As stated in the introduction, policies are a vessel for ensuring accountability at the institutional setting and serve as a strategy for an institution's plan to address an issue on its campus. In this study, a policy scan was conducted because this method could uniquely highlight areas in which institutional policy exceeds expectations or is lacking. A policy scan could also reveal oversights in institutional policies, and ultimately mirrors the results that stakeholders and students would see if they sought out these policies. In this study, compliance with the "Changing Campus Culture" Report's recommendations is defined as those actions that are codified in official university policies, which are accessible online for students, faculty, staff, stakeholders and the broader local community.

As stated on ODHE's Report website, participation in the "Changing Campus Culture" initiative was not mandated by the state, but 100 percent of public schools opted to participate, with 81 percent of all public and private schools in Ohio opting in ("Changing Campus Culture: Benchmark Data"). There were no incentives to encourage participation, but participating institutions had access to advice, expertise, and financial aid to support their implementation efforts.

The data set includes Title IX, Sexual Misconduct and Student Code of Conduct policies from 14 public four-year schools and 14 private four-year schools. The policies considered from each school can be found in Tables 21 and 22 in Appendix B. The colleges and universities considered in this policy scan are listed in Table 1.

The public institutions chosen include all 14 four-year colleges listed on ODHE's website ("Ohio Public Institutions"). Private schools with at least 2,500 enrolled students were chosen for this scan. Because eleven of the 14 public institutions considered in this research have at least 10,000 students enrolled, selecting the larger private institutions with at least 2,500 enrolled undergraduates allowed for a more applicable comparison between the two types of institutions. These private schools were selected to be scanned using the filtering resource available on the Ohio Private Colleges website to sort by the number of students enrolled ("Ohio Private Colleges"). It is predicted that the Ohio Department of Higher Education strategies outlined in the "Changing Campus Culture" Report will result in substantial institutional policy improvements at the colleges and universities in Ohio that opted to participate in the "Changing Campus Culture" initiative. It is further predicted that public institutions will have higher rates of compliance than private institutions because public institutions have been required to comply with federal safety laws and regulations for a much longer period of time than have private institutions. Policies for the colleges and universities scanned were obtained through Google using the key search terms "Title IX Policy," "Sexual Misconduct Policy," and "Sexual Assault," among others listed in Table 23 in Appendix B. Information listed on school webpages was excluded from the analysis, with only official school policies being considered, except for webpages directly referenced and linked through in-

stitutional policy. For example, one public university included information on its Sexual and Relationship Violence Support Services website about its many training and awareness events, including Green Dot, Take Back the Night and the Clothesline Project. However, because this information was not included in the school's policy documents, it was not considered in this policy review. Information on webpages was only considered for institutions that, instead of including all relevant information directly in their policy, included a link to a webpage that hosted that information.

Out of the "Changing Campus Culture" Report, five recommendations and seven sub-objectives were identified, as shown in Table 2.

Although not included in the main five components of ODHE's Report, some aspects of the Report were implied to be actions above and beyond the framework established in the Report's recommendations, and are detailed here as supplemental policy recommendations, as listed in Table 3. These supplemental points of analysis are important additions included in ODHE's report, all of which are considered here, that can contribute to the creation of a comprehensive sexual violence policy. Whereas the Report's five main recommendations are meant to create uniform minimum standards across Ohio's campuses, these supplemental policy points can help inform not only which colleges have already met those minimum standards, but which colleges have progressed above and beyond state or federal requirements to develop a more holistic approach to sexual violence prevention and response.

Compliance with Report recommendations was scored as follows: for each individual recommendation, if the institution met all of the objectives in the Report, the school received a 2 for that recommendation. If the school met at least one, but not all, of the objectives of the recommendation, the school received a 1 for that recommendation. If the school did not meet any of the objectives of the recommendation, that school received a 0 for that recommendation.

The policies from each institution scanned received a score from 0-2 for each sub-objective listed in Table 2, as well as an overall score for each recommendation included in the Report. A school received an overall score of 2 if all of the sub-objectives received a score of 2. A school received an

overall score of 1 for each recommendation in which at least one sub-objective received a score of at least 1. A school received an overall score of 0 for each recommendation in which no sub-objective received a score greater than 0.

Results

Tables 4-7 include the results of the policy scans conducted, separated by Spring and Fall results for public and private institutions. If institutions received a score of at least one for a certain recommendation or sub-objective, that institution is considered minimally compliant with the recommendation set forth in the Report.

Recommendation 1: Use Data to Guide Action

Recommendation one from the Report, using data to guide action, had two identified sub-objectives: the first was the administration of an annual climate survey and the second was the measurement of the effectiveness of all programs offered.

According to institutional policies, in Spring 2016, Ohio State University was the only school out of all 28 schools scanned (4%) that administered an annual climate survey. In Fall 2016, there was no mention of the administration of a campus climate survey in any policy documents for any schools scanned.

These results, however, do not align with ODHE's posted list of institutions that reported completing a campus climate survey in the past year, a list that included 25 of the institutions considered here. The only three institutions considered here that did not report the completion of a campus climate survey to ODHE were Cedarville University, Franklin University, and Ohio Northern University ("Ohio Campuses Reporting Completion of a Campus Climate Survey in the past year.").

In Spring 2016, two schools (7%), Ohio State and Oberlin University, included statements in policy documents regarding the measurement of the effectiveness of all programs, but only one school (4%), Ohio State, included such information in Fall 2016.

Recommendation 2: Empower Campus to Respond Through Evidence-Based Training

The second recommendation from the Report asked schools to empower the campus community to prevent and re¬spond to sexual violence using evidence-based training. The two sub-objectives identified for this recommendation were whether the training program addressed multiple stakeholders and whether the program used feedback gained from the climate survey.

In Spring 2016, 15 schools (54%) included information in their policies regarding a training program offered to the university community that received a score of at least 1. In Fall 2016, that number had increased to 18 schools (64%) that had included information about a training program in their policies. In Spring 2016, only one school (4%), Ohio State, included information about the campus climate survey being used to design training programs, and by Fall 2016, that number had decreased to zero schools. Table 8 lists the training programs included in institutional policies at Ohio colleges and universities.

Recommendation 3: Communicate a Culture of Shared Respect and Responsibility

The Report's third recommendation asked institutions to utilize campus awareness campaigns to communicate a culture of shared respect and responsibility. In Spring 2016, five schools (18%), Miami University, Ohio State, Ohio University, the University of Findlay, and Xavier University, had some kind of campus-wide campaign that was cited in policy and earned a score of at least 1, including the It's On Us campaign, Not Anonymous, No More and I Am Miami, among others. By Fall 2016, only four schools (14%), Miami University, Ohio State, Findlay, and Xavier, included a campus awareness campaign in institutional policy. Table 9 lists the awareness programs and events that were found in Ohio college policy documents.

Recommendation 4: Develop a Comprehensive Response Policy

Recommendation four asked institutions to develop a comprehensive response protocol that is both survivor-centered and preserves the rights of the accused. In both Spring 2016 and Fall 2016, all 28 institutional policies scanned (100%) documented the use of a response protocol that met the Report's qualifications.

Recommendation 5: Adopt a Survivor-Centered Response

As the final recommendation of the Report, recommendation five asked institutions to adopt a survivor-centered response to sexual violence, such as providing confidential advisors, victim advocates, or including a sexual assault response guarantee in their policy.

In Spring 2016, 26 of the institutional policies scanned (93%), all except for Shawnee State University and the University of Northwestern Ohio, documented the university's provision of some kind of survivor-centered response that received a score of at least 1, such as providing confidential advisors, victim advocates, or detailing extensive interim measures that can be taken to protect survivors, among other possible responses. In Fall 2016, 27 schools (96%), all except Shawnee State, offered some kind of survivor-centered response documented in policy.

Supplemental Policy Analysis

Tables 10-13 include the results of the supplemental policy scans conducted, separated by Spring and Fall results for public and private institutions. If institutions received a score of at least one for a certain recommendation or sub-objective, that institution is considered minimally compliant with the recommendation set forth in the Report.

As codified in institutional policy, in Spring 2016, nine schools (32%) offered bystander intervention training on campus, and another nine schools (32%) also provided self-protection training, such as risk factor training and self-defense training. In Fall 2016, that number increased to 10 institutions (36%) implementing each bystander intervention training and self-protection training.

Trauma-informed training prepares campus responders such as investigators, police, and Title IX coordinators to recognize and understand the guilt and memory fragmentation obstacles often experienced by survivors of traumatic crimes such as sex-

ual violence. According to institutional policies, in Spring 2016, only one school (4%), Ohio State, provided trauma-informed training for first responders, with that number increasing to three schools offering such training (11%), Ohio State, Miami University, and Ohio Northern University, in Fall 2016.

In both Spring 2016 and Fall 2016, Miami University was the only school (4%) that offered the It's On Us campaign on campus, according to institutional policies.

Confidential advisors, as detailed in the Report, are trained professionals who can support survivors and safeguard them from engagement in subsequent investigative processes. Confidential advisors commonly hold mental health practitioner certifications, and throughout the course of this scan, were overwhelmingly housed with the institution's student counseling services. In Spring 2016, twenty schools (71%) included information in their policies about a confidential advisor for survivors of sexual violence, a number that increased to twenty-six institutions (93%), all except Shawnee State and Youngstown University, offering such services in Fall 2016. Similar trends were seen with the institutions that provided a victim advocate. Victim advocates work one-on-one with survivors to offer information, emotional support, 24/7 response at the hospital during evidence collection, assistance with interim measures, help finding resources, and aid in the filing of victims' compensation, among many other critical services. In Spring 2016, according to school policy, thirteen schools (46%) provided a victim advocate, while fifteen schools (54%) provided an advocate in Fall 2016.

In both Spring 2016 and Fall 2016, there were two institutions (7%), Ohio State and Miami, that included a sexual assault response guarantee in their response protocol. Such a guarantee serves to explain in survivor-friendly terms what can be expected in the reporting process and aims to alleviate possible concerns a survivor may have, such as when they will meet with the police and how their identity might be protected.

Tables 15-16 include the rates of compliance for public and private institutions for the five Report recommendations and for the supplemental policy analysis points. Tables 17-18 include compliance rates for all institutions in the Spring and Fall, for the five Report recommendations and for the supplemen-

tal analysis points. The right-hand column shows the percent of change between Spring and Fall, in order to show the rates of improvement or lack thereof for each recommendation and analysis point.

Overall, as shown in Table 14, only 46 percent of institutions issued a revised policy from Spring 2016 to Fall 2016. Although ODHE's stated compliance goal was 100 percent compliance by August 2016, the "Changing Campus Culture" Report did not specify that ODHE required that institutional policy be changed to show compliance. While ODHE may consider the overall compliance of all of a school's actions, this study was designed to determine if the recommendations included in the Report are explicitly documented in school policies across Ohio.

Discussion and Recommendations

Out of all recommendations measured in this scan, the provision of a confidential advisor for survivors experienced the greatest growth from Spring 2016 to Fall 2016, with six additional schools including information in institutional policy about offering such a resource to survivors in the Fall. According to institutional policies, two additional schools (7%) offered a victim advocate, two additional schools (7%) offered trauma-informed training, one additional school (4%) offered bystander training, and one additional school (4%) offered self-protection training between Spring 2016 and Fall 2016.

Compared with all other recommendations, the number of schools complying with recommendation four, developing a comprehensive response policy, and recommendation five, adopting a survivor-centered response, was surprisingly high, with the policy content corresponding with these recommendations being especially robust. Both of these recommendations had almost 100 percent compliance, an impressive rate when compared to the rates of compliance for other recommendations that focus more on prevention and education than on post-assault support and response. It is possible that this circumstance exists because institutions have had much more time to comply with laws and regulations governing these aspects of sexual assault response – about 25 more years.

There is a loose association between the size of the institution and the level of compliance with the recommendations listed in the Report. Ohio State,

Miami, University of Cincinnati, University of Toledo, and Ohio University, five of the biggest universities in the state by enrollment, received some of the highest compliance scores out of all schools scanned. Smaller institutions tended to receive much lower scores, to have fewer innovative policies or programs, and tended to only address sexual assault in one or two paragraphs in the Code of Conduct or the Student Handbook, rather than dedicating an entire policy to the issue. Larger schools likely have more resources, greater sources of funding, more staff that can dedicate their time to preventing sexual violence, and likely have more political capital, and experience more political pressure, than do smaller institutions in Ohio.

A joint Washington Post–Kaiser Family Foundation poll surveying students from more than 500 universities indicated that campus attributes such as public or private status, religious affiliation, or size do not impact the prevalence of campus sexual assault (Anderson & Clement, 2015). However, the results of the present analysis could indicate that these attributes may impact institutional response to campus sexual assault.

Strikingly, there were several areas where institutional policy regressed from Spring 2016 to Fall 2016. According to the school policies considered, in comparison to the Spring policy scan, by Fall 2016, one fewer school (4%), Ohio State, implemented a campus climate survey, one fewer school (4%), Oberlin, measured the effectiveness of all programs offered, one fewer school (4%), Ohio State, used the climate survey results in the development of training programs, and one fewer school (4%), Ohio University, utilized a campus-wide awareness campaign. This phenomenon could be attributed to a host of causes. Many institutions worked to improve their policies, and in the process changed the titles, organization, and content of these policies. For some schools, new policies were created, and for others, policies were consolidated or superseded by other, newer policies. This could have created the kind of discrepancy viewed in this study, where some information was removed, moved, or edited so that it no longer fulfilled the Report's requirements, and made it so that some institutions seemed to move backwards between the Spring and the Fall.

There were other examples of institutional oversight in campus policies, as well. In Spring 2016, ten schools (36%) included at least one non-functional link in their policy, with one school having as many as 12 dysfunctional links. In Fall 2016, ten schools (36%) still had at least one malfunctioning link, with the greatest number of broken links being six. One school even included a link that re-directed to Utah State University's website. One school left an outdated policy available online that offered information about resources and offices on campus that had changed names or no longer existed and were contradicted by a second, more recent Title IX policy. Many policies did not use consistent language and had many typos and grammatical errors. Many schools used sexual violence, sexual assault, sexual harassment, and rape interchangeably, despite the distinct differences separating each of these offenses. For recommendation three, communicating a culture of shared respect and responsibility, a surprising number of schools included vague statements about campus-wide campaigns in their policies that lacked specificity. Such statements in policy documents included phrasing such as: the "University provides comprehensive, intentional, and integrated… campaigns intended to end sexual assault" or "The University has developed an annual educational campaign consisting of presentations that include distribution of educational materials to new students; participating in and presenting information and materials during new employee orientation; and presentations, activities and other programming initiatives on an ongoing basis to employees and students." Similar results were seen with policy descriptions of prevention, education and training programs. One school stated that the university is dedicated to "education and prevention programs that inform the community about the risks and myths that contribute to Title IX offenses." Another institution's only reference to training programs was in a bullet point, under the responsibilities of the Title IX coordinator to "prepare and arrange for a preventative education program. Such programs will include information designed to encourage students to report incidents of sexual violence to the appropriate University and law enforcement authorities."
All in all, many of these policies were incredibly difficult to find. Some policies were easily accessible from Google using keywords such as "Title IX" or "Sexual Misconduct," but many others were embedded within the school's Code of Student Conduct

or Student Handbooks or were listed on webpages where each section of the policy was found through a different link. Furthermore, many schools did not have one central webpage or policy with all resources, procedures and information pertaining to sexual violence, but rather had separate webpages for Title IX, sexual violence education and prevention, student conduct, university police, human resources, and/or the University counseling center, making it difficult to discern where to go first.

A study conducted by researchers at the Ohio State University and Central Michigan University saw similar results, finding that colleges in Ohio are deficient in making their sexual assault policies accessible online, directly from search engines. These considerations should not be taken lightly, seeing as recent research has suggested that students are likely to turn to the Internet as a source of information for responding to sexual assault (Krivoshey et al., 2013). Given this information, Ohio's institutions should endeavor to make policies and procedures much more searchable from platforms such as Google or Yahoo and should maintain policies and resources in predictable and intuitive locations. Many policies migrated from one website to another between Spring and Fall, and while this researcher was under little time constraint to find the correct policy, survivors searching for information after an assault would likely have a great deal of trouble navigating through webpages to find support resources and reporting information.

Although there were certainly many areas for improvement among the institutions scanned, it is equally as important to recognize exceptional policies at some of Ohio's colleges and universities. Cleveland State University's Sexual Violence Response Guide includes a section dedicated to men and sexual assault and reminds survivors that "the most important things to remember are that men can be sexually assaulted; men who have been sexually assaulted experience emotional reactions to their assault; men who have been assaulted are entitled to the same medical, legal and emotional support. Men who have been sexually assaulted are never to be blamed for their assault [emphasis original]." This section continues on to de-bunk rape myths surrounding men and sexual assault ("Sexual Violence Response Guide").

Kent State University's Sexual and Rela-

tionship Violence Support Services website included resources and information for the university's branch campuses, not just the main campus in Kent ("Regional Campus Resources"). With a total of 24 branch campuses from the 14 public universities across Ohio, a significant number of students at public universities study at branch campuses – about 52,732 students according to ODHE – but are often excluded by sexual misconduct and Title IX policies ("Ohio Public Institutions").

Miami University of Ohio had perhaps the most extensive and impressive policies of all schools scanned. In addition to having numerous education and training programs, Miami also has two student organizations dedicated to sexual violence prevention: Men Against Rape and Sexual Assault (MARS), and Women Against Violence and Sexual Assault (WAVES) ("MARS (Men Against Rape and Sexual Assault)"; "WAVES (Women Against Violence and Sexual Assault)"). MARS is a male-only group whose main goal is to educate men about the issue of sexual violence and inform them of ways to prevent it. WAVES works to promote awareness and educate the Miami campus community through events, peer programming and victim support, and also provides safe spaces and resources to those personally affected by sexual and interpersonal violence.

Miami University also offers the free Just in Case App to students who are in need of guidance for how to approach friends in possibly dangerous situations and offers emergency information on resources in the area ("Just In Case App").

The University of Akron is home to a campus- and community-wide Sexual Assault Resource Team (SART) founded in May 2014. SART releases an annual report with comprehensive information about awareness and prevention programs, the university's partnership with the Akron-based Rape Crisis Center, and reports on the status of implementation of recommendations from the November 2014 SART report ("Sexual Assault Resource Team (SART)").
Bowling Green State University posted a thirty-minute long sexual assault mock hearing on its website intended to educate the campus community on what a student conduct hearing encompasses and what the university consequences of sexual assault might be ("Sexual Assault Awareness Mock Hearing"). Similarly, Ashland University posted a script of a typical

student conduct hearing on its website to give survivors an idea of what a hearing might entail ("Student Conduct Hearing Board Agenda and Procedures"). Case Western Reserve University's sexual misconduct policy includes a section describing the difference between intention and impact in sexual violence, another important distinction that is rare in university policies. This section explains that, "The fact that someone did not intend to engage in sexual misconduct against an individual is not considered a sufficient explanation to a complaint of sexual misconduct…Although the respondent's perceptions will be considered, in most cases, it is the effect and characteristics of the behavior on the complainant, and whether a reasonable person in a similar situation would find the conduct offensive that determine whether the behavior constitutes sexual misconduct" ("Sexual Misconduct Policy").

Finally, the University of Dayton offers a unique program for professors who are unable to host class. Instead of cancelling, that professor may invite educators from the Sexual Violence Prevention Education Office to present a training program during class time. The university takes same-day reservations for these training programs and offers many different training options, including programs on the neurobiology of trauma, supporting survivors, rape culture, healthy relationships, bystander intervention, and many others ("Sexual Violence Prevention").

Limitations

The results of this study should be considered in light of several limitations. Institutional policies were downloaded for the first time in February 2016, about four months after the Report was released in October 2015. It's possible that institutions improved their policies before this researcher acquired them on February 1, thus limiting the benefits of the comparison between Spring and Fall compliance. Furthermore, a policy scan is a somewhat subjective method. Two people might rate the same sentence differently, and this study utilized only one coder, with no other researchers to actively question assumptions. Despite this, concrete steps were taken to eliminate as much subjectivity in this analysis as possible. A codebook of clear compliance expectations was created, along with a numerical rating system with very distinct levels of compliance for each

numerical score and an accompanying excel spreadsheet that guided the analysis on multiple points. Additionally, Table 23 in Appendix B lists the exact search terms used when locating institutional policies through a search engine. With these steps having been taken, the study becomes more replicable and reliable. Having said this, institutional policies are ever changing, and even a replica of this study that is conducted one month after its conclusion could yield different policies, and thus different results.

Conclusion

By examining institutional policies at 14 public institutions and 14 private institutions in Ohio, it's clear that there is a need for substantial improvement in the incorporation of ODHE's recommendations into policies for higher education institutions in Ohio, as demonstrated by the low rates of compliance among Ohio's institutions. Although some institutions have demonstrated exceptional and innovative policies and programs, no institution in Ohio has fully complied with the recommendations set forth in ODHE's "Changing Campus Culture" Report. In fact, many Title IX and sexual misconduct policies considered in this scan included typos, outdated information, grammatical errors, and broken links. Many policies were not quickly or easily accessible, and a majority of the policies considered contained only a framework, with little concrete or specific information available.

While the sections of policy devoted to responding to sexual assaults on campus and detailing campus conduct procedures were significantly more robust and detailed, primary prevention and education fell by the wayside. Institutions should endeavor to develop policies that are, first and foremost, accessible, searchable and predictable. Students should be able to find them quickly, easily search for key words and phrases, and predict where phone numbers, emails, or other support information can be found, all in a short period of time. Sexual misconduct policies should also consider the needs of all students, including international students, LGBTQ students, men, women, graduate students, undergraduates, commuter students, and branch campus students, all of whom may require different support services. Institutional policy must also be a comprehensive source of information for students, so that victims do

not have to navigate through numerous sexual assault response websites before they access the information they need.

Institutions in Ohio are not on their own when improving policies, though. There are state and federal resources available to aid in the development of a more comprehensive institutional policy. For examples of model sexual violence policies, institutions can visit the U.S. Department of Justice's Office of Violence Against Women website on protecting students on college campuses. The Pennsylvania Coalition Against Rape also offers a resource where colleges can access their level of readiness for the primary prevention of sexual violence on campus, and then adopt strategies for prevention appropriate to their campus' readiness (Wasco & Zadnik, 2013). In Ohio, the Ohio Alliance to End Sexual Violence and the Ohio Domestic Violence Network are two statewide coalitions that address sexual and intimate partner violence in Ohio and that have both received funding to advance efforts to create safer campus communities across the state. Although there is still much work to be done, there is a great deal of support behind college campuses to support sexual violence victims and improve prevention efforts, and together, Ohio can overcome this perplexing, destructive crime that afflicts our communities.

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Testing of the Triggering Interferometric Sum Correlator and the Tunable Universal Filtering Frontend

By Michael Kovacevich

Abstract

The Antarctic Impulsive Transient Antenna (ANITA) is a balloon-borne radio experiment that is a collaboration between multiple universities, including Ohio State University, and is designed to detect ultra-high energy (UHE) neutrinos and cosmic rays. The fourth iteration of ANITA is currently flying and was launched on December 2, 2016 in Antarctica. ANITA 4 will fly for twenty to forty-five days at heights that range from thirty-five to forty kilometers. After ascending to these altitudes, ANITA 4 observes the ice below it for radio pulses that are a result of neutrino interactions with the ice.

During the summer, two of the main components of the ANITA 4 data acquisition system were worked on at Ohio State University (OSU). These components were the Triggering Interferometric Sum Correlator (TISC) and the Tunable Universal Filtering Frontend (TUFF). The TISC was designed to make the ANITA 4 triggering system more efficient and enable it to observe more frequent, low-energy events. The TUFF was designed to block out certain continuous wave frequencies. Eighteen TUFFs, four per quadrant of ANITA and two extra, were assembled and then the hardware problems were debugged and fixed for both circuit boards. Different software was required for each board to help calibrate the various components while also ensuring that they communicated correctly with the rest of ANITA 4. The boards were also tested in environments similar to those where ANITA 4 is currently flying. While testing the TISC, it was found that some of the components, namely the Field Programmable Gate Arrays, did not work correctly. This problem caused specific bits of data to be inverted or locked into state. This in turn made the TISC not perform correctly and made it unusable for ANITA 4. The TUFF was assembled and modified based on subsequent tests and is currently onboard ANITA 4. The TUFF should allow ANITA 4 to obtain more extensive data about cosmic rays and UHE neutrino interactions during its flight.

How Gene Ownership Affects Seed Markets and the Various Effects of Gene Patents on the Seed Supply

By Jonathan Kubesch

Abstract

As food consumers increasingly call for tighter controls on the food system and increased knowledge of the productions chains involved, the cultural practices of agriculture and techniques are gradually meeting these new demands of localized sustainability. However, in addition to restructuring how crops are grown, consumers are demanding changes in the genetic manipulation of the crops themselves. Genetically modified organism (GMO) technology presents an additional aspect to agriculture: a new realm of intellectual property. The patenting of life presents an issue in maintaining seed sources for these changes in consumer preference and the markets for seed, both GMO and non-GMO. Upon further investigations of industry, academic, and legal literature, biological action and current property rights structure create a regulatory environment that complicates the seed production landscape. This impedes seed production on both sides of the GMO fence.

Introduction

According to present United States patent law, "[a] living plant organism which expresses a set of characteristics determined by its single, genetic makeup or genotype, which can be duplicated through asexual reproduction, but which cannot otherwise be "made" or "manufactured.","" qualifies for a plant patent. While many GMOs are first genetically altered and then bred to create a seed crop, "utility applications" still qualify the organism for patenting despite the organism being a product of replication through procreation (The United States Patent and Trademarks Office, 2014). These patents can also apply to non-GMO seed but in a different legal format. The patented seed is sold with a specific contractual obligation for use in only one season but prohibits saving seed; yet, some farmers enter into seed production agreements to produce the seed for companies to market for the next growing season. In addition to these limitations on the seed, technology use agreements often demand farmers, "to implement an Insect Resistance Management ("IRM") program," and limits seed production to those who have, "entered into a valid, written Seed production agreement." (Burrus Seed, 2014). Seed production of GMO seed is limited by technology agreements and the deliberate and undeliberate theft of intellectual property: altered genes. Seed production of non-GMO and organic seed is limited by undeliberate intellectual property theft and the contamination of seed supply sources.

Body:

The biological disregard to human delineations of fields and crops meddles with

these agreements through a process known as GMO contamination. Pollen spreads across crops without respect to the technology agreements. As noted by Mercer and Wainwright in the study of corn gene pools in Mexico, contamination regularly occurs between fields following an edge gradient (Mercer and Wainwright, 2007). Additionally, the centralized seed supply often finds various patented strains mixed in as for farmer use, inadvertently breaking patent law and driving some seed companies towards legal action, also known as litigation. The legal risks of GMO contamination make scarce "clean seed," which is seed safe for growing for seed, while contamination itself limits the supply of quality seed for breeders to develop. Haslberger points out that, "EU Scientific Committee on Plants states that contaminations are inevitable," (Haslberger, 2001). Despite the stringent standards to reduce the effects of cross pollination, contamination may be inevitable; the cost on producers currently to mitigate genetic contamination to this level even presently raises seed prices (Hallauer, 2013). Farms trying to breed GMO hybrid seed under contract must work to prevent other farmers from contaminating their crops while also preventing their own crop's genes to travel by pollen the other way.

Legally, many biotech firms, such as Monsanto, regard any contamination as a patent violation. Even farmers who are not growing Monsanto seed, but find Monsanto contamination, risk litigation for any contamination that appears in their crops. Monsanto justifies this in three reasons, citing that compensation is due for the technology, research in and of itself deserves remuneration via the final product, and that this would not be fair to the farmers honoring present technology agreements (Monsanto 2014). In Monsanto's case, nine of 145 lawsuits over patent infringement went through complete trial and the biotech firm won every time (Monsanto, 2014). In contrast to these worries of patent infringement, the Queen Mary Institute—a United Kingdom intellectual property research group—acknowledges, "in its report on EC Regulation of Genetic Modification in Agriculture (1998) the Select Committee of the British House of Lords also warned of the problem of cartels and monopolies in the agrochemical/seed sector, pointing out that the degree of consolidation was already much greater than in the pharmaceutical sector," (Queen Mary Intellectual Property Research Institute, 2004). In fear of legal reprimand for contamination, farmers trying to secure seed must either pursue seed directly from biotech companies and subsidiary seed dealers, or purchase seed from a small market share of non-GMO plant breeders. GMO contamination extends to grain as well. The Ohio-based agricultural corporation, Cargill, is currently suing the Swiss company Syngenta over the release of a transgenic seed corn not yet approved for importation into China. (Pearson, 2014). Pearson notes that MIR 162 presented a market liability to the export grain market, and when released across the American grain production chain without Chinese approval grain containing the trait would cause shipment rejections and market losses (Pearson, 2014). In the courts, the biotechnology firms hold monetary and representative power over smaller seed production firms and the legal process regarding biotech intellectual property as a consequence of legal precedence and the industry trend towards consolidation; this financial power far outweighs the resources of the average producer.

Organic firms face the issue of finding pure seed supplies that are both non-GMO and meet organic standards. Even in 2004, researchers from the Netherlands noted that, "for various crops the supplies of organic produced seeds are still insufficient," despite the limited availability of GMO seed sources at that time. "A consequence of the omission of chemicals in the organic production system is the increased risk of the occurrence of diseases during production of some crops, as long as disease resistant varieties are not available. This holds also for seed production, especially, for biennial crops, which are exposed to various diseases during two subsequent seasons," (Groot, van der Wolf, Jalink, Langerak, and van den Bulk, 2004).

Methods:

Google Scholar was consulted for technical and academic articles from the database there as well as from the "Science Direct" journal, in addition to the publication, "Seed Testing International". Seed technology agreements were consulted as they were available to the public. In arranging resources, a thorough review of the rulings of the Supreme Court, and a chronological sequencing of literature, the other derived the following results and conclusions per-

taining to the seed market and the GMO preference. The author searched the seed technology agreements available to the public, while also searching the following keywords through a general Google Scholar search: "GMO contamination," "cross pollination," "agricultural intellectual property," "seed technology," "biological patent law," "trait discovery," and "gene ownership." Individual company websites and similar investigations came at the recommendation of Dr. C. Filson (Ohio State University, Dept. of Agricultural Communication).

Results:

The study produced a mixed opinion of current gene ownership. Legally, biotechnology companies hold intellectual property over any and all seed that contains their specific gene sequences, even when the gene sequences exist in contaminated seed on another plot of land (Burrus 2013; Haslberger 2001; U.S. Patent Office 2014). Contamination and the legal damages often lie on unintentional cross-pollination between populations (Hallauer 2013). Seed technology agreements also limit the supply of GMO seed crop available in a season, as companies limit GMO seed production to contract farms (Pearson 2014). Non-GMO seed contaminated with GMO transgenes therefore threatens the non-GMO seed producer with legal action even though the producers don't desire this GMO pollination (Mercer and Wainwright 2008; Groot et. al. 2004). Economically, the wholesale elimination of gene ownership would harm both GMO and non-GMO seed producers and marketers, as the gene material would easily replicate and no single entity could secure their proprietary claim to the seed with explicitly contract farming all seed and instigating draconian isolation distances impractical to small and large producers alike (Groot et. al. 2004; Mercer and Wainwright 2008). Without any reward for maintaining specific seed lines, the biotechnology firms would not invest as heavily in improving crop yields and current GMO strains. This would slow and ultimately stop the advancements of GMO seed as well as the accompanying pest and weed management technologies (Pearson 2014). This tragedy of the genetic commons would limit the current proprietary rights of non-GMO seed and also limit the development of these seed strains (Monsanto 2014; Groot et. al.

2004).

At the same time, seed GMO and the regulatory apparatus accompanying it threatens the end product, namely grain sales (Monsanto 2014). Given that most grain now moves through an international import-export system, GMO technology without regulatory approval threatens sales when mixed with non-GMO and approved GMO product, and thereby creates another commons situation that harms all economic actors (U.S. Patent Office 2014; Queen Mary Intellectual Property Research Institute 1998; Pearson 2014).

Conclusion:

Currently, national and international law recognizes the right of biotechnology firms and researchers to genetically modify then patent seed technology (U.S. Patent Office 2014). These companies can sell seed to farmers through contracts that prohibit the direct theft of the genetic intellectual property, but can also use litigation to protect intellectual property that spreads through biological happenstance (Groot et. al. 2004). Unlike a patented television or other consumer product, seed replicates and spreads copies of transgenes that cost firms millions of dollars and years of research to develop (U.S. Patent Office 2014). Contamination harms non-GMO seed producers, as biotech firms often sue for patent infringement but the contamination itself also threatens the value of the non-GMO seed crop (Haslberger 2001).

Without intellectual property rights on the seed, biotech firms lose the desire to invest in seed technologies while non-GMO producers lose the limited rights to develop non-GMO strains (Monsanto 2014; Haslberger 2001). Solutions to this property rights issue include allowing biotech firms to own the modifications of the seed genetics they produce while restructuring the way that GMO contamination proceeds through the judicial system. Intentional and unintentional contamination cases deserve different legal actions, as the former harms biotech firms more than the latter, which actually harms farmers and non-GMO seed producers (Groot et. al. 2004). As these patents apply to genes modified in a strain at present, limiting patents to the specific gene modifications would alter the patents currently active domestically and abroad.

Future works should include additional research into the international recognition of the genetic intellectual property and a study of transgenes in animal systems and the contamination inherent in animal genetic modification. Additionally, property rights framework that protect biotechnology property rights while preventing overextension onto non-GMO producers might improve relations between these industry sectors and allow better market interactions to take place.

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Risky Decision Making in College Students as a Function of Self-Reported Eating Behaviors

By Wesley R. Barnhart and Melissa T. Buelow

Abstract

Individuals with eating disorder diagnoses may experience difficulties with decision making, often focusing on immediate gains at the expense of long-term outcomes. Previous research showed decision making deficits in Anorexia Nervosa, Bulimia Nervosa, and Binge Eating Disorder. However, many college-aged individuals engage in disordered eating behaviors (e.g., food restriction and ritualistic caloric consumption) that do not meet criteria for an eating disorder. We examined behavioral decision making in college students self-reporting a range of typical and atypical eating behaviors. Participants (n = 550) completed an online session that assessed eating behaviors. Of these, 110 participants then completed the Iowa Gambling Task (IGT) and Game of Dice Task (GDT) as part of a separate, in-lab session. A total of 11.27% of screening session participants scored above the cut-off score of 20 on the Eating Attitudes Test, indicating the presence of possible disordered eating behaviors. Multiple regressions indicated higher scores on the Eating Concern subscale of the Eating Disorder Examination Questionnaire were associated with decreased risk-taking on the IGT (fewer Deck B selections, p = .006; greater Deck D selections, p = .010). We failed to find significant predictors of GDT performance, ps > .232. The present results suggest that decision making deficits seen in eating disorder samples may not be present in individuals self-reporting disordered eating behaviors. However, this initial examination utilized college student participants, and it is important for replication to occur to best discern how decision making functions in pre-clinical eating pathology.

Keywords: eating behaviors, disordered eating, decision making, Iowa gambling task, game of dice task

Introduction: Risky Decision Making in College Students as a Function of Self-Reported Eating Behaviors

Eating behaviors, in general, constitute feeding activities such as intake and regulation of calories necessary to sustain body weight (or to depreciate body weight via caloric deprivation), and in the context of the present study, fall along a spectrum in terms of severity (Levine & Smolak, 2016; Vartanian & Porter, 2016). Along this spectrum, eating behaviors can be further grouped into typical (least severe), disordered eating (severe), and clinical eating disorder pathologies (most severe) (Levine & Smolak, 2016; Vartanian & Porter, 2016). The present study focuses on disordered eating, a class of atypical eating behaviors observed in pre-clinical samples that may represent an at-risk stage in the development of a clinical eating disorder

(Hudson, Hiripi, Pope, & Kessler, 2007). Much of the research to date highlights factors related to disordered eating to better assess symptoms and generate more effective interventions and treatments. In particular, research examined relationships between disordered eating and emotion regulation (Cooper & Wade, 2015; Cooper, O'Shea, Atkinson, & Wade, 2014), impulsivity (Lundahl, Wahlstrom, Christ, & Stoltenberg, 2015), and perfectionism (Boone & Soenens, 2015; Graziano & Sikorski, 2014; Peixoto-Plácido, Soares, Pereira, & Macedo, 2015; Wade, Wilksch, Paxton, Byrne, & Austin, 2015). However, no research to date examined behavioral decision making in disordered eating despite multiple studies showing risky decision making across eating disorder pathologies. The present study sought to examine behavioral decision making in college students with and without self-reported disordered eating behaviors.

Eating Disorders and Disordered Eating

Eating disorders are life-threatening psychiatric disorders that are complex in etiology, with some research pointing to the potential intersection of sociocultural, psychological, and biological influences on development and maintenance of eating disorder pathologies (Culbert, Racine, & Klump, 2015). According to the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5; American Psychiatric Association, 2013), eating disorders are subdivided into three diagnoses: Anorexia Nervosa (AN), Bulimia Nervosa (BN), and Binge Eating Disorder (BED). AN encompasses three diagnostic features: a) persistent caloric restriction; b) fear of weight gain; and c) disturbed perception of body weight/shape (APA, 2013). BN includes three diagnostic features that distinguish it from AN: a) repeated binges (i.e., episode of significantly increased caloric intake in a short amount of time with associated lack of control over eating behaviors); b) repeated engagement in compensatory mechanisms (e.g., excessive exercise, use of laxatives, purging); and c) distorted self-evaluation (APA, 2013). BED is a new diagnosis in the DSM-5, with symptoms including: a) repeated episodes of binge eating; b) during a binge, experiencing such behaviors such as eating quickly, eating despite feeling full, and eating alone due to embarrassment; and c) distress about the

binges (APA, 2013).

Disordered eating can be thought of as at-risk eating behaviors, in that such behaviors can cause severe detriment to one's quality of life but fail to meet the diagnostic criteria for one of the three eating disorders outlined above (DiPasquale & Petrie, 2013). Researchers examined the risk factors associated with eating disorder development and in doing so, highlighted behaviors that may constitute disordered eating (although the precise symptoms have not reached consensus) (Hudson et al., 2007; Rohde, Stice, & Marti, 2015; Wilksch et al., 2015). High rates of atypical eating behaviors (e.g., ritualistic food/caloric consumption, food restriction, binge/purge episodes, and/or extreme dieting) and employment of compensatory mechanisms (e.g., vomiting, use of laxatives/diuretics, and/or exercise) were seen in college-aged samples with disordered eating (Cooley & Toray, 2001; Krahn, Kruth, Gomberg, & Drewnowski, 2005; Loth, MacLehose, Bucchianeri, Crow, & Neumark-Sztainer, 2014). Such disordered eating behaviors are similar to those observed in eating disorders; however, these disordered eating behaviors are typically less intense in terms of both frequency and severity (DiPasquale & Petrie, 2013; Uzun et al., 2006). Along these same lines, Uzun and colleagues (2006) theorized that researchers could find few college-aged participants who meet complete criteria for an eating disorder but many who exhibited disordered eating behaviors. However, published rates of disordered eating varied considerably due to factors such as the types of behaviors assessed, participant sex, and intensity of eating symptoms (Uzun et al., 2006). Some estimates were that 80% of first-year college women engaged in extreme dieting while 50% engaged in binge eating (Uzun et al., 2006). In terms of attitudes toward food, 82% of women demonstrated a marked drive to lose weight throughout college, with numbers dropping to 68% after college (DiPasquale & Petrie, 2013). In general, high rates of some disordered eating behaviors are seen in college-aged women who do not meet criteria for a DSM-5 eating disorder diagnosis.

Of note, research examining disordered eating behaviors from the male perspective is lacking. This sex discrepancy is also observed with eating disorders, as significant sex differences exist in diagnostic rates for AN, BN, and BED (APA, 2013). It may be that eating disorders are socially constructed as

"feminine" disorders, thereby discouraging men to openly discuss atypical eating behaviors with friends, family, and health professionals (Bunnell, 2015). Although we expect higher rates of disordered eating in women than men, just as is seen with eating disorders, it is very likely that disordered eating is present in men as well as women (Uzun et al., 2006). College is a period in which stress levels are high and academic achievement and identity exploration are at the forefront, factors that can exacerbate disordered eating behaviors (Uzun et al., 2006). The present study seeks to add to the research examining disordered eating prevalence rates while also furthering our understanding of how variables such as decision making may be related to severity of disordered eating behaviors.

Decision Making and Eating Behaviors

Neuropsychological studies revealed deficits in several cognitive domains across individuals with eating disorders (see Tchanturia et al., 2004, for review). Most notably, deficits in executive functioning were observed in individuals diagnosed with AN and BN (Brand, Franke-Sievert, Jacoby, Markowitsch, & Tuschen-Caffier, 2007; Ehrlich et al., 2015; Juarascio, Manasse, Espel, Kerrigan, & Forman, 2015). Executive functioning refers to higher-order cognitive processes coordinated by the frontal lobes, including organization, planning, problem solving, set shifting, and working memory (Lezak, Howieson, & Loring, 2004; Wiechmann, Hall, & Azimipour, 2015). Another commonly assessed executive function is decision making, a process that can be defined as, at its simplest, a selection between two or more options. From a clinical perspective, risky decision making was defined as a myopic focus on immediate rewards at the expense of long-term outcomes (Bechara, Damasio, Damasio, & Anderson, 1994). For example, an individual who decided to take a larger, immediate reward associated with larger, long-term losses engaged in riskier decision making than an individual who decided to take a smaller, immediate reward associated with smaller, long-term losses. Within the eating disorder literature, several studies found evidence of decision making deficits on formal behavioral tasks assessing risky decision making. These behavioral tasks included the Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Ander-

son, 1994), a measure of risky decision making utilized in clinical and research settings. With the IGT and similar tasks, risky decision making was shown in individuals diagnosed with AN (Brogan, Hevey, & Pignatti, 2010; Cavedini et al., 2004), BN (Boeka & Lokken, 2006; Brogan et al., 2010; Liao et al., 2009), and BED (Danner, Ouwehand, van Haastert, Hornsveld, & de Ridder, 2011). Individuals with eating disorders may make riskier decisions due to a focus on immediately rewarding behaviors over less rewarding but more positive/healthy long-term behaviors. Food deprivation, binging, and purging may mimic an immediate reward for the individual that outweighed potential long-term negative consequences (e.g., abnormally slow heart rate, endocrine dysfunction, gastric rupture, low blood pressure, peptic ulcers, and more) (Wierenga et al., 2014). Decision making deficits (i.e., increased risk-taking) were also seen as a function of obesity (Brogan et al., 2010; Brogan, Hevey, O'Callaghan, Yoder, & O'Shea, 2011), and risky decisions predicted successful versus unsuccessful weight loss in a weight management program (Emery, Buelow, Olson, Landers, & Thaxton, 2016). Differences in Body Mass Index (BMI) were not associated with differences on the IGT (Brogan et al., 2011), yet BMI is frequently utilized as a control variable across studies of decision making and eating behaviors (e.g., Davis, Levitan, Muglia, Bewell, & Kennedy, 2004; Brogan et al., 2010). These patterns of real-world behaviors, and the focus on immediate versus long-term consequences, mimic how decisions were made in these lab-based behavioral decision making tasks.

While the focus of research to date has been on eating disorder samples, the present study extends the current literature to hypothesize risky decision making may also be present in individuals self-reporting disordered eating behaviors, as both share similar features. The present study stands alone in its examination of decision making outcomes in individuals self-reporting a range of disordered eating behaviors. Such research could identify potential risk factors that lead to eating disorder development, thereby providing insight into treatment programs targeting risky decision making among individuals with disordered eating behaviors.

The Present Study

The present study examined behavioral decision making in a sample of college students self-reporting eating, both typical and disordered, behaviors. Previous research suggested risky decision making across eating disorder diagnoses. Considering that eating disorders and disordered eating share many features, similar decision making deficits may be present in a disordered eating sample. Importantly, the presence of this relationship at an earlier, at-risk stage in the development of eating pathology would highlight a potential point upon which intervention and/or treatment could be implemented. The first study aim was to assess rates of disordered eating behaviors among college students. Next, risky decision making was assessed through administration of two computerized tasks. It was hypothesized that individuals with greater disordered eating behaviors will display riskier decision making compared to individuals with fewer disordered eating behaviors, as individuals endorsing disordered eating may rely more on immediate, emotion-centered decision making strategies. It is this propensity towards short-term, reward-focused outcomes that mimics real-world behaviors in general (Bechara et al., 1994) and to disordered eating behaviors more specifically. As such, we find it necessary to approach this potential relationship from a behavioral—rather than self-report—perspective.

Method

Participants

The study was approved by the University's Institutional Review Board and all participants provided informed consent. Two studies were conducted: an online study assessing rates of disordered eating behaviors and an in-person study assessing relationships between disordered eating behaviors and risky decision making. Any participant completing the first study was eligible to complete the second study (i.e., there were no additional restrictions on participation for the in-person study). A total of 550 participants, all over age 18 (244 men, Mage = 18.85, SDage = 2.77, 69.5% European American, 13.5% African American, 5.2% Asian American or Pacific Islander, 2.3% Hispanic American, 9.5% Other Ethnicity) and enrolled in introductory psychology courses completed the online study. Of these, 120 also scheduled and completed an in-person session assessing behavioral decision making. The number of in-person participants was limited in part by lab space constraints. Ten participants were removed from further analyses (six reported a diagnosis of Attention-Deficit/Hyperactivity Disorder, one reported a diagnosis of BN, and three had previous experience with the behavioral tasks), leaving a final sample of 110 participants (35 men, Mage = 18.46, SDage = 0.95, 67.6% European American, 15.2% African American, 4.8% Asian American or Pacific Islander, 4.8% Hispanic American, 7.6% Other Ethnicity). Independent-samples t-tests indicated no significant differences between those who completed just the online study and those who also completed the in-person study in terms of study variables, ps > .345. All participants were debriefed upon completion of the study protocol.

Measures

Eating Attitudes Test-26 (EAT-26). The EAT-26 is a 26-item measure used as a screening tool for the presence/absence of an eating disorder (Garner, Olmsted, Bohr, & Garfinkel, 1982). It was included due to its inclusion of questions assessing different disordered eating behaviors. Responses ranged from 0 (none to minimal) to 3 (always), with higher scores (range: 0-78) indicating a greater likelihood of eating disorder pathology. Summed scores were calculated for the present study. Additionally, scores on this measure were split by participants scoring above or under the cut-off score of 20 put forth by the authors to indicate at-risk eating behaviors (Garner et al., 1982). Internal consistency was high in our sample (alpha = .89). Previous psychometric examinations of the scale showed high discrimination between individuals with and without AN (84.9% correctly classified based on cut-off score of 20) and moderate to strong correlations with weight, body size estimates, and body image (Garner et al., 1982).

Eating Disorder Examination Questionnaire (EDE-Q). The EDE-Q is a 28-item measure of eating disorder severity (Fairburn, Cooper, & O'Connor, 2008), and was also selected due to its use as a screening instrument for disordered eating behaviors. The EDE-Q includes four subscales that further assess the cognitive structure of eating disorders: Re-

straint, Eating Concern, Shape Concern, and Weight Concern. Responses were calculated according to the amount of days (out of the past 28 days) one has acted on the question (e.g., "Have you been deliberately trying to limit the amount of food you have been eating to influence your shape or weight (whether or not you have succeeded)?"), with responses ranging from 0 (No days) to 6 (Every day). Summed scores for each of the four subscales were calculated, with higher scores indicative of more severe eating behavior symptomology (Fairburn et al., 2008). Internal consistency was high in our sample (alpha = .90 total; .84-.94 by subscale). Previous research has indicated good concurrent and criterion validity for the measure (Mond, Hay, Rodgers, Owen, & Beumont, 2004).

Game of Dice Task (GDT). The computerized GDT assesses risk-taking behavior as a function of decision making (Brand et al., 2005), and was chosen due to the focus on behavioral risky decision making. The GDT mimics a gambling-type situation. Participants were told to maximize profit by predicting 18 throws of a single virtual die (Brand et al., 2005). Prior to each throw, participants were instructed to select/predict a single number or combination of numbers (up to four numbers), with each selection bearing potential gain/loss amounts. Selecting a single number yielded the greatest gain but also the greatest loss ($1000). Conversely, selecting a combination of numbers yielded smaller gains but also smaller losses: $500 for a combination of two numbers, $200 for a combination of three numbers, and $100 for a combination of four numbers. The number of selections indicated greater (1,2) or lesser (3,4) risky decision making (Brand et al., 2005). The present study assessed risky decision making by utilizing the proportion of risky choices (1 or 2 number combinations), with greater values indicating riskier decisions. Scores could range from 0% (no risky choices) to 100% (only risky choices). The GDT differentiated between patient and healthy control samples, and showed some correlations with other behavioral decision making measures (Schiebener & Brand, 2015).

Iowa Gambling Task (IGT). Participants completed the standard computerized version of the IGT to assess risky decision making (Bechara, 2007; Bechara et al., 1994), as the IGT is currently the only clinically-available behavioral measure of risky

decision making. Participants started with a loan of $2,000 and were given instructions to maximize profit over 100 trials. Participants made selections from four decks of cards (Decks A, B, C, and D). Selections from Decks A and B resulted in an average profit of $100 per selection, whereas Decks C and D resulted in an average profit of $50 per selection. However, after making 10 selections from Decks A and B, participants incurred a net loss of $250. After making 10 selections from Decks C and D, participants incurred a net gain of $250 (Bechara et al., 1994). Therefore, Decks A and B were termed "disadvantageous" decks, whereas Decks C and D were termed "advantageous" decks. It is important to analyze performance on the IGT as the task progresses, as such information provides critical distinctions in decision making performance across earlier and later deck selections. The initial trials of the IGT, termed decision making under ambiguity (Brand, Recknor, Grabenhorst, & Bechara, 2007), constitute selections from both disadvantageous and advantageous decks as participants do not know much about the relative risks and benefits of each deck yet. The final trials (60 [Brand et al., 2007] or 40 [Ko et al., 2010; Noel, Bechara, Dan, Hanak, & Verbanck, 2007]), termed decision making under risk, are different from the initial trials in that participants have gained enough experience to learn of the relative risks and benefits of each deck. Therefore, continued selections from disadvantageous decks during the final trials constitutes risky decision making. To examine the influence of disordered eating behaviors on decision making under risk, we analyzed the percent of individual deck selections (A,B,C,D) on the last 60 trials. Scores could range from 0% (no selections from that deck) to 100% (only selections from that deck). Validity for the IGT has previously been shown (Bechara, 2007), with continued concerns about test-retest reliability due to strong practice effects (Buelow & Suhr, 2009). Impaired decision making on the IGT is seen among individuals with pathological gambling, frontal lobe injuries, schizophrenia, and high levels of psychopathy characteristics (Buelow & Suhr, 2009).

Procedure

Information about both the online and in-lab sessions was posted on the department's online

research sign-up system, and interested participants were able to read additional information about each study prior to choosing a study session. Participants gave informed consent for both the online and in-lab sessions and were debriefed at the end of each session. The online session included administration of the EAT-26, EDE-Q, and demographic questionnaires (including questions about age, gender, ethnicity, and current height and weight to allow for calculation of BMI). At the end of the online session, participants read a debriefing statement and information about the lab-based session. Completion of the online session allowed interested participants to sign up for the lab-based session. The second, in-person session consisted of the GDT and IGT completed in a randomized order, and participants were debriefed at the end of the study. Participants were given course credit after each session.

Results

Descriptive statistics are provided in Table 1. A power analysis conducted with G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007) indicated that a sample of 89 participants was needed to detect a medium effect with alpha of .05 and power of .95. The first study aim was to assess rates of disordered eating in a college (undergraduate student body) sample. This aim was addressed by examining scores on the EAT-26 and EDE-Q in the online sample. Garner and colleagues (1982) stated that a score of 20 on the EAT-26 should act as a cut-off, with scores above 20 indicating concerns about eating behaviors warranting follow-up assessment. In the present study, 62 participants (11.27%) scored above the cut-off score, and a greater proportion of women (15.89%; M = 11.71, SD = 9.16) than men (5.74%; M = 8.18, SD = 6.56) fell in this range, χ^2(1,N = 546) = 13.83, p < .001. No differences were found between men and women on the study variables, ps > .103; however, due to sex differences in disordered eating behaviors and behavioral decision making, sex was included as a predictor in the remaining analyses.

Prior to addressing the second study aim, IGT deck preferences were examined with a repeated measures ANOVA due to lack of independence of observations. Mauchly's Test of Sphericity was significant, χ^2(5) = 43.73, p < .001; therefore, the Greenhouse-Geisser correction was applied. The overall ANOVA was significant, F(2.495, 269.490) = 16.59, p < .001, partial η^2 = .133. During the later IGT trials (Trials 41-100), participants preferred Deck D to Deck A (p < .001) and Deck C (p < .01), Deck C to Deck A (p < .01), and Deck B to Deck A (p < .001). Therefore, participants in general avoided Deck A compared to the other decks.

The second study aim was to assess the relationship between disordered eating behaviors and risky decision making. It was hypothesized that individuals with greater disordered eating behaviors will display riskier decision making compared to individuals with fewer disordered eating behaviors. Multiple regressions were utilized to assess this hypothesis. Sex, current BMI (M = 25.16, SD = 5.37) based on self-reported current height and weight, scores on the EAT-26, and scores on the EDE-Q subscales were the predictors, and performance on the IGT (percent selections from Deck A, B, C, D) and GDT (proportion of disadvantageous selections) were the outcome variables. Correlations between the predictor variables are presented in Table 2.

First, the assumptions of multiple regression were examined per Tabachnick and Fidell (2013) and Cohen and colleagues (2003). The outcome variables (GDT, IGT scores) were measured on a continuous scale, and the predictor variables were measured on a categorical (sex) or continuous (BMI, EAT-26, EDE-Q) scale. Six predictors remained in the analyses following examinations of multicollinearity, and our total sample size was slightly under the recommended 20 per predictor (Tabachnick & Fidell, 2013). The presence of outliers was examined with scatterplots and histograms of the residuals. No outliers emerged for the GDT or IGT Decks B and D, but potential outliers were identified for Deck A and Deck C. An examination of leverage and Cook's D indicated one outlier in the Deck A analysis that also showed high leverage. This data point was removed from the remaining analyses. The assumption of normality of residuals was examined with residual plots. The Kolmogorov-Smirnov statistic was significant for IGT Decks C and D, indicating concerns with normality. In addition, distributions of the residuals indicated concerns about heteroscedasticity for the Deck C analyses. To correct for these concerns, a square root transformation, due to the presence of zeros in the data, was applied to each of the outcome variables. Finally, multicollinearity was assessed

with the Variance Inflation Factor (VIF). When all four EDE-Q subscales were included in the regression, the VIFs for Shape Concerns (VIF = 7.77-7.94) and Weight Concerns (VIF = 7.68-7.81) were over 5. To correct for this, Shape Concerns, the highest VIF, was removed from the analyses. The VIF for the remaining six predictors was under 5 (see Table 3). Results of the multiple regressions are presented in Table 3. To minimize Type I error rate, only analyses significant at the .01 level were interpreted. No significant predictors emerged for risk-taking on the GDT, ps > .232, or in IGT Deck A, ps > .088, or Deck C, ps > .147, selections. Greater Eating Concerns on the EDE-Q were associated with fewer Deck B selections, p = .006, and greater Deck D selections, p = .010, on the later trials (Trials 41-100) of the IGT.

Discussion

The present study examined behavioral decision making in college students self-reporting a range of eating behaviors on a spectrum from typical to atypical, but in the absence of a diagnosed eating disorder. Two overall study aims were addressed. First, descriptive information was provided regarding prevalence of self-reported disordered eating behaviors. We found 11.27% of our sample scored above the recommended cut-off score on the EAT-26, indicating concerns about disordered eating behaviors. Additional examination of scores by sex showed a greater prevalence of self-reported disordered eating in women than men; however, given the difference in number of men (244) versus women (306) in the study, this result should be replicated in a larger sample and with a more equal sex distribution. Our present finding of a sex difference is consistent with the gendered disparity of eating disorder diagnosis rates more generally, as well as with previous research on disordered eating behaviors (Bunnell, 2015). However, given the nature of the self-report data in this study, it is unclear whether the eating behaviors endorsed were indicative of behaviors that could lead to a diagnosable eating disorder or those that may represent a lifestyle modification to improve health and well-being.

The second study aim was to assess risky decision making in individuals self-reporting a spectrum of disordered eating behaviors. We hypoth-esized individuals with greater disordered eating will display riskier decision making compared to individuals with fewer disordered eating, but our results did not support this hypothesis. No significant relationships were found between eating behaviors on the EAT-26 or EDE-Q and the GDT. This finding is in contrast to previous research showing risky decisions on the GDT as a function of eating disorder diagnosis (Brand et al., 2007), but again our participants did not have a self-reported eating disorder diagnosis. Although in general (independent of eating behaviors) participants learned to avoid Deck A during the later IGT trials, we found few relationships between disordered eating and performance on the IGT. Specifically, the only significant findings were between Eating Concerns and Deck B and D selections. Contrary to prediction, individuals endorsing a higher level of disordered eating on the EDE-Q Eating Concerns subscale made more advantageous—not riskier—selections from these decks. Individuals bypassed the high immediate rewards (but long-term negative consequences) of Deck B in favor of the lower immediate rewards (but long-term positive outcomes) of Deck D (Bechara, 2007). However, it should be noted that the overall proportion of variance in decision making accounted for by disordered eating was low (.07-.09 across decks), reflecting an overall low practical significance of these findings.

Taken together, the present findings are inconsistent with research findings of risky decision making among individuals with eating disorders on the IGT (e.g., Boeka & Lokken, 2006; Brogan et al., 2010) and GDT (Brand et al., 2007). Yet, no studies to date have examined risky decision making in a pre-clinical sample (i.e., individuals with disordered eating but not a diagnosed eating disorder). Therefore, the present preliminary study provides initial evidence that the decision making deficits seen in various eating pathologies (AN, BN, BED, obesity) may not be evident in disordered eating behaviors. Given the types of eating behaviors included in disordered eating, and the lack of formal diagnostic criteria, it is possible that our results are a function of eating "oddities" or dieting/lifestyle changes intended to improve health. For example, an individual in the process of increasing their fitness level, with associated restrictive eating patterns, in an effort to improve overall health could result in higher scores on the EAT-26 or EDE-Q. Participants may have ex-

hibited advantageous decision making performance on the IGT due to this focus on longer-term positive consequences (i.e., greater monetary gains on the IGT; improved health outcomes in the real world). It is unclear, however, why only the Eating Concerns subscale was associated with IGT performance. Examining the individual items from this subscale show some overlap with obsessive-compulsive symptomatology. Endorsing these items may incline such individuals to be acutely aware of changes in their environment, leading to improved decision making strategies such as those seen in some individuals diagnosed with obsessive-compulsive disorder (Buelow & Suhr, 2009). Other items on the Eating Concerns subscale assess behaviors such as eating in secrecy, social eating, and guilt (Fairburn et al., 2008). Endorsement of these items—as well as those previously discussed—could reflect one of two behaviors: (a) a predisposition to future eating disorder pathology or (b) an attempt to model healthier eating behaviors, such as by following a physician's strict diet to improve health. As the present study relied on self-report in non-treatment seeking college students, it is unclear to what degree some eating behaviors may be inaccurately identified as disordered on these measures. Future research should aim to tease apart these differences in reasons behind eating behaviors. There are differences in the type of decision making assessed with the IGT and GDT, which help to better understand the inconsistent findings across measures. On the IGT, participants must learn to choose advantageously via feedback on previous trial wins/losses (Brand et al., 2007). These relative risks are not known at the start of the study, and participants must pay attention to the feedback in order to learn. This learning process is reflected in the differentiation between decision making under ambiguity (first 40 trials) and decision making under risk (last 60 trials) on this task. On the GDT, however, the risks associated with each decision are made explicit at the start of the task (Brand et al., 2005). On the first GDT trial, participants know the exact monetary value of choice. The amount of money at stake on each IGT selection ($50-100 gains) is lower than the amount of money at stake on each GDT selection ($100-1000) as well. It is possible our results differed on the IGT and GDT due to differences in learning the probabilities associated with each decision, or to differences in the magnitude of the wins/losses across tasks.

Limitations

The present study had several important limitations. First, we relied on self-report measures to assess disordered eating. In general, self-report measures could underestimate the actual prevalence of behaviors if individuals are uncomfortable sharing such information with a researcher. Future research should attempt to better assess disordered eating behaviors with the use of more thorough measures, including both self- and other-report, and a structured clinical interview. It could also be the case that social desirability factors influenced responses, particularly among men. As atypical eating behaviors are often regarded as "feminine" issues, accurate disclosure of disordered eating behaviors could be withheld among men due to societal pressures to conform to normative masculine behavior. Due to disparities in the number of participants across sex (more women than men), future research should seek the better highlight sex differences in examinations of both prevalence rates and the presence of decision making deficits. Our sample size was also a potential limitation in the present study. Although a power analysis indicated likely sufficient power to detect medium effects, the study was underpowered to detect smaller effects. Future research utilizing a larger sample of participants is necessary to better ascertain differences in decision making as a function of typical and atypical eating behaviors. Finally, the present work was limited in the lack of a consistent definition of disordered eating behaviors. Future research is needed to better delineate the disordered eating construct, including a better way to distinguish between behaviors that reflect health and wellness (e.g., dieting to lose weight for better cardiovascular health) and those that reflect detrimental, atypical eating behaviors. A consistent definition and conceptualization of disordered eating will allow future researchers to examine how it functions as an at-risk stage in eating disorder development.

Conclusions

Taken together, the present results provide evidence of a relationship between self-reported eating behaviors and behavioral decision making. These preliminary data suggest that decision mak-

ing deficits seen across eating disorders may not be present in an earlier, pre-clinical stage; however, it is important to note that this study utilized a small sample of non-treatment seeking college students. Future research should replicate and expand on these findings with a more diverse sample, a more in-depth examination of potential confounding behaviors such as healthful dieting, and different measures of decision making to examine whether probability learning or type of decisions made are affected by eating behaviors.

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Table 1. Means and standard deviations for study variables.

Variable	Online Screening			In-Person Session
	Total	Men	Women	
	M (SD)	M (SD)	M (SD)	M (SD)
EDE-Q				
Restraint	0.74 (1.13)	0.51 (0.91)	0.92 (1.25)	0.77 (1.24)
Eating Concerns	0.47 (0.91)	0.27 (0.60)	0.63 (1.06)	0.52 (0.93)
Shape Concerns	1.55 (1.61)	0.83 (1.18)	2.13 (1.68)	1.63 (1.62)
Weight Concerns	1.36 (1.51)	0.74 (1.08)	1.86 (1.61)	1.45 (1.51)
GDT	--	--	--	42.35 (27.00)
IGT				
Deck A	--	--	--	15.92 (10.16)
Deck B	--	--	--	31.01 (16.74)
Deck C	--	--	--	22.22 (23.58)
Deck D	--	--	--	32.66 (19.05)

Note: BMI = Body Mass Index; EAT = Eating Attitudes Test-26; EDE-Q = Eating Disorder Examination; IGT = Iowa Gambling Task, selections from each deck during Trials 41-100; GDT = Game of Dice Task, proportion of disadvantageous selections.

Table 2. Correlations between predictor variables.

Variable	1	2	3	4	5	6
1. BMI	--	.088	.148	.089	.297*	.307*
2. EAT-26		--	.686*	.553*	.469*	.510*
3. EDE-Q Restraint			--	.714*	.619*	.644*
4. EDE-Q Eating				--	.624*	.677*
5. EDE-Q Shape					--	.929*
6. EDE-Q Weight						--

*$p < .01$

Note: BMI = Body Mass Index; EAT-26 = Eating Attitudes Test-26; EDE-Q = Eating Disorder Examination, Restraint, Eating Concern, Shape Concern, and Weight Concern subscales.

Table 3. Regression analyses.

Outcome	Predictors	F	p	R^2	VIF	B	SE(B)	β	t	p
GDT		0.74	.620	.04						
	Gender				1.24	-0.07	0.18	-0.04	-0.40	.687
	BMI				1.12	0.02	0.02	0.13	1.20	.233
	EAT-26				1.67	0.09	0.09	0.14	1.09	.276
	Restraint				3.01	-0.08	0.21	-0.07	-0.41	.682
	Eating				2.48	0.23	0.22	0.16	1.06	.294
	Weight				2.63	-0.19	0.17	-0.18	-1.09	.278
IGT A		0.95	.465	.05						
	Gender				1.22	0.22	0.16	0.16	1.43	.155
	BMI				1.11	0.01	0.01	0.08	0.75	.453
	EAT-26				1.67	0.02	0.07	0.04	0.33	.741
	Restraint				3.03	0.21	0.18	0.20	1.20	.232
	Eating				2.51	-0.15	0.19	-0.12	-0.78	.435
	Weight				2.62	-0.25	0.14	-0.27	-1.72	.089

Table 3 (continued).

Outcome	Predictors	F	p	R^2	VIF	B	SE(B)	β	t	p
IGT D		1.34	.247	.07						
	Gender				1.24	0.07	0.14	0.05	0.50	.616
	BMI				1.11	-0.00	0.01	-0.01	-0.10	.918
	EAT-26				1.66	-0.02	0.06	-0.04	-0.34	.731
	Restraint				3.04	-0.23	0.15	-0.25	-1.52	.132
	Eating				2.53	0.43	0.16	0.40	2.63	**.010**
	Weight				2.64	-0.06	0.13	-0.08	-0.49	.626

Note: BMI = Body Mass Index; EAT-26 = Eating Attitudes Test-26; EDE-Q = Eating Disorder Examination, Restraint, Eating Concern, and Weight Concern subscales.

Outcome	Predictors	F	p	R^2	VIF	B	SE(B)	β	t	p
IGT B		1.58	.160	.09						
	Gender				1.23	0.02	0.14	0.01	0.11	.909
	BMI				1.11	-0.00	0.01	-0.03	-0.25	.807
	EAT-26				1.67	0.08	0.07	0.15	1.24	.220
	Restraint				3.05	0.13	0.16	0.13	0.78	.435
	Eating				2.53	-0.48	0.17	-0.42	-2.79	**.006**
	Weight				2.65	0.18	0.13	0.21	1.35	.181
IGT C		0.68	.669	.04						
	Gender				1.24	0.03	0.17	0.02	0.17	.870
	BMI				1.11	0.01	0.01	0.10	0.95	.343
	EAT-26				1.66	0.05	0.08	0.07	0.56	.575
	Restraint				3.04	0.03	0.20	0.02	0.14	.892
	Eating				2.53	-0.31	0.21	-0.23	-1.46	.148
	Weight				2.64	0.01	0.16	0.01	0.07	.948

The Math of Music: An Algorithm of Allegros

By Sara Louise Wilkins

Abstract

Math and music: two things that to most people, seem entirely different. However, they are more alike in countless ways than they are different. As early as the Greek philosophers, there have been brilliant people who have dedicated their time to creating a link between math and music. It is in this attitude that I attempt to bridge the relationship between math and music.

At its core, music is created entirely by mathematics. The humming of strings and the strike of a piano key may indeed carry out sound, but it also carries a plethora of mathematical equations and theorems to support it. Whether it be a relation of Hertz or even a derivative of a famous mathematical equation like Pythagorean's Theorem, this paper promotes the idea that mathematics can be used to describe every type of music.

Whether you prefer rock to classical, rap to pop, all music is broken down into notes and chords. Sound is created using electronic equipment that has been perfected over centuries. Instruments have been refined to make the most brilliant sound that their materials allow, all of this and more is in part due to the brilliant relationship that music and mathematics share.

Introduction

As a student, here, at The Ohio State University, being a theoretical mathematics major along with having a minor in business and another minor in economics takes away from the glamour of college life. I was a part of the STEM-EE scholars program in my freshman and sophomore year, and just being a part of Honors & Scholars College in general, had been a rewarding experience all in itself and has made up for any and all experience I might have missed as a mathematics student. As a requirement, all second-year STEM-EE students must complete a sophomore thesis project. A lot of students do internships or volunteer work, but I wanted to do a project that went into depth about a topic that I felt passionately about. After a couple efforts to relate the project to my major, I was really stuck about what I should do, but then I thought, what is a topic that I could argue over for hours that I spend hours a day thinking about? And that's when I came to music. Music for my generation is one of the biggest topics and is THE most successful industry in the world. Throughout my studies here at The Ohio State University, I have found out that one cannot have music without math. Artists create albums that are composed using some of the greatest technology the industry has to offer, and after stripping music down to the basics, it is apparent that math is the foundation of it all.

Content

"There is geometry in the humming of strings, there is music in the spacing of spheres." As stated by Pythagoras, founder of the Pythagorean Theorem, there could not be a more perfect representation of what was accomplished throughout this research project. What many people don't know, is that Pythagoras was one of the first philosophers to realize that the different notes and tones of music are mathematically related. Today, we call these relations octaves, fifths, and thirds, which are the different steps it takes to go from one tone to another. According to a list composed of "The 100 Greatest Mathematicians," which spanned from the Greek age all the way to the postmodern age, over twenty percent of the people on the list either had studied music, or tried to relate music to some mathematical proof. Showing the relationship between great mathematicians and music throughout the span of history displays the vast importance and impact music has had and is, in some instances, the by-product of the great mathematical minds in history (Allen).

The first aspect of music, the most basic part, is that music is simply vibrations through the air that are received through the ears as sound. Hearing was one of the final senses to develop, which makes sense from an evolutionary standpoint, as it was more important to see a predator rather than to hear it. Ironically, despite its delayed evolution, the human ear is the most sensitive part of the body, being able to sense a change in air pressure (or vibration) as much up to a ten-thousand-millionth percent. The process of hearing occurs because of the structure of the ear. The nerves in the ear are quite powerful. For example, when any animal, say a deer, turns its head, or any upper part of its body, it can instantly survey surrounding sounds, and its ears send appropriate reactions to the brain on what to do, i.e., fight or flight. Therefore, even the slightest change of a musical note, certainly someone playing off-key, is detectable to the human ear.

The patterns of the human ear can be measured using things called "Sound Curves." Just like when an earthquake is recorded on a Richter scale, the ear measures vibrations in and around our body (Jeans). However, upon further investigation, it becomes apparent that the patterns resemble mathe-matical techniques related to sound reflection from objects, today known as sonar. Sonar technology has undergone a massive shift in the past 100 years. Scott Rickard, a mathematician, did a TED talk study on this and labeled it "The Beautiful Math behind the World's Ugliest Music," in which he goes into detail about the topic of patterns and repetition, saying how music today is ruled by repetition. Sonar originally had a single "ping," much like the downward riff of a piano. In 1960, John Costas was attempting to enhance on the Navy's sonar system, which used the same downward piano riff "ping." He designed a different kind of "ping," one that, to the eye, looks random, yet is distinct in that each note of the "ping" is mathematically pattern free, and not relatable to the next. These "patterns" are what make up what is now known as the Costas Arrays. Based off Galois Field Theory (which described the mathematics of prime numbers), theses arrays, are generated by repeatedly multiplying by the number three. In the 88 by 88 Costas Array, John Costas solved the navy's sonar pattern. As pointed out by Scott Rickard in his presentation of this research, "there happen to be 88 keys on a piano" (Rickard).

Thirty years before Costas, a man named Arnold Schoenberg was dealing with a problem very similar to Costas. Famed as one of the greatest postmodern composers in the history of music, Schoenberg developed a technique called twelve tone, or dodecaphony. The technique is a means of ensuring that all 12 notes of the chromatic scale are sounded as often as one another in a piece of music while preventing the emphasis of any one note using tone rows, or orderings of the 12 pitch classes. All 12 notes are thus given approximately equal importance, and the music avoids being in a certain pattern or key. This is done through the process of mathematical invariants, defined as, "A quantity which remains unchanged under certain classes of transformations." Many mathematicians have classified 12 tone dissonancy as the greatest example of mathematical variants of our time. So, a musical genius turned out to be a mathematical one as well (Rickard). The math behind this is relatively very straightforward. So, let's have a defined number p/1. And let's define p as being on a prime interval where p is greater than 2. Now, we have this inequality:

$$1 < \left(\frac{p}{2^n}\right) < 2$$

equation 1.1

This inequality is the definition of a sound interval, like the ones that I mentioned earlier, a third, fifth, octave, etc. If we do more manipulation we get this second inequality:

$$2^n < p < 2^{n+1}$$

equation 1.2

Based on this second interval, we can assign predetermined values of musical rations.

$$a = \log(2) \qquad v = \log\left(\tfrac{3}{2}\right) \qquad t = \log\left(\tfrac{5}{4}\right)$$

equation 1.3

These values work because the size on the interval is the logarithm of its ratio. The values of "a, t, v" are units of frequencies. Now the size of a specific interval is the following equation:

$$ma + nv + qt$$

equation 1.4

Substituting the values of a, v, t, the new value is:

$$ma + nv + qt = (m)\log(2) + (n)\log\left(\tfrac{2}{3}\right) + (q)\log\left(\tfrac{5}{4}\right)$$

equation 1.5

Then by properties of logarithms, the front constant can be moved to the exponent position:

$$= \log\left(\tfrac{2}{1}\right)^m + \log\left(\tfrac{3}{2}\right)^n + \log\left(\tfrac{5}{4}\right)^q$$

equation 1.6

By the other properties of logarithms, addition amongst multiple logarithms can be multiplication of a single logarithm:

$$= \log\left[\left(\tfrac{2}{1}\right)^m \cdot \left(\tfrac{3}{2}\right)^n \cdot \left(\tfrac{5}{4}\right)^q\right].$$

equation 1.7

This means if we start at some pitch – any pitch – go up two octaves, then up on major third, and down three perfect fifths, we end on a pitch whose ratio is (40/27) multiplied by the original pitches value. This is a precise language for describing interval relationships and calculating the composition of any interval from our fundamental values (Kepner).

So, a big part of all this math is the unit in which it measured: frequencies. Frequencies play a big part in a lot of aspects of music and mathematics. The equation listed here is the basic equation for hertz in terms of frequencies of the different musical notes.

$$440 \cdot 2^{n/12}$$

equation 1.8

When you plug in a certain value of n, it is possible to get a range of notes and their hertz value. Figure one cites a table of notes and their mathematical hertz value, and then a graphical representation of the same equation, showing the trend of hertz produced by each note when it is played is represented in Figure two.

Going back to our old friend Pythagoras, we can now go into a little more depth about his original musical thoughts. Around 500 BC Pythagoras studied the musical scale and the ratios between the lengths of vibrating strings needed to produce certain sounds. Since the string length and tension were needed for frequency, the ratios also provide a relationship between the frequencies of the notes. Pythagoras developed what may be the first completely mathematically based musical scale. The following equation describe the basic part of frequencies of certain beats, or musical notes:

$$f_{beat} = |f_1 - f_2|$$
$$f_1 = f_0\left(\tfrac{3}{2}\right)^6 \times 2^{-3}$$
$$f_2 = f_0\left(\tfrac{3}{2}\right)^{-6} \times 2^4$$

equation 1.9,10,11

When these different notes were played together, their harmonics would beat against each other. This typically sounded unpleasant in music and thus the desire was created to avoid multiple frequencies beating at the same time, therefore leading to the various musical scales being created, all thanks to the equations above (Kepner).

Conclusion

While growing up, I heard my peers complaining that they would never use the math they were "forced" to learn. Being a mathematics major, I do get to use the math I learned since elementa-

ry, middle, and high school. However, I also get to experience math in my everyday life. In my studies, I have uncovered a relationship figuratively as old as time between math and music, even going back to evolutionary times. This generation and the ones prior seem to push music aside, and focusing solely on hard sciences. The many mathematicians of the past developed what would turn out to be the basis for the modern world in which we live. Most, if not all mathematicians, I predict, have turned to music as a form of relaxation and an outlet for creativity. As I stated earlier, twenty percent of the greatest mathematical minds on this earth attempted to show the correlation between music and math, which goes to show how important the connection between the two is. Math and music are, and will continue to be, inherently intertwined. What I have proven in this research project, and what is essential for mathematicians and musicians alike to understand, is that there is no music without math.

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Figure 1. Notes and their mathematical hertz value (based off of the piano)

Note	Frequency	Note	Frequency	Note	Frequency	Note	Frequency
C	130.82	C	261.63	C	523.25	C	1046.5
C#	138.59	C#	277.18	C#	554.37	C#	1108.73
D	146.83	D	293.66	D	587.33	D	1174.66
D#	155.56	D#	311.13	D#	622.25	D#	1244.51
E	164.81	E	329.63	E	659.26	E	1318.51
F	174.61	F	349.23	F	698.46	F	1396.91
F#	185	F#	369.99	F#	739.99	F#	1479.98
G	196	G	392	G	783.99	G	1567.98
G#	207.65	G#	415.3	G#	830.61	G#	1661.22
A	220	A	440	A	880	A	1760
A#	233.08	A#	466.16	A#	932.33	A#	1864.66
B	246.94	B	493.88	B	987.77	B	1975.53
						C	2093.00

Figure 2. The trend of note frequencies as they increase
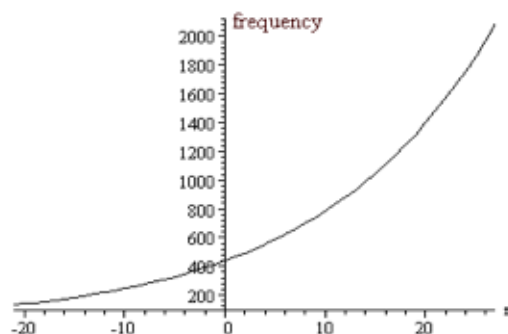
Justice for All? Economic Situation, Political Attitudes, and Trust in the Judicial System in Poland

By Lauren E. Sayers

Abstract

The judicial system is a foundational democratic institution that is charged with the legal protection of citizens and their rights. Recent events in the US, Russia and Poland regarding the ill-functioning of the judicial system have inspired debate on the relationship between citizens and the judicial system's tendency towards justice or, in some cases, injustice. While there is a large international literature on trust in institutions, there is very little on trust in the judicial system, specifically. This subject has not been adequately studied in the countries of Central and Eastern Europe, where the association between social structural position and political attitudes on one side of the equation, and trust in the judiciary on the other, is not well-established. This research uses the Polish Panel Survey, POLPAN for the 2008 and 2013 waves, to answer the question, "to what extent does economic situation and political attitudes influence individual trust in Poland's judicial system?" Results suggest a positive and substantial relationship between subjective social status and the dependent variable, trust in the judicial system. High trust in other institutions—in this case, political parties and European Parliament—along with perceived positive influence of the government on corruption, also leads to increases in trust in the judicial system. The variable with the most significant and surprising impact on the dependent variable was age: Older Poles, who remember the failure of judicial and other major institutions during the Communist era, are less likely to trust in the judicial system than younger Poles who have no such direct memory. Further research regarding the relationship between aging and trust could perhaps offer institutions and social scientists a better understanding of public perception and contribute to explanations of attitudinal changes throughout the life course.

Introduction

The judicial system is a foundational democratic institution that is charged with the legal protection of citizens and their rights. Recent events in the United States regarding inequalities and the judicial system have sparked social movements and inspired debate on the relationship between disadvantaged groups and the judicial system's tendency towards justice or, in some cases, injustice. There is a well-established literature on demographic and attitudinal correlates of trust in institutions, especially in the United States with its long-serving system of laws (Levi & Stoker 2000). This literature finds that the economically advantaged are more likely to trust the judicial system than the disadvantaged (Levi & Stoker 2000; Smith 2010). While there is a large international literature on trust in institutions, there is very little on trust in the judicial system, specifically. In the context of the Central

and Eastern Europe (CEE), with its relatively recent institutionalization of democratic law, the association between demographics and political attitudes on one side of the equation, and trust in the judiciary on the other, is not well-established. The main research question of this project is, "To what extent does economic situation and political attitudes influence individual trust in Poland's judicial system?"

I examine this question in the context of Poland. One of the largest countries in Europe, and the largest of the CEE, Poland had a Communist government from the end of World War Two until 1989. Poland continues to experience radical social change: In addition to the upheavals of 1989, the rush to European Union accession in 2004, and the late lustration policies of 2005-2007, the judicial and other governance institutions went through major reforms. In 2015, Law and Justice (PiS), a populist Catholic nationalist political party which was last in power during the 2005-2007 period, sought to change the laws that govern the operation of the constitutional courts . These changes to the judicial system have sparked mass demonstrations and a rebuke from the European Union that Poland is slipping away from its democratic ideals .

To address my research question, and to meaningfully add to the debates on economic situation, political attitudes, and trust in the judicial system, I have analyzed the Polish Panel Survey, POLPAN, a nationally representative panel dataset of Poles who were interviewed every five years since 1988. I focused on the 2008 and 2013 waves. These years cover the longest period of political stability in Poland's post-Communist history: Civic Platform, a centre-right political party that promotes the European Union, globalization, and free markets, held the majority in parliament from 2007 to 2015.

Theory and Hypotheses

I engage with theories of institutional development, trust in institutions, and social stratification. Institutional development is the idea that institutions evolve through time: major changes are in terms of function, whether the new institution has been constructed over top of the old, or if the institution loses its relevance to society (Murillo and Levitzky 2009). Murillo and Levitzky (2009) argue that new institutions can be weakly enforced, and as such the

masses can question the validity of the rule of law. This, in turn, breeds uncertainty and an erosion of trust in institutions . Corruption also makes a difference in this idea. Rothstein and Uslaner (2005) argue that, "Countries that start out with high levels of inequality and corrupt governments will be caught in a vicious circle or 'inequality trap'" (45). After 1989, Poland built its judicial system based on Western European standards, but it developed in the post-Communist context of radical changes and deep distrust in government and its system of laws.

I focus on two major correlates of trust in the judicial system. One is economic situation. On the topic of economic disadvantage and trust, Smith (2010), argues that disadvantaged members of society trust less because they perceive, and are likely to experience, discrimination across multiple institutions, including that of the judicial system. The other correlate is trust in other political institutions. Nannestad (2008) argues that trusting one institution can lead to the growth and prosperity of others. Mishler and Rose (2001) showed that 48 percent of Poles included in their survey distrust the courts. The rest of the survey respondents were relatively split between trusting the courts (28 percent), and neither trusting nor distrusting, i.e. neutral (23 percent). Corruption, or the appearance of corruption, can influence trust in the judicial system, too (Toma 2015). Countries with the highest aggregate corruption levels were found to suffer the lowest levels of aggregate trust in institutions, and those countries with low government performance most frequently experienced lower levels of trust (Sullivan and Transue 1999; Armingeon and Guthmann 2014; Rothstein & Uslaner 2005; see also Czarnota and Krygier 2006). Mishler and Rose's (2001) survey used a seven-point Likert Scale measuring from strong distrust on one end of the spectrum, to strong trust on the other— similar to the format of the POLPAN questionnaire. As Mishler and Rose (2001: 38) argue, "When there are major dislocations in society, however, especially when accompanied by fundamental changes in social and political institutions such as have occurred in post-Communist societies, then political trust will be relatively volatile, and cultural and institutional theories can provide very different, even contradictory, predictions about political trust." Mishler and Rose (2001) argued that attitudes toward the success of government policies and the character of political in-

stitutions, along with one's life experiences with the institution, are also correlated with trust in political. Armingeon and Guthmann (2014) included information from 26 European countries; of those countries, Poland ranked 25th in regards to country-level satisfaction with democracy, and 26th in regards to trust in parliament. Poland's economy has grown in the past few decades, and a significant number of those surveyed in the past felt favorably towards it.

I posit the following hypotheses for Poland during 2008 to 2013:

Hypothesis 1: Advantaged social classes express greater trust in the judicial system than disadvantaged classes, controlling for age, gender, religion, and trust in political institutions.

Hypothesis 2: Those with high trust in the judicial system are also likely to have high trust in parliament and political parties, controlling for social class, age, gender, and religion.

Hypothesis 3: Those who perceive that the government has a positive impact on corruption will be more likely to have high trust in judicial system, controlling for social class, age, gender, religion, and trust in political institutions.

Data, Variables and Methods

POLPAN is a panel survey of Poles that began in 1988. Respondents were re-interviewed every five years thereafter. The latest wave of responses was collected in 2013 (for details on the survey, see Slomczynski et al 2015). I use the 2008 and 2013 waves. POLPAN contains data on various aspects of human social life, including those pertinent to this study: economic situation, trust in institutions, political attitudes, and demographics such as gender, age, and education.

My primary dependent variable is trust in the judicial system, measured with the item, "I will list various institutions. Please indicate to what extent you have trust in them: justice system." The response categories range from "to a very high extent" (5) to "very little or not at all" (1). For the purpose of this research, the phrase "judicial system" will encompass the function and motives of the phrase "justice system." The main independent variables are economic situation and political attitudes. For economic situation, I will use an objective indicator, combining respondent's years of education and a measure of the frequency of privileged respondents in the 2008 wave of POLPAN. I will also include a subjective indicator of economic situation, which is that of respondent's self-ranked social status on a 10-point scale.

I include three types of political attitude variables. First, I include trust in other institutions, including trust in parliament and in political parties. Second, I include perception of government effectiveness against corruption, with the item "Many countries experience such problems as unemployment and corruption. Do you evaluate the effectiveness of actions undertaken by the current Polish government towards reducing corruption as very high, somewhat high, average, somewhat low or very low?" Third, I have included a measure of confidence in the government, through respondent's evaluation of the phrase "In Poland, there has yet been no government which could be trusted to undertake the right actions." In addition, I have included the control variables gender, age, and religiosity (frequency of attending Church services).

Results

Table 2 illustrates the strength and direction of the relationship between these selected variables and the dependent variable, trust in the judicial system. Only lack of confidence in the government, subjective social status, and age proved to be significant at $p < 0.05$, and a confidence interval of 95 percent. Age has the strongest relationship with trust in the judicial system. Table 3 was used as a mechanism to test hypothesis 1, that advantaged social classes express greater trust in the judicial system than disadvantaged classes, controlling for age, gender, religion, and trust in political institutions. Because there was no statistically significant correlation found to exist between privileged social class and trust in the judicial system, the variable has not been included in any subsequent tables.

The model represented by Table 3 shows us that only 6.1 percent of the variance in trust in the judicial system can be accredited to the selected independent variables, and that age has the strongest impact on trust in the judicial system. I found that older respondents are less likely to trust the judicial system than younger respondents. In addition, we can reject the null hypothesis that advantaged social

classes express the same level of trust in the judicial system as disadvantaged classes.

In terms of our initial measure of advantage, subjective social status, hypothesis 1 cannot be rejected: The greater the subjective level of privilege, the greater the trust in the judicial system, controlling for lack of confidence in the government, gender, years of education, age, and religiosity. Similarly, we can surmise from this same data that those that are economically disadvantaged will trust less. Interestingly, years of education is negatively related to trust in the judicial system: as education increases, trust decreases, ceteris paribus.

Table 4 informs us that there is a moderate positive relationship between trust in political parties, trust in European Parliament and trust in the judicial system: as trust in political parties and European Parliament increase, trust in the judicial system will increase, as well. The model presented in Table 5 is meant to test hypothesis 3, in which 12.6 percent of the variance in the dependent variable can be explained by these selected independent variables. Table 5 illustrates that the stronger the belief that the government can influence the level of corruption, the greater the level of trust they will have in the judicial system.

Conclusion and Discussion

This article examines the relationship between economic situation, political attitudes and trust in the judicial system. Hypothesis 1, that advantaged social classes express greater trust in the judicial system than disadvantaged classes, controlling for age, gender, religion, and trust in political institutions, is empirically supported. Hypothesis 2, that those with high trust in the judicial system are also likely to have high trust in parliament and political parties, also has empirical support. Hypothesis 3 proposes that those who perceive that the government has a positive impact on corruption will be more likely to have a high level of trust in the judicial system, and this, too, is empirically supported.

Tables 3 and 5 were most surprising in terms of the strength of the variables and their influence on trust in the judicial system. In Table 3, years of education was one of the most significant variables. In Table 5, when the influence of the government on corruption is considered, years of education becomes the least significant variable; it is unclear why this is the case. In both models, age was shown to have the greatest impact; as age increases, trust decreases. Further research regarding the relationship between age and political trust is needed.

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iii Deutsch Welle. "EU launches first-ever rule of law review against Poland." http://www.dw.com/en/eu-launches-first-ever-rule-of-law-review-against-poland/a-18975646. In a related article, "The European Commission, the European Union's executive branch, has launched an unprecedented inquiry into whether Warsaw's new nationalist-minded government has breached the bloc's democracy standards in taking more control of the judiciary and public media." (http://www.reuters.com/article/us-poland-usa-idUSKCN0V20PX).

iv Trust can be a very general term. Levi and Stoker (2000) differentiate between "diffuse support" to represent trust in an institution and "specific support" to represent trust in an individual. My research focuses on diffuse support of the judicial system as an institution, rather than on specific aspects of the system.

Appendix

Table 1: Recoding Variables
Trust in the Judicial System (2013):
recode E05C (9=.)
recode E05C (1=5) (2=4) (3=3) (3.1=3.1) (4=2)
(5=1), gen (trustj13)
label var trustj13 "1=Very Low Degree 2=Low
Degree 3=Average Degree 3.1=DK 4=High Degree
5=Very High Degree"

Lack of Confidence in the Government (2008):
recode VM02A (9=.) (1=5) (2=4) (3=3) (8=3.1)
(4=2) (5=1), gen (nogovtrust08)
label var nogovtrust08 "1=Disagree Strongly 2=Dis-
agree Somewhat 3=Neutral 4=Somewhat Agree
5=Strongly Agree "

Privileged Social Class (2008):
recode Clss3cat2008 (1 2 =0) (3=1), gen (spriv08)
label var spriv08 "1=Privileged 0=Neutral & Disad-
vantaged"

Subjective Social Status (2008):
rename VSUBJ_STATUS08 statussubj08
label var statussubj08 "1= Lowest 10=Highest"

Years of Education (2008) :
Did not recode
Gender:
Did not recode
Respondent's Age (2013):
Did not recode

Religiosity (2008):
recode VW21 (98=.) (1=0) (2=1) (3=2) (4=3), gen
(mass08)
label var mass08 "0=Never 1=Once a month or less
frequently 2=Between once a month and once a week
3=About once a week or more than once a week"

Influence of the Government on Corruption (2013):
recode C04B (9 -1=.) (1=5) (2=4) (3 8=3) (4=2)
(5=1), gen (govco13)
label var govco13 "1=Very Low 2=Rather Low
3=Average 4=Rather High 5=Very High"

Trust in Political Parties (2013):
recode E05D (1=5) (2=4) (3=3) (8=3.1) (9=.) (4=2)
(5=1), gen (trustpp13)
label var trustpp13 "1=Very Low Degree 2=Low
Degree 3=Average Degree 3.1=DK 4=High Degree
5=Very High Degree"

Trust in European Parliament (2013):
recode E05E (9=.) (1=5) (2=4) (3=3) (8=3.1) (4=2)
(5=1), gen (trustep13)
label var trustep13 "1=Very Low Degree 2=Low
Degree 3=Average Degree 3.1=DK 4=High Degree
5=Very High Degree"

Table 2: Correlation of Trust in the Judicial System
(2013) with Lack of Confidence in the Government
(2008), Subjective Social Status (2008), Years of
Education (2008), Gender, Age (2013), Religiosity
(2008)
pwcorr trustj13 nogovtrust08 statussubj08 Eduyrs08
sex AGE2013 mass08, sig obs

Table 3: Linear Regression of Trust in the Judicial
System in 2013 on Lack of Confidence in the Gov-
ernment in 2008 and Other Selected Variables
regress trustj13 nogovtrust08 statussubj08 Eduyrs08
sex AGE2013 mass08, vce(robust) beta

Table 4: Partial correlation of Trust in the Judicial
System (2013) with Trust in Political Parties (2013)
and Trust in the European Parliament (2013)
pcorr trustj13 trustpp13 trustep13

Table 5: Linear Regression of Trust in the Judicial
System (2013) on Influence of the Government on
Corruption (2013) and Other Selected Variables
regress trustj13 govco13 nogovtrust08 statussibj08
Eduyrs08 sex AGE2013 mass08, vce(robust) beta

Table 1. Descriptive Statistics for All Variables

Name of variable (year of POLPAN wave in parentheses)	Original variable as listed in the data set	Coding of the variable as used in this paper	Distribution		
			Means or proportions	Standard Deviation	Number of Observations N
Dependent Variable(s)					
Trust in the Judicial System Q: To what extent do you trust the justice system? trustj13 (2013)	E05C	1=Very Low Degree 2=Low Degree 3=Average Degree 3.1=DK 4=High Degree 5=Very High Degree	2.44	0.96	2194
Independent, Control, and Additional Variables					
Lack of Confidence in the Government Q: Evaluate the statement "In Poland, there has yet been no government which could be trusted to undertake the right actions" nogovtrust08 (2008)	VM02A	1=Disagree Strongly 2=Disagree Somewhat 3=Neutral 4=Somewhat Agree 5=Strongly Agree	4.00	1.00	1470
Privileged Social Class spriv08 (2008)	Clss3cat2008	1=Privileged 0=Neutral & Disadvantaged	0.11	0.31	6016
Subjective Social Status Q: Please indicate where on this scale you would locate yourself among other [social] groups? statussubj08 (2008)	VSUBJ_STATUS08	Ranges 1 through 10, 1 being the lowest on the scale and 10 the highest	5.24	1.74	1421
Years of Education Eduyrs08 (2008)	Eduyrs08	5, 8, 10 through 14, 16, 17, 21 years of education	11.88	3.11	1468
Gender sex	sex	1= males 0= females	0.47	0.50	7359
Respondent's Age AGE2013 (2013)	AGE2013	(Range 21 years old to 91 years old)	45.54	19.58	2196
Religiosity Frequency of Mass Attendance mass08 (2008)	VW21	0=Never 1=Once a month or less frequently 2=Between once a month and once a week 3=About once a week or more than once a week	2.15	0.96	1375
Influence of the Government on Corruption Q: In your opinion, the effectiveness of the actions undertaken by the current Polish government towards reduction of corruption is… govco13 (2013)	C04B	1=Very Low 2=Rather Low 3=Average 4=Rather High 5=Very High	2.32	1.10	1923
Trust in Political Parties Q: To what extent do you trust political parties? trustpp13 (2013)	E05D	1=Very Low Degree 2=Low Degree 3=Average Degree 3.1=DK 4=High Degree 5=Very High Degree	1.70	0.80	2190
Trust in European Parliament Q: To what extent do you trust the European Parliament? trustep13 (2013)	E05E	1=Very Low Degree 2=Low Degree 3=Average Degree 3.1=DK 4=High Degree 5=Very High Degree	2.58	0.87	2195

Table 2. Correlation of Trust in the Judicial System (2013) with Lack of Confidence in the Government (2008), Subjective Social Status (2008), Years of Education (2008), Gender, Age (2013), Religiosity (2008)

Trust in the Judicial System (2013)	Total Correlation	N Number of Observations
Lack of Confidence in the Government (2008)	-0.127*	1049
Subjective Social Status (2008)	0.134*	1014
Years of Education (2008)	0.021	1048
Gender	-0.025	2194
Age (2013)	-0.234*	2194
Religiosity (2008)	0.001	981

* $p < 0.050$

Table 3. Linear Regression of Trust in the Judicial System in 2013 on Lack of Confidence in the Government in 2008 and Other Selected Variables

Independent and Control Variables	Trust in the Judicial System (2013)		
	b Coefficient	Robust Standard Error	Beta
Lack of Confidence in the Government (2008)	-0.110*	0.031	-0.115
Subjective Social Status (2008)	0.059*	0.019	0.104
Years of Education (2008)	-0.018**	0.010	-0.058
Gender	-0.050	0.062	-0.025
Age (2013)	-0.011*	0.002	-0.189
Religiosity (2008)	0.010	0.033	0.009
Constant	3.329	0.249	.
Fit Statistics	$F=9.770*$ (df=6) $R2= 0.061$ Root MSE=0.948		N=945

* $p<0.050$ ** $p<0.100$

Table 4. Partial correlation of Trust in the Judicial System (2013) with Trust in Political Parties (2013) and Trust in the European Parliament (2013)

Trust in the Judicial System (2013)	Total Correlation	Controlling for Subjective Social Status (2008), Years of Education (2008), Gender, Age (2013), Religiosity (2008)	N Number of Observations
Trust in Political Parties (2013)	0.258*	0.300*	2189
Trust in the European Parliament (2013)	0.228*	0.215*	2189

* $p<0.050$

Table 5. Linear Regression of Trust in the Judicial System (2013) on Influence of the Government on Corruption (2013) and Other Selected Variables

Independent and Control Variables	Trust in the Judicial System (2013)		
	b Coefficient	Robust Standard Error	Beta
Influence of the Government on Corruption (2013)	0.176*	0.034	0.200
Lack of Confidence in the Government (2008)	-0.105*	0.035	-0.107
Subjective Social Status (2008)	0.054**	0.022	0.091
Years of Education (2008)	-0.001	0.011	-0.002
Gender	0.029	0.067	0.015
Age (2013)	-0.015*	0.002	-0.211
Religiosity (2008)	-0.006	0.036	-0.006
Constant	2.874	0.297	.
Fit Statistics	$F= 14.830*$ (df=7) $R2= 0.126$ Root MSE= 0.912		N=769

* $p<0.050$ ** $p<0.100$

The Blue Crab Fights Against External Challenges

By Sara Louise Wilkins

Abstract

Being a part of the supplemental summer diet all along the east coast, the Maryland Blue Crab has seen its share of changing times. Throughout the crab's history, the iconic, colorful animal has met external factors out of its control that have affected its population.

In its earliest years, The Maryland Blue Crab can be traced back to the diet of Native Americans and early settlers from 1600 through the 1700s. As soon as the modern technology of refrigeration hit America in the early 1900s, the crab became a main commodity for those who live along the length of the eastern shore. In this day and age, modern challenges to the Blue Crab include pollution, increased human population, and global warming; all of which contribute to what seems like a steady decline in the population of this iconic species.

The people who most enjoy the Blue Crab have felt the effects of the population decrease as well. Prices of Blue Crab, in any form, have increased almost exponentially in the past fifty years. In the past five years alone, prices of the crab in the mid-east coast have nearly doubled in price compared to fifteen years prior. Although far from being endangered, it becomes increasingly important to understand why this historic species cannot hold its own in the fight against external challenges.

Introduction

Callinectes Sapidus goes by many names: the Atlantic Blue Crab, the Chesapeake Blue Crab, and the Virginia Crab; however, to most people living on the East Coast, it will always be the Maryland Blue Crab (Figure 1). In recent years, the Blue Crab has seen its share of modern times, more specifically modern challenges. Whether it be pollution, increased human population along the coastline, or global warming, there are many factors that are contributing to what seems like a steady decline in the population of this iconic species. Not only are the crabs themselves being affected, the ecosystem of the Chesapeake Bay, including the people that enjoy the benefits that it produces, have felt the effects of the declining population.

Content

As the world swells in population size, so does the number of mouths to feed. Since water covers 75% of the Earth, it is only natural to turn to the ocean and freshwater bodies of water to feed the ever-growing world. The Blue Crab has been providing a source of food and nourishment, whether it be to humans or to its fellow species in the aquatic ecosystem. Maryland, however, is not the only source of crab; Louisiana and the Gulf Coast are some of the biggest exporters of crab in the United

States.[1] It may not specifically be Blue Crab, yet it is still part of the economic input of the eastern shore. Recently there have not been many crabs pulled out of the Louisiana/Gulf Coast area, which means that Maryland has to pull out more Blue Crabs from the Chesapeake in order to meet the demand for crab in general. This problem has especially been prevalent since Hurricane Katrina and the numerous oil spills around the Gulf Coast region[1]. Weather fronts have also been known to play a part in whether the population of crabs will be greater or lower than the previous year (Figure 2).

Natural disasters, including weather patterns, are not the only contributing factor to a steady decline in the population of Blue Crabs. One of the biggest threats to the population is man-kind. Pollution and overfishing have been the most detrimental challenges the Blue Crab species has come to face. In the 1990s the most prevalent cause of population decline was overfishing[2]. Human production around highly populated areas, such as the Chesapeake region, produces a lot of pollution, which disrupts the natural environment[2]. One of the biggest sources of pollution in the region emanates from excess nitrogen run-off originating from poultry farms along the eastern shores of Maryland, Virginia, and Delaware. Poultry waste is rich in nutrients, especially nitrogen, however seemingly endless poultry farms are popping up, causing a massive increase in nitrogen run-off which finds its way into the Chesapeake, damaging the fragile ecosystem[3]. Crabs cannot live in an environment rich in nitrogen, as it disrupts the water-to-oxygen flow on which their bodies depend. Additionally, it damages the algae food source that the crabs depend on for survival. Pollution leads to lower population, which in turn leads to over fishing of the crab population. Male Blue Crabs are especially prone to dangerous declining levels in population, as male crab meat is usually of higher value compared to female meat. For the past twenty years, on average, male population declines about threefold for a three-year average, compared to the female population which decreases twofold for a three year average[3].

The decline of the Blue Crab population follows a peculiar trend; the population increases right before it decreases[2, 8]. In 2016 the population of the Blue Crab in the Chesapeake increased 35%, however researchers warn that this sudden increase shouldn't mean loosening public policy about har-

vest quantities[4, 5]. There are many laws and public policies in place that describe when, where, and what size crabs can be harvested. The economic benefit of this partial increase spreads across the east coast, not only into consumers' pockets but to producers as well. (Figure 3) shows the monetary values across the most predominant states that benefit from Blue Crab production, which is labeled under the general fish category. The recent success of the population increase in Maryland seems to be due to the fewer cold days Maryland experienced in the past winters. This ensured that fewer crabs die from the frozen water. In addition to this, warmer days lengthen the spawning period for female crabs, which in turn, ensures that more crab eggs will be able to hatch and reach maturity. Each female crab has the potential to lay three million larvae three to five times a season, so per season a single female crab can lay from three to fifteen million larvae[6]; only a small percentage of these larvae reach full adulthood with sexual maturity.

Multiple scientific studies have been performed concerning the topic of the Blue Crab. Since studying something under the ocean is extremely difficult, researchers use a method called "Trapping and Tagging" which is where a large population of crabs are lured into an area and trapped there, so they can be researched. Some of those crabs are then tagged, much like sharks and dolphins are tagged to track their movements; crabs are given a small tag, thus allowing their migration patterns or movements to be tracked. Stocking has been a method that has attempted to replenish the population of the Blue Crab. In order to replenish the population properly (Figures 4 and 5), one has to consider the time of year, and at what point/age in formation the Blue Crab can be released into the wild. For example, the female population potential survival rate increases if it is released in the spring, in order to mate properly by the summer. This is done in attempt to lay eggs more than once a season (April-September)[7]. Male crabs can be released earlier than females, since their size usually protects them longer against predators. Recently, however, male size has been declining overall[8, 9]. Since larger male Blue Crabs are preferred in market because of their quantity of meat, they are generally harvested in greater numbers when compared to smaller male crabs and female crabs. Thus, only the smaller Blue Crabs are left to mate with the females,

passing on the lower size gene10.

Conclusion

The Maryland Blue Crab has been a symbol of many states along the east coast: Maryland, Virginia, Delaware, and the entire Chesapeake Bay region. The crab has been a major part of the supplemental summer diet for millions of citizens living along the east coast. For the past fifty years, the blue crab population, both male and female, has been on a steady decline. Much has been done to figure out why; research, trapping and tagging, stocking, etc., seeking to discover how to save this colorful and iconic species. While it fights against constant changing weather patterns, pollution, and overfishing due to a growing human demand, the Blue Crab continues to survive against what seems like a countless number of external challenges.

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Figure 1. Maryland Blue Crab

Figure 2. Overall median temperatures during 2014, which show that the east coast was cooler than average; this possibly being a factor of the lower population and overall harvest.
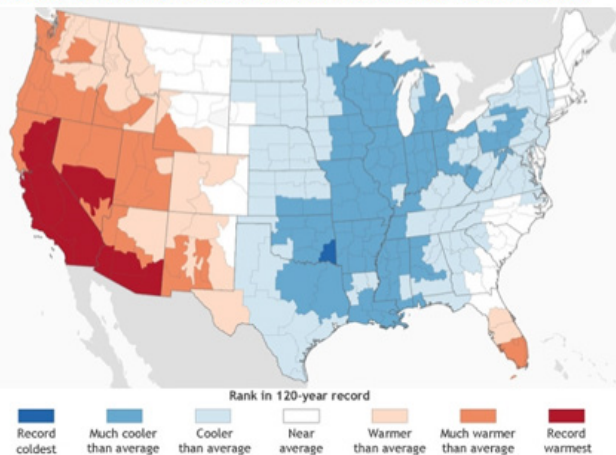
Figure 3: Fish Values from 2000 to 2016 for the four top exports of Crabs in the United

Fishery value in millions of dollars (and percentage of national harvest weight)[25]					
Year	Maryland	Virginia	North Carolina	Louisiana	National
2000	31 (12.3)	24 (15.5)	37 (21.8)	34 (28.0)	164
2001	35 (16.3)	26 (15.8)	32 (20.2)	32 (26.3)	158
2002	30 (15.1)	21 (15.5)	33 (21.5)	31 (28.5)	147
2003	35 (16.3)	19 (12.6)	37 (25.0)	34 (28.1)	154
2004	39 (19.4)	22 (15.8)	24 (19.6)	30 (25.4)	146
2005	40 (21.9)	21 (16.4)	20 (16.0)	27 (23.9)	141
2006	31 (17.7)	14 (13.7)	17 (15.3)	33 (32.1)	126
2007	42 (19.6)	16 (16.0)	21 (13.6)	35 (28.7)	149
2008	50 (21.5)	18 (14.3)	28 (20.3)	32 (25.7)	161
2009	52 (22.0)	21 (18.6)	27 (16.8)	37 (30.1)	163
2010	79 (33.2)	29 (19.3)	26 (15.4)	30 (15.4)	205
2011	60 (25.3)	26 (19.6)	21 (14.9)	37 (21.7)	184
2012	60 (24.4)	25 (18.5)	23 (14.9)	39 (22.8)	188
2013	50 (17.9)	24 (18.0)	30 (16.5)	51 (28.8)	192

Figure 4. Amount of Blue Crab in Chesapeake Bay: Showing a steady decline over time in the total pounds of crab harvest in the Chesapeake Bay

Chesapeake Bay Hard Crab Harvest
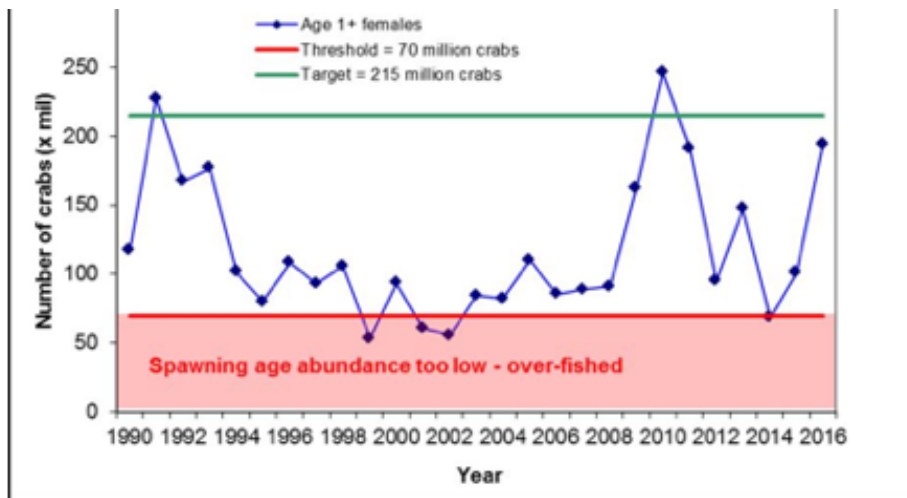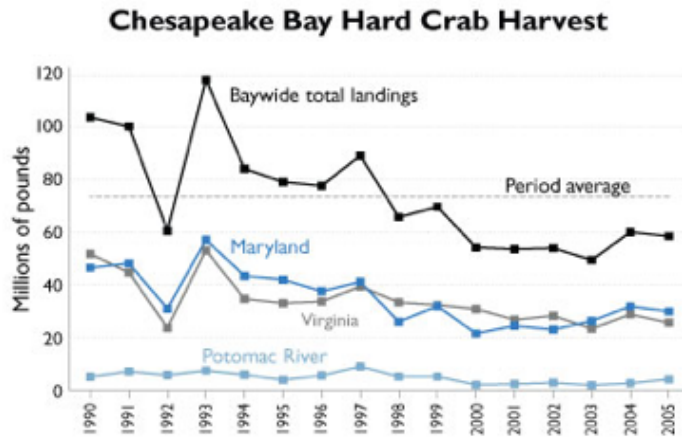
Corn: A Cultural Shift in American Identity Due to Severe Food Insecurity

By Dana Outcalt

 Abstract

The story of Thanksgiving is a more complicated and complex story than the tale of peaceful beginnings that is typically associated with the Pilgrims' meals shared with Native Americans. The story of the pilgrims' first years included tragic death, severe food insecurity and a politically charged meal that brought enemies together. The first Thanksgiving is a tale of a dramatic shift in American identity and culture as pilgrims struggled to survive in a harsh, unfamiliar world. Corn, a food source associated with poverty, simplicity and demeaned as "native" and unworthy of European palettes became a central staple in the diet and a central feature in a shared American identity. Yet, it was the death of half the colony and lack of preparation (as they faced starvation and uncertainty) that introduced corn to the American diet. Today, corn has become interwoven into our diet and American consumerism. My paper documents this surprising and dramatic shift and follows the corn as it goes from a hated food source to become an integral iconic part of the American identity.

Fifty died so this food could feed billions. Many people know of the Mayflower voyage from England as an escape from religious persecution and the start of a new life in a new world. As the story goes, the Pilgrims befriended the Native Americans and by the following November, they were celebrating Thanksgiving arm in arm, tables abundant with corn, turkey, and squash. While this is a sweet story, it is hardly a realistic representation of the Pilgrims' first year at Plymouth, during which the Pilgrims suffered hardship and loss, due to their inability to adapt their English values and indignant attitudes toward the Native Americans and realities of the environment and climate. For the Pilgrims, their story was one of food insecurity and how they would adopt their diet to a changing situation. The behaviors and values of the Native Americans directly contrasted with those of the Pilgrims. After a traumatic winter and the desperate realization that they were failing, the Pilgrims were forced to compromise their culture and food practices for their survival. One practice in particular would be vital to the survival of the Plymouth Colony—the production and consumption of corn. A seemingly simple solution as a response to an ecological stressor was actually a radical change in food culture. Originally seen as savage and a food for animals, corn became a means of survival and its adoption required the Pilgrims to change their food values. Corn was such a deviation from the English values and it would become so important to the New World colonies that fifty years after its adoption into the New England diet, a representative of the colony would travel back to Europe to convince English society of the virtues of corn and argue its acceptance into the diet as an alternative for wheat (McWilliams 55). Corn would go

from a hated food to become an integral part of the American identity, immortalizing as an icon in the quintessential Thanksgiving picture.

From England, the Pilgrims brought with them seeds and livestock to fuel their new lives in the New World. These foods included peas, wheat, English grass, various vegetables, cows, pigs, and chickens (Philbrick 64). Also, they planned to produce cider, beer, and rum. These English foods were a part of their cultural identity. However, upon arrival, the Pilgrims quickly learned that the New England landscape, though green and fertile, would be hard to work. Many of their seeds would not grow in the New World, and the ones that did yielded little (Deetz 3). With a lack of sufficient grass for the livestock, dairy was unavailable in the winter as well (McWilliams 59). The Pilgrims tried to replicate their way of life in England, it was all they knew in an unfamiliar world. It must have been a cultural shock and hardship when those plans did not work (McWilliams 63). It became obvious just how far from home and alone the Pilgrims were, and that failing meant death for the whole colony. It would take perseverance and adaption to keep the colony alive.

When the first winter arrived, the Pilgrims suffered. They were in unfamiliar territory and their scouting parties yielded little information. They landed in Plymouth without knowing what the land would look like or where the best place to settle would be. It took three weeks for the Pilgrims to move off the boat, and by that time snow covered the ground and supplies were dwindling (Deetz 55). It was during these first expeditions that the Pilgrims encountered American corn, stored in empty Native American huts. Knowing their supplies were dwindling and uncertain of the fertility of the soil, the Pilgrims stole some of the corn seed for future use, willing to try anything to survive (Philbrick 64). The unique quality of American corn that made it especially valuable to the Pilgrims was that the dry seed would keep indefinitely, so they could store it for the winter and it would be good to plant in the spring (Philbrick 62). The Pilgrims viewed corn as food for the livestock and unfit for human consumption. It was a marker of the Native American society as savage, among other practices that conflicted with the Pilgrim values. The Pilgrims' way of life included a division of labor in the family household, where women worked in the house and men worked out-

side (McWilliams 11). The Pilgrims saw the Native Americans as primitive and uncivilized because the women did most of their work outside in the gardens, while the men went off hunting for game or fishing (McWilliams 9). Yet, the Native Americans did well for themselves, surviving off the land's resources and supplementing with their own vegetable gardens that grew in abundance (McWilliams 59). The Pilgrims would suffer heavy losses and despair before they would face the realization that the Native Americans were better adapted to surviving and being successful in the New England environment.

In a land that appeared plentiful, the Pilgrims faced food insecurity, meaning they did not have access to "nutritionally adequate and safe foods or… [the] ability to acquire acceptable foods in socially acceptable ways" (USDA 2017). Corn was defined a savage food, considered dirty and unfit to eat, yet on their own they did not have enough food, much less enough of the right food. Confronted with food insecurity, the Pilgrims were forced to adopt the native food. This was a major cultural shift for them; they had to trust in a food that was unknown and eaten by people considered to be savage.

The adoption of Native American practices was vital to the Pilgrim's survival, but it did not come easily or without compromise. The Pilgrims were ill-adapted to survive the harsh first winter. Its many storms prevented the Pilgrims from building homes and kept them on the ships much longer than planned (Philbrick 60). From December through February, half the colony died. This reduced their labor force significantly, and induced desperation in the spring. Without any other options and fear their own seeds would not grow in the tough soil, the Pilgrims were in despair. Far from home with no other options, the Pilgrims faced a cultural crisis. If they stayed true to their English values the entire colony would die, but to survive meant lowering themselves to what they believed was the level of savages and eating food meant for animals. The decision to change their cultural practices was not simple. The Pilgrims recognized the success of the Native Americans in their food production, and they began to adopt some of the Native American practices, realizing the need for the rest of the colony to survive as greater than preserving the English cultural behaviors.

After the first winter, the Pilgrims were desperate to plant. The tragedy of losing fifty percent

of the colony's population encouraged them to turn to the Native Americans for help, adopting some of their practices. These practices included the adoption hunting game and growing beans, squash, and corn (Fischer et al. 90). Corn, in the northeast, is a versatile and hardy crop. It grows well in the hard soil and is easy to manage, freeing time for other activities (McWilliams 8). The Native Americans were vital in providing knowledge of the land and its resources to the Pilgrims, with whom they negotiated a peace treaty. The Native Americans assisted the Pilgrims in learning how to work the hard soil and grow corn, among other crops. The Pilgrims learned to fertilize the soil with fish, which allowed corn, beans, and squash to grow in abundance (Philbrick 102). Previous to this new practice, the Pilgrims' own crops did poorly, planted in neat rows in the unfertilized soil, unlike the successful Native American practice of scattering seeds haphazardly. The adaptability and willingness to compromise previous cultural practices allowed the Pilgrims to survive after the first winter and begin to build a colony and a new home.

At the end of the harvest period in 1621, the Pilgrims held a three-day festival and invited the local Native Americans as guests, initiating the first Thanksgiving. The harvest for that season was small, but yielded enough to celebrate, and central in this celebration was corn (Deetz 64). This festival became known as the first Thanksgiving and it represented a cultural shift from remaking the English way of life, to founding their own way in the New World, with corn at the center of this picture. The cultural adaptations the Pilgrims were forced to make in response to ecological hardship would become an identity, ingrained in the colony's history. Corn would become a representation of the perseverance and survival of the Pilgrims, and that success would not come easy to those who would not work for it. These Pilgrim values became American values as Thanksgiving became an annual celebration of the success of a colony once doomed to fail.

From a perspective of the study of food and culture, it is shocking that a culture would adopt a food practice that was seen as barbaric. The Pilgrims' culture shunned corn because it was a food for animals, turning to it only as a way of survival. The Native Americans taught the Pilgrims how to plant crops that would grow in the hard, New England soil, including corn. Food insecurity is not just a lack of food, but also a lack of the right food. For the Pilgrims, the food insecurity they faced was a combination of the two. They lacked sufficient amount of food because their crops grew poorly. They also lacked the right food because even though they had stolen corn seeds from the Naussets during their winter explorations, they refused to produce and consume the corn for themselves. It takes a drastic event to change food practices in a culture. Faced with losing the entire colony, the Pilgrims fought for their lives by adopting corn into their diet. At the first "Thanksgiving," a three-day harvest festival, corn sat on the table as a miracle crop, saving the Pilgrims from another deadly winter.

After the first Thanksgiving, corn grew to become a central staple in the American diet. In modern times, it is produced in copious amounts and used in a multitude of consumer products, not just as a food source. Corn has become a central Thanksgiving dish as well, never absent from the table. What was once consumed as a necessity for survival is now a beloved, quintessential American dish. There are even multiple types of corn dishes that adorn the Thanksgiving menu, including corn bread, corn pudding, sweet corn, and corn on the cob. The importance of corn today reflects its importance to the Pilgrims at that first Thanksgiving. Without corn, the Plymouth Colony may have failed, and the holiday Americans celebrate today may not have existed. The changes in culture the Pilgrims underwent to survive a time of food insecurity were significant in creating a part of the American identity.

Ironically, the food that helped the Pilgrims through their time of food insecurity has become perverted in today's society to create food insecurity. Corn is extremely starchy and thus difficult for the body to process (Lustig, Schmidt, and Brindis 2012). For a starving population, it is a great food. In a population that already runs rampant with diabetes and obesity, the manufactured derivatives of corn only add to the overarching problem society has to face. Corn has been manipulated into less-healthy corn by-products, such as corn starch, corn syrup, and other high sugar by-products that are present in most foods found in grocery stores today. Corn has become engrained in American culture and scaling back on its production and consumption or replacing it with a healthier food would be extremely difficult. What once was shunned as an insufficient

food source has become an integral ingredient in the American diet and identity.

The introduction of corn into the Pilgrim diet was a direct result of the tragedy they suffered during the first winter at Plymouth. The desperation they felt after losing half the colony's population and the food insecurity they faced caused a cultural shift to adopt corn into their diet, rather than to limit it to livestock feed. This was a cultural response as much as an ecological response to the food insecurity they faced. Many people starved and died before the Pilgrims made a cultural shift, emphasizing that a drastic event is required for a people to dramatically change their values and food staples. The Pilgrims were forced to adapt to the ways of which they considered savage. The value of corn went from feed for livestock, to a necessity for survival, to a vaulted commodity. In time, corn became an integral part of the American diet, as it was easy to grow in the hard, New England soil. It continued to become a part of the American identity, cemented in the history of the Plymouth Colony. Corn has since become central in the iconic perception of the first Thanksgiving and is considered an American staple. It is a food that links to the American culture and identity to its roots in the Plymouth Colony.

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Undergraduate Cardiac Arrest Internship Program Leads to Well-Trained Peer-To-Peer Instructors and Increased Community CPR Training

By Lyndsay Boyd, Rachel VanScoy, Alexis Benisek, Dr. Ashish Panchal

Abstract

Despite advances in prevention and acute care, cardiac arrest remains a public health risk and leading cause of death in the United States. Bystander CPR is provided at low rates throughout the US, which provides a substantial need to address this issue. Many states have developed programs and legislation for CPR instruction in high schools; however, programming lacks in the collegiate setting. The objective of this study was to describe an undergraduate Cardiac Arrest Internship Program that was designed to train peer-to-peer CPR instructors, increase CPR instruction in the community, increase bystander CPR rates, and provide students with a structured experience in resuscitation science.

Undergraduate students applied for volunteer internship positions with a minimum commitment of 10 hours/month. With support from the Center for EMS at OSU and the American Heart Association, interns were provided Basic Life Support (BLS) certification along with monthly didactics on resuscitation science, training in public speaking and CPR instruction, and 16 hours of shadowing experiences in the emergency department and with emergency medical services. For the first 2 months, interns were trained and assessed on their community CPR training skills. Following confirmation of proficiency, interns began independent CPR training on campus and in the surrounding community.

The Cardiac Arrest Internship Program was launched in June 2016 with 15 undergraduate students selected and grew to 25 interns for 2017. Intern training was conducted with all participants achieving BLS certification and passing their training evaluations and confirm their ability to teach community CPR. Intern planned programs, taught classes, and facilitated community outreach by developing a website and a social media presence (https://cprohiostate.com/). Since 2016, 106 CPR classes were planned and conducted, including both on-campus and community settings (67 and 39, respectively). The total number of bystanders that were trained in CPR was 3,206, of which 57% (1,843) were undergraduate students trained on campus. Development of the Cardiac Arrest Internship Program led to undergraduate students who were well-trained in community CPR instruction and a more educated community. Future work will focus on evaluating the effectiveness of peer-to-peer CPR training through measurement of CPR quality metrics.

Cardiopulmonary Resuscitation training by Peer to Peer trainers yields Bystanders Trained to Provide High Quality CPR

By Rachel VanScoy, Lyndsay Boyd, Alexis Benisek, and Ashish Panchal, M.D., Ph.D.

Abstract

The quality of bystander CPR training is unknown in the United States. One major mechanism of this training is through the American Heart Association's CPR in Schools Program. However, the quality of CPR provision following this training has not been assessed. The objective of this study was to evaluate the effectiveness of CPR training (depth and rate of chest compressions) of lay bystanders following training through the CPR in Schools: University Program.

During the 2017 academic year, the effectiveness of teaching lay bystanders Hands-only CPR, through the CPR in Schools – University Training Program, was examined. 120 undergraduate students (without prior CPR training) from The Ohio State University receiving AHA Hands-Only CPR training. Following training, students were given two minutes to perform CPR on Laerdal Little Anne CPR Training manikins where data was collected on performance. Data was collected using Laerdal Skillreporter software on the quality of their compressions, including rate and depth. Data was evaluated in STATA 12 for descriptive statistics.

The training began in September 2017. Interns held group trainings where the participants received instruction in small groups on CPR. 120 people were trained, and all but 18 participants were disqualified from the study based on past education in CPR, failure to give contact information, etc. After training, preliminary data was collected using the Laerdal Skillreporter on CPR rate, depth and compression fraction. On the preliminary analysis, a mean CPR rate of 108.126 compressions per minute, mean depth of 52.359 millimeters, and a mean compression fraction of 64.136% was observed.

The University Program training method can be adapted to train individuals in higher quality CPR using the preliminary analysis alongside additional data analysis to gage where the instruction has neglected specific skills. Specifically, the analysis will determine whether the University Program lacks adequate training of rate, depth, or compression fraction. Future work in the coming months will be directed at examining retention of knowledge over time.

Abstract
Hands-Only Cardiopulmonary Resuscitation Program Peer Training Yields Increased Knowledge and Familiarity

By Rachel VanScoy, Lyndsay Boyd, Alexis Benisek, and Ashish Panchal, M.D., Ph.D.

Abstract

The CPR in Schools: University Program has been designed based on the proven high school program from the American Heart Association (AHA) that has trained millions of students within the United States. It is unclear if the methodologies used at the high school level will be as effective for a university population. One of the primary limitations to administering bystander CPR is lack of knowledge about the process and reasoning behind the methodology. Once individuals have been properly trained in Hands-Only CPR, they are more likely to be confident enough to assist a cardiac arrest victim and understand details about the methodology.

During this academic year, 119 undergraduate students (age ≥ 18 years old) on OSU's Main Campus were trained using the AHA - Training in Schools Program. Of the students trained, 14 were disqualified due to refusal to complete the survey or based on prior CPR training. Before the training program was initiated, a pre-survey was given which covered demographic information, knowledge about CPR, and willingness to perform bystander CPR. After a 30-40 minute training, which included both lecture and hands-on experience, the participants were given a post survey to complete. The post survey is a duplicate of the pre-survey questions to gage their increase in CPR knowledge and willingness to perform bystander CPR due to the training they received.

Based on the data collected, a significant increase was seen in both knowledge about CPR and personal willingness to perform CPR after peer-to-peer trainings. Of the five hands-only CPR knowledge questions asked, the data shows an average increase of 33.48% in correct responses demonstrating an increased factual understanding of hands-only CPR. Willingness to help also increased significantly with 86.67% of respondents indicating they would be very comfortable/somewhat comfortable performing CPR in contrast to the 20.95% that responded the same way in the pre-test. The pre-survey and post survey comparison allows for evaluation of the American Heart Association - Training in Schools Program. The results can be used to gage areas where the participants did not gain the appropriate knowledge and to improve future programs.

Article

Is Foreign Aid an Effective Cure for Global Poverty?

By Tatyana Sinetskaya

ABSTRACT

This paper argues that the top-down foreign aid system is inefficient and possibly damaging for poverty reduction and long-term sustainable economic growth, due to the lack of accountability and local knowledge. The paper assesses the efficiency of alternative models of development assistance programs with an emphasis on community-based participatory development projects.

The evaluation of the Brazilian Bolsa Familia and Indonesian Kecamatan Development programs showed promising results. The evidence of the research leads to the conclusion that the hybrid form of foreign aid whereby the international community provides technical assistance, resources, expertise, and knowledge in designing and carrying out projects with a great degree of participation from the local communities seems to be a more effective alternative to the existing top-down aid paradigm. Project designs of participatory programs, however, must guarantee a viable monitoring system to avoid corruption and elite capture.

Introduction:

This work considers whether governments and other actors should create a supportive environment for development assistance policies, with greater engagement of the local communities to gradually replace the existing top-down, "one size fits all" foreign aid paradigm. The public interest theories, based on state-led aid systems, argue that it is sufficient to fill a financial or investment gap with foreign aid to lift the countries out of a "poverty trap" (Sachs 2015). This remains the core argument for the use of foreign aid for the past 50 years. Contrasting theories contend that foreign aid is inefficient and possibly damaging (Coyne 2013, Easterly 2006, Moyo 2005). Consequently, policy-makers need to look for increasingly efficient and cost-effective ways to institute foreign aid, while designing development assistance programs aimed to reduce poverty and to facilitate long-term sustainable growth.

Additionally, this work argues that participation of the local communities in humanitarian aid delivery and long-term foreign aid development projects are more cost-effective and efficient relative to the conventional top-down foreign aid assistance. It evaluates the performance of some community-driven development projects and safety net and conditional transfers programs. This work concludes that the emerging alternatives to the traditional state-led humanitarian assistance, which feature participatory objectives, are more cost-effective and efficient at poverty reduction and sustainable growth. Meanwhile, the main argument of the paper under-

lines the necessity of the public sector assistance in those projects. While the top-down, state-led foreign aid paradigm is contended to have fallen short to deliver services in an efficient way, humanitarian aid development programs will not survive without help of the international community. The evidence of the research also reveals that important component of a successful development and short-term relief aid program is a sense of ownership and empowerment of the local communities.

The common consensus on what leads to inefficiency in the top-down programs is the lack of accountability and local knowledge. Thus, this paper attempts to assess the efficiency of alternative models, namely participatory community-based and safety net and conditional transfers programs, by evaluation of the degree of accountability and information. Although community-based development efforts have had mixed results (Mansuri 2013), namely falling short in monitoring system, they make crucial steps toward finding alternative solutions to official state-led aid system.

Official State-Led Foreign Aid

At the United Nations Sustainable Development Summit on 25 September 2015, the world leaders adapted 17 Sustainable Development Goals (SDGs), which were the extension of the Eight Millennium Development Goals. Three main pillars of sustainable development are economy, environment, and social community with world poverty at the epicenter. It comes as no surprise that ending world poverty takes first place on the list of SDGs.

Since the Point Four Program, announced by Harry Truman in his inaugural address on January 1949, it has become evident that the West, predominantly North America and Western Europe, would take the lead in building programs for "the improvement and growth of underdeveloped areas" (Truman). In recognizing that it was the responsibility of the West to relieve the suffering of the less developed countries of the world, his speech broke new ground. Truman's speech started a chain reaction of the "state planning" mindset. A handful of agencies were created after World War II to implement the programs: the International Monetary Fund, the World Bank, the United States Agency for International Development (USAID), the United Nations Development Program

(UNDP), the Inter-American Development Bank (IDB), and many more. The future course of eliminating poverty and fighting humanitarian crises was out of the discussion. The consensus was clear: both short-term emergency relief aid and development of long-term assistance programs were to become a state-led international effort with the means of foreign aid.

Analysis of the state-led humanitarian efforts distinguishes multidimensional issues of the virtue and hidden agenda of self-serving motives of national interests (Barnett 2008; Coyne 2013; Easterly 2006), the issue of sovereignty and emergency intervention by donor states, the chronic aid-dependence of recipient states (Moyo 2009), the resentment to donor states and their efforts by the recipient states based on the sense of embarrassment over weakness vis-à-vis superpower states, the security issue of aid personnel, and the corruption of recipient states' governments (Moyo 2009). Setting aside the issue of motives and moral obligations, the most prominent critics of the state-led foreign aid examine cost-effectiveness and efficiency on poverty reduction and long-term growth alike.

Michael Barnett calls for a regime change for humanitarian aid to make it more accountable and efficient. Although Michael Barnett focuses on short-term relief aid, his analysis is equally applicable to the long-term development assistance. He points out that the humanitarian community is aware of its prime failures in delivering aid. He questions, however, whether the old system is resilient to adopt the emerging changes in the humanitarian aid paradigm (Barnett 2015).

Michael Barnett, a professor of international affairs and political science, argues that the 'Humanitarian Club', the elite players of the humanitarian community that includes a network of donors, international organizations, and non-governmental organizations with the UN at the epicenter, is aware of the aid delivery flaws. In recent years, humanitarians, faced with wide-ranging criticism for their failures, responded with reforms. They have made remarkable progress in improving their competence, coordination, and professionalism The UN replaced its outdated Department of Humanitarian Affairs with the Office of the Cooperation of Humanitarian Affairs in 1998. NGOs drew up a voluntary code of conduct, crafted a common standard for meeting victims' basic

needs such as food, water, health care, and shelter, and built a network to strengthen program evaluation and accountability.

More comprehensive reforms took place in 2005, and later the Transformative Agenda, launched by the UN in 2011, an updated funding system for assistance from most UN agencies, followed suit with pooled resources in the new Central Emergency Response Fund. Better reporting and new data-collection techniques have kept aid workers accountable and allowed them to learn from past mistakes.

Improving reporting methods also furthered financial transparency of aid agencies. Thus, the availability of the data registered with the Center for Global Development exposed information regarding projects in post-earthquake Haiti. It was revealed that approximately 90 percent of the US aid contributions dissolved into international agencies and organizations (Barnett 2015). A large donor may provide a grant to a large INGO which may channel money to smaller NGOs, faith-based organizations, or Haitian community groups. Each layer in the process may absorb up to ten percent for administrative costs.

On an optimistic note, "when it comes to efficiency of aid delivery, there has been slow but steady progress," (Barnett 2015), more coordination, and centralization at the top. The humanitarian community has been preparing for another big push for reform that will be discussed at the World Humanitarian Summit convened by the UN secretary-general in 2016.

To conclude, Barnett argues that there is optimistic evidence that the members of the top-down humanitarian system have made attempts to build stronger partnership with local communities and recognized the necessity of reform. However, the future of the global humanitarian sector depends on the "club's willingness and ability to continue to evolve," to share its power and accept a diminished role on the world stage.

Christopher Coyne argues in Doing Bad by Doing Good that the humanitarian aid system falls under "the man of the humanitarian system mentality" that does not refer to a specific person, rather to a mentality, which contends that modern humanitarian action must be state-led. This mentality holds that human suffering can be removed if the right people, who possess the required resources and power, are in charge. Under this mentality, the problem of suffering can be eliminated by simply applying a purely technological universal solution to complex economic, political, and social systems of the developing world. According to Coyne, "instead of appreciating these complexities, the man of the humanitarian system views the world as a grand science project that can be improved upon as he wishes" (17). As an outcome of this mentality, humanitarian action suffers from the "planner's problem," which, in essence, refers to disempowerment of citizens in the recipient states to find innovative paths towards sustainable growth through engagement with the market.

By state-led actions, Coyne infers "a government or a group of governments as a leading role for the agenda setting, carrying out, funding, and overseeing the humanitarian efforts" (37). Almost all major humanitarian aid, as we know it today, is built by wealthy country governments and international NGOs. In some cases, the state's role is less evident than in others. For instance, majority of NGOs are viewed as principal actors, but in reality, they receive funding from private donors or governments. Subsequently, NGOs have become dependent on continued government contracts and funding, furthering the ability of the governments to influence the work of NGOs with their own political and military agendas. Another case in point is international NGOs, the major players of the humanitarian aid system, which have increasingly contracted aid delivery out to local NGOs. On the surface, it is an honorable deed, but in fact, most local NGOs are staffed with Western experts, not local citizens. As Coyne concludes, "NGOs have increasingly come to rely on governmental funding of their aid programs, and such funding has entailed increasing government control over the actions of these ostensibly private organizations" (23).

To illustrate how humanitarian aid programs operate on the international scope, Coyne makes a comparison to the Soviet Union. Similar to the Soviet centrally planned economy, humanitarians tend to rely on central planning to allocate their resources. The central planning of humanitarian action takes place through numerous, and often times overlapping layers of bureaucracy. The most prominent example is the expansion of the United Nations system with its numerous agencies that perform similar functions and whose work often overlaps. The problem with central planning, as in the case with the Soviet Union, is a lack of incentives for a higher perfor-

mance and knowledge constrain that lead to overpro-duction and waste.

Coyne argues that "planners outside markets cannot solve the economic problems, or replicate the ability of markets to foster societal economic prog-ress" (77). Planners lack local knowledge due to the absence of economic calculation to anticipate and coordinate goods in order to complete the projects. In lieu of the knowledge, planners attempt to replicate conditions of their own developed countries. This model discourages productive entrepreneurship and impedes promotion of society-wide economic devel-opment. Coyne argues that the best means to achieve the end of poverty is by providing citizens with the means to engage with the free market. To accomplish this arduous task, William Easterly suggests to em-power "searchers."

In his book The White Man's Burden, East-erly distinguishes between those who play the tra-ditional role in providing international aid through the Big Plan ("planners"), and those who actively challenge the existing system, searching for alter-native ways to deliver goods and services ("search-ers"). Searchers are oftentimes local actors that find creative solutions to specific problems, provided they are granted resources, and other actors who are willing to get genuinely engaged in the process.

Easterly urges the readers to note that the statements, such as the one Jeffrey Sachs makes in his book The End of Poverty (2005), despite the purity of intentions, can be misleading. Sachs con-cludes in his book that "success in ending the poverty trap will be much easier than it appears" (56). He contends that the world poverty can be overcome with the help of a Big Plan, the widespread Planners' approach to design the ideal aid agencies, administra-tive plans, and financial resources. William Easterly's counterargument is based on the fact that planners do not possess the knowledge and motivation of search-ers, therefore, a Big Plan of the existing foreign aid scheme is bound to fail.

Easterly draws a distinct line between "plan-ners" and "searchers" to show how the traditional model of planned state-led humanitarian action falls short. Planners think they know already the uni-versal answers; they think of poverty as a technical engineering problem. Searchers admit that they do not know the answer in advance; they believe that poverty is a complicated tangle of political, social,

historical, and institutional factors. Searchers hope to find answers for individual problems only by trial and error experimentation. Searchers believe only insiders have the knowledge to find solutions, and that most solutions must be homegrown. Even when Planners have good intentions, they do not motivate anyone to carry them out, neither do the Planners take responsibility for their actions. Planners deter-mine what to supply; Searchers find out what is in demand. Planners apply global blueprints; Searchers adapt to local conditions. Planners at the top lack knowledge of the bottom; Searchers find out what the reality is at the bottom. Planners never hear whether the end users got what is needed; Searchers find out if the customer is satisfied.

Two key elements that make Searchers work highly efficiently are feedback and accountability. Searchers know if something works only if the peo-ple at the bottom can give feedback. Easterly asserts that lack of feedback is one of the most critical flaws in existing aid system. More importantly, Searchers take responsibility for the outcome. Easterly suggests that the balance of power in aid ought to be shifted from Planners to Searchers.

Participation Is the Key Solution to Efficiency

Although the two prominent economists do not suggest a feasible alternative scheme to the existing 'Big Plan' humanitarian action and for-eign aid development, participation of the local communities seems to be a viable solution. Com-munity-based development (CBD) narrows the gap between knowledge on the ground and implementing agencies. Community-based development refers to a broad spectrum of program approaches that channel aid directly to the community and often prioritizes participation and ownership by community members in program implementation (Mansuri 2013).

Poverty alleviation through participatory development projects has originated in a language of critique of the dominant state-led development initiatives. They have now become part of accepted organizational action used by multilateral and bilat-eral development agencies, governments and orga-nizations of civil society. The CBD programs with participation are increasingly regarded as a solution to the accountability problem.

Participation is viewed as most common

means to empowerment of the poor in development. A more engaged citizenry should be able to achieve a higher level of cooperation and make government more accountable. Organic participation (World Bank 2013)-- participation spurred by civic groups, acting independently from government-- can be an important component of the new tendency in humanitarian aid. For instance, the Garmeen Bank in Bangladesh is a successful example that can serve as a template for microcredit lending.

For example, given the absence of a stable banking system, Africa, which is founded on a communal sense of interdependency and trust, could use a grassroots model of microcredit lending. Microcredit schemes were designed by a Nobel Prize winner, a Bangladesh national, Muhammad Yunus, to lend to the poorest and most rural segments of countries. The mechanics of the Grameen Bank ("Bank of the Village") are straightforward. The Grameen Bank lends to a group $100. Within that group the amount is passed on to trader A for a certain period. When the loan is repaid, the next $100 loan is made to trader B. If trader A fails to repay, the group is cut off the future loans.

The Grameen model, in one form or another, has been adopted in at least forty-three countries around the world. In 1995, a few years into its success, the Grameen Bank adopted the principal "No Donor Money, No Loans." It decided to not receive any more donor funds, and today it funds itself 100 per cent through its deposits. The Grameen Bank is intended to ensure individual accountability. Individuals tend to be more accountable to groups of their peers with whom they have to continue to live and work than the external agents with whom they do not share their daily lives (Barnett 2015).

Another emerging alternative to the conventional top-down aid system is unconditional direct cash transfer (UCT) programs. The spectrum of donors can vary from private, bilateral and multilateral actors, and national government. For instance, Chris Blattman sets an example of a UCT program initiated by the Nigerian government in 2011 which according to Blattman (2014), boosted the Nigerian economy. The Nigerian government handed out 600 million dollars to about 1200 entrepreneurs. As a result, three years later, hundreds of newer companies opened, employing 7000 new people.

The emerging models of foreign aid, such as unconditional cash transfers (ex. GiveDirectly project in Kenya, the Nigerian case) and microcredit lending (ex. the Garmeen Bank) provide poor households with resources that meet their most-pressing needs. These alternatives to the top-down humanitarian aid development are designed to improve psychological and economic well-being of impoverished communities.

Although the unconditional direct cash transfers and microcredit lending bypass middle-men and corrupt officials avoiding the cost-ineffectiveness problem and, as indirect result, target the local knowledge problem, its limited scope cannot replace the large-scale of induced development programs, such as community-driven development and safety net and transfers programs. Direct cash transfers and microcredit lending are disputably applicable to the settings of building infrastructure and institutions for better political stability and sustainable economic growth. Rather, these aforementioned models have the potential to become complement to the participatory community-driven and decentralized development projects.

The World Bank Policy Research Report of 2013 distinguishes two major modalities for local participation: community-driven development and decentralization of resources and authority to local government, also known as induced programs (Mansuri 2013). Community-driven projects support efforts to bring civil groupings to manage developing resources by engaging in service delivery and design of the programs without relying on local governments. The degree of community participation in design and management of the project can vary.

On the other hand, decentralization participatory programs are carried out by the local government. They are claimed to strengthen citizens' participation in governments and become a conduit for political culture, social, and institutional change. Decentralization may pave the way for greater control over decision-making at the local level, closing the gap between citizens and local officials. On a negative note, decentralization may shift power from central to local governments without any empowerment of the poor.

Although unconditional cash transfers and microcredit lending have the potential to become the most commonplace humanitarian aid delivery and development aid model, it has the disadvantage of a

limited scope. The unconditional cash transfers and microcredit lending should be complementary to the long-term decentralized projects that are designed and implemented in collaboration between central governments, local governments, NGOs, and independent project implementation agencies with a high degree of local participation.

Induced programs are bureaucratically managed; they are long-term development interventions that ideally require monitoring and evaluation system. The biggest advantage of the induced type of development programs is the technical and financial assistance provided by bilateral and multilateral donors. More narrowly, decentralized participatory projects run by national government and carried out locally with various degrees of community participation can target a larger scope of population, have the potential for changing political culture, and can lead to sustainable economic growth. One example of decentralized participatory projects is the Bolsa Familia Program.

Decentralized Participatory Program: Bolsa Familia-Safety Net and Conditional Transfer Program
Bolsa Familia Program (BFP) is a centerpiece program in the Brazil's social safety net. On the other hand, it is a model of conditional cash transfers program that provides money directly to poor families in return for keeping their children in school and attending preventive health care visits. The program was launched by the newly elected government of Luiz Lula da Silva in 2003 to stimulate rapid growth and social progress. Since its launch, it has covered about 46 million people.

Regarding the social aspect, the BFP was a comprehensive reform of Brazil's social safety net, which integrated four previously existing cash transfer programs into a single program under a newly created "Ministry of Social Development." The transfers are made preferentially to women in each family. The program supports the formation of human capital such at children's attendance, health care, and other social services. It also aims to break the poverty cycle and to assure 'graduation' from cash transfers dependency by providing job-related services.

Regarding the international aspect, the Bolsa Familia Program is an example of an induced decentralized development program. The BFP is run by the Brazilian federal government and carried out by 5,564 municipalities. The program has a decentral-

ized institutional context with technical and financial support from the World Bank. The Brazilian government requested the World Bank to partner over the BFP in the context of longstanding Bank support for its social agenda. The first WB four-year loan was US$572.2 million (The World Bank 2007). It is a large-scale multilateral program that is also supported by the UK, the UNDP, and the Inter-American Development Bank. It has been applied in this form or the other in five other cases: Mexico's Education, Health and Nutrition Program (Progresa), the Families in Action in Colombia, the Social Protection Network in Nicaragua, the Family Assistance Program in Honduras, the Program of Advancement through Health and Education in Jamaica, and the Social Solidarity Fund in Turkey.

Domestically, the BFP showed positive results. By the end of 2006, the Bolsa Familia Program covered 11.2 million families (about 44 million people). It is merely 0.2-0.5% of Brazil's GDP. It has become an instrument for long-term human capital investments (i.e. attendance rates in educational institutions, vaccination, pre-natal visits) and short-term social assistance. It helped promote the dignity and autonomy of the poor. This is particularly true for women, who account for over 90% of the beneficiaries. Interestingly, unconditional cash handouts are perceived as negative in Brazil. The BFP is expanding into empowerment of the BFP beneficiaries by linking them to job-related services to help the poor break the cycle and "graduate" from dependence on cash-assistance. Given the program has expanded beyond country boundaries to be replicated in other countries, it is a fair question to ask whether the program is efficient and cost-effective.

Bolsa Familia is a decentralized program run by the federal government and carried out by municipalities. It is expected that its implementation requires high bureaucratic spending. Controversially, the evaluation of Progresa, the Mexican analogous of the Brazilian Bolsa Familia, revealed that conditional cash transfer investments can be delivered cost-effectively. Money is transferred directly to poor families' bank accounts. Data shows the BFP administrative costs of delivering to poor households are very low, MEX$8.9 to MEX$100 (Rawlings et al. 2005). The largest cost components are those associated with household targeting (nearly 30 percent), followed by those associated with conditioning the receipt of

transfers (26 percent). The data is at odds with the Barnett's argument about the conventional top-down aid delivery which states that only ten percent of the donor funds reach the goal.

Efficiency evaluation of accountability and sufficient knowledge shows a mixed record. First, grants are distributed directly to poor household, thereby removing the intermediaries and changing accountability relationships among the national government, service providers, and the poor. Second, the program targets mainly women. Preference for payment to women reflects the international experience that suggests that women are more likely to invest into improving education, health, and welfare of their families. Third, the use of cash leads to the creation of domestic markets. Fourth, decentralized context creates opportunities for better knowledge gathering at municipal level. Furthermore, the BFP targeting system enables municipalities to collect data and register poor families efficiently. The results show that the BFP is extremely well targeted. According to the World Bank report data (2007), 85% of all benefits went to the poorest, while none went to the rich population.

Decentralized context frames challenges and opportunities for better accountability and knowledge acquisition. While the BFP is managed by the Ministry of Social Development, it is carried out by the municipalities. State governments provide technical support and training to municipalities. Three control agencies are responsible for oversight and monitoring of the program. The principal challenge is principle-agent dilemma for "third party implementation." This challenge involves how to develop management mechanism to oversee and promote quality of implementation by actors other than the Federal Government, namely municipalities that are constitutionally autonomous and the federal bank.

To solve the dilemma, the federal government signed agreements with municipalities to clarify roles and responsibilities and to establish minimum institutional standards for program operations at the municipalities level. Meantime, the federal government rewarded innovations in implementation and exchange of experiences between municipalities. In some ways, the decentralized context has created conditions for experimenting with service delivering, additional conditionality and different approaches to monitoring. However, monitoring covers only certain aspects of the BFP. The joint management agreements and the Decentralized Management Index are important tools of monitoring, but additional designs are needed, such as random audits, implementation evaluation based on field feedback, not on administrative data.

Programs of the nature of Bolsa Familia require sufficient administrative capacity with extensive banking system. Its replications in this form or another can be found in Mexico, Nicaragua, Jamaica, Turkey, Honduras, and Colombia. Although the program proves to be cost-effective, its efficiency showed a mixed record. Decentralization helps inquire local knowledge, however, there is room for improvement in monitoring for better accountability.

Community-Driven Development Programs

Participatory development approach is broadly varied. Its typology ranges from community control over decision-making and management of grants, such as the Indonesian Kecamatan Development Program or the Philippines KALAHI-CIDSS, to a lesser degree of community involvement via inputs into planning process of local government through semi-autonomous governmental bodies, such as the Brazilian Bolsa Familia Program. How are other emerging participatory models comparable to the BFP in regard to efficiency on poverty elimination and sustainable growth?

Benjamin Olken conducted a field experiment of top-down monitoring in 49 Indonesian villages that applied for infrastructure projects as part of the Indonesian Kecamatan Development Program (KDP). Similar to the Bolsa Familia Program, the KDP is a national Indonesian government program, carried out in a decentralized context, and funded through a loan from the World Bank. The main difference of the KPD is its high degree of community involvement in the process of project design and funds allocation. Olken suggests that better monitoring and punishment can reduce corruption using the strategies of monitoring by the government auditors and grassroots participation in the village. He offers an example of how a carefully designed monitoring system can keep in place villagers' deep participation meantime avoiding corruption and elite capture.

In the context of the Kecamatan Development Program, the results of the independent government

development audit agency were read publicly to an open village meeting by the auditors, and also were sent to the central government, project officials and other villages. Under means of punishment, village officials faced several sanctions: retribution from the village or the possibility of criminal action; public return of stolen money or the possibility that the village would not receive a grant in the future which result in social sanctions. Aside from random audits, the local officials need to file an accountability report at the end of the project in order for the village to apply for a project next year.

The grassroots participation is prone to capture by local elites. Although open to the entire village, the meetings aimed to design projects and discuss funds allocation, are typically attended by only 30-50 people, most of whom are members of the village elites. In the case of Indonesia, Javanese villagers consider it rude to attend a meeting to which they have not been formally invited. To assure a broader diversity in attendance, Olken performed an experiment in which he distributed written invitations, most effectively with the help of school children. Invitations included a comment form asking villagers' opinion of the project for anonymous comments to increase the villagers' fear of retaliation from the elites.

The KDP monitoring model can be used in participatory development projects with the purpose of enabling poor people to monitor service providers and preventing elite capture. Its design can be used as a template and evidence that better monitoring is conceivable. It is fair to assume that each community-driven program will require various monitoring and punishment designs.

Controversially, analysis of the grassroots democratic intervention in 1,250 villages randomly selected to participate in a four-year long community-driven development project "Tuungane" in eastern Congo showed mixed or no positive effect on participation, accountability, efficiency, transparency, and capture (Humphrey 2015). Tuungane sought to "improve the understanding and practice of democratic governance, improve citizens' relationships with local government and thereby communities' ability to resolve conflict peacefully" (Humphrey 2015). Thus, population was trained and mobilized before organizing elections by the means in which the Village Development Committees of locals were formed.

The committee members decided how to allocate the loans and design a development project. The projects were then voted on by the whole village. Thus, the village members were holding the committee accountable. The committee members had to participate in intense training on leadership, responsibilities, gender issues, and principles of good governance. The leaders were trained in financial management and accounting practices. The project made a significant emphasis on the inclusion of women and other vulnerable groups. In addition, villages were granted unconditional cash transfers to enable the committees to decide who should manage the funds and how to spend it.

To measure the effect of Tuunagane project on participation, accountability, transparency, and capture, the implementation agency employed observers of behavior in the villages, performed extensive audits and survey data collection. The overall conclusion based on the findings can be summarized as follows: "exposure to grassroots democratization left power structures and related behavior unaffected" (Humphrey).

The example of the Tuungane program shows that community-driven models can target a large scope of issues. However, implementation and monitoring design require extensive expertise and creative thinking. Although the emerging participatory development programs suggest templates of various participatory programs components, each case must be carefully designed and accordingly adapted to its historical, geographical, political, and economic particularities. The biggest challenge of the participatory programs reflects the conclusion that "one size fits all" will never work in its context. Humanitarian community and development agencies need to find new avenues to empower local searchers and to incentivize searchers in the West.

Conclusion

This paper argues that empowerment of local communities through participation leads to additional efficiency and overall effectiveness by addressing the issues regarding accountability and local knowledge. Participatory programs eased by implemented agencies or local government officials constrained by a carefully designed monitoring system prove to be more efficient types of participatory develop-

ment programs. The Bolsa Familia Program and the Kecamata Development Program showed promising results in addressing cost-effectiveness and efficiency problems in traditional top-down foreign aid programs. The international community can share its technical assistance, resources, expertise, and knowledge in developing the design and implementation of projects. From the research presented in this paper, two paths towards increased effectiveness of foreign aid programs become apparent. First, a renewed commitment to information and resource sharing paradigms can empower local communities through participation to plan and manage the activities needed on the ground. In addition, design must guarantee a viable monitoring system to avoid corruption and elite capture. A combination of these steps can assist in the further development of poorer countries, and provide economic prosperity by ensuring all boats rise.

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A Multidisciplinary Approach to Cancer Treatment: Computationally Guided Discovery of Novel PRMT5 Inhibitors

Joshua Ong, Sarah Schlotter, Chenglong Li, Robert Baiocchi

Abstract

Disruption in the regulation of gene expression has been described as a factor promoting the development of cancer. Protein Arginine Methyltransferases (PRMT) are a group of enzymes that methylate arginine residues in histones and other proteins. The overexpression of PRMT5 has been noted in numerous cancers such as glioblastoma, EBV-driven cancers, diffuse large B-cell lymphoma and mantle cell lymphoma. Given that PRMT5 remains a target involved with oncogenesis, a collaborative group at OSU has developed a first-in-class PRMT5 inhibitor. Prior work has shown that PRMT5 knockdown with shRNA leads to decreased growth and viability of numerous cancer cell lines1. Mantle Cell Lymphoma cell lines were initially screened via MTS assay, a light colorimetric assay at assesses cell metabolic activity and cellular proliferation, with Compound 5, a 1st generation PRMT5 inhibitor. In addition to the biological assays, one approach to optimizing PRMT5 inhibitors was analyzing Compound 5 through molecular modeling tools such as UCSF Chimera and Autodock Vina. UCSF Chimera and Autodock Vina provide structural analysis of chemical bonds by measuring specific affinity levels between the inhibitor and protein. Based on computational analysis, molecular optimizations of Compound 5 were conducted to develop a second generation of PRMT5 inhibitors. Of these novel inhibitors, Compound ICD18 exhibited significant anti-cancer activity during MTS screening. Novel compounds were optimized based on ICD18 to produce a third generation of PRMT5 inhibitors that could outcompete PRMT5's cofactor, S-adensyl methionine. These compounds will be screened through MTS to examine the specificity and selectivity of inhibiting PRMT5 activity. Our immediate goal is to select lead PRMT5 inhibitors for further optimization in in vitro and in vivo preclinical cancer models. Our ultimate goal will be to identify key lead PRMT5 inhibitor drugs for preclinical efficacy, PK and toxicity studies allowing for filing an investigational new drug application (IND) with the FDA and move this new class of compounds forward for clinical investigation treating patients with diverse cancers.

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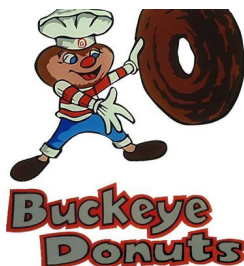
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For their highly generous contributions and support, including the funding of this journal. This would not have been possible without their support. We give you thanks from the bottom of our hearts.

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