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The Implications of Blue Light due to Light's Physical Characteristics

Amariah Alabi

With the introduction of technology in the 21st century comes improvements in healthcare, education, and security. However, recent discussions surrounding the impact of blue light exemplify how the risks of interacting with such innovations are yet to be fully understood. This specific color of visible light is naturally found in sunlight but also emitted from a host of electronic devices ranging from handheld cell phones to portable laptops.¹ Around 85% of adults claim to go online daily which suggests that they are taking in the blue light emitted from their technological devices². Because of its abundance in everyday life, media sources ranging from The Guardian to ABC News highlight concerns about its potentially negative impact on an individual's physical well-being.^{3,4} Many articles also differ in support or critique of counteracting inventions claiming to protect consumers from the light's harms. While some inventions may claim to protect their consumers' sleep, others might emphasize their ability to cease eye strain.⁵ Its dominance in the news cycle suggests there is still confusion surrounding the impact of blue light. So, this paper aims to discuss the physical science behind blue light's interactions with the eye as well as its sources. After, it will address the misconceptions surrounding the light's impact and solutions as well as how the eye is affected when accommodating digital images. Finally, it will end by discussing suggested approaches for dealing with these technologies.

To understand blue light, one must first be aware of the physical characteristics light possesses. In its wavelength form, light exists as electromagnetic radiation that carries energy across long distances. Due to variations in the sizes of wavelengths, a broad spectrum of light exists. For example, the smallest gamma rays have a wavelength of approximately 10–12 meters while long radio waves have an approximate wavelength of 103 meters.⁶ Notably, the light that humans see, also known as visible light, exists within a range of about 400

¹Harvard Health. (2020, July 7). Blue light has a dark side. <https://www.health.harvard.edu/staying-healthy/blue-light-has-a-dark-side>

²Pew Research Center. (2021, June 5). 31% of American adults are online almost constantly | Pew Research Center. <https://www.pewresearch.org/short-reads/2021/03/26/about-three-in-ten-u-s-adults-say-they-are-almost-constantly-online/>

³Mehta, D., Tang, E., & Gregory, A. (2023, August 22). Study indicates blue light filtering glasses have little benefit for most: 3 eye-healthy habits to adapt instead. ABC News. <https://abcnews.go.com/GMA/Wellness/study-blue-light-filtering-glasses-benefit-3-eye/story?id=102419275>

⁴Snape, J. (2023, October 2). Should I worry about blue light? The Guardian. <https://www.theguardian.com/lifeandstyle/2023/oct/01/should-i-worry-about-blue-light>

⁵Iuliano, A., & Iuliano, A. (2023, September 19). The Benefits of Blue Light Lenses | Cochrane. River Heights Eye Care -. <https://riverheightseyecare.com/what-are-the-benefits-of-blue-light-glasses/>

⁶Pinetti, E. (2022, November 30). From gamma rays to radio waves: Dark Matter searches across the spectrum. arXiv.org. <https://arxiv.org/abs/2212.00125>

nanometers to 700 nanometers long.⁷ Violet light is the shortest light within this range while red light is the longest. Blue light is among the shortest, being 450 nanometers to 495 nanometers long. So, it carries more energy than longer wavelengths of light. Planck's equation explains the reason for this difference. According to the equation, the energy each photon of light carries is equal to the frequency of the light times Planck's constant.⁸ Because frequency is equal to speed divided by wavelength, frequency and wavelength have an inversely proportional relationship. Due to this relationship, blue light has a greater frequency than longer wavelengths of light and thus possesses more energy.

The fact that blue light carries more energy than other wavelengths of visible light plays a role in its interaction with the eye. When light strikes an object, it can be absorbed and transformed into heat, transmitted through the object, or reflected off its surface. When humans view images, they are seeing light reflected into the eye. Usually, the source of this light is the Sun which emits all frequencies of visible light. When this light is incident upon a surface, it will be scattered in various directions. However, only when they enter the eye are they seen as an image.⁹ These rays of light are first received by the cornea whose shape helps bend the light. Then these rays are focused when the muscles in the lens contract and relax to change the focal length of the light. Because of this focusing power, these rays reach the focal point on the retina and are seen clearly.¹⁰ On the retina, photoreceptors such as cones and rods send light down the optic nerve as electric signals for the brain to interpret as an image. Because blue light carries more energy than other wavelengths of visible light, it has the potential to damage photoreceptor cells when absorbed at higher doses.

This raises the question of what typical sources of blue light are. Blue light is not solely sourced from electronic devices. Contrary to popular belief, the Sun emits white light, a combination of the visible spectrum, rather than the orange-yellow portion. This combination is the reason why humans can see various colors of objects on Earth. Blue light represents a third of visible light and is scattered more than other colors of light due to its short wavelength. This partially explains why the sky appears blue and further supports the fact that blue light is present in the natural world. The distinction arises when considering the presence of blue light from artificial sources in comparison to other

⁷Sliney, D. H. (2016). What is light? The visible spectrum and beyond. *Eye*, 30(2), 222–229. <https://doi.org/10.1038/eye.2015.252>

⁸Khadka, C. B., & Author Id, N. (2022). Redefinition of De-Broglie Wavelength Associated with Material Particle. *Indian Journal of Advanced Physics*, 2(1), 14–16. <https://doi.org/10.54105/ijap.c1020.041322>

⁹Westheimer, G., & Campbell, F. W. (1962). Light Distribution in the Image Formed by the Living Human Eye*. *Journal of the Optical Society of America*, 52(9), 1040. <https://doi.org/10.1364/josa.52.001040>

¹⁰Spadea, L., Maraone, G., Verboschi, F., Vingolo, E. M., & Tognetto, D. (2016). Effect of corneal light scatter on vision: a review of the literature. *International Journal of Ophthalmology*. <https://doi.org/10.18240/ijo.2016.03.24>

wavelengths. LEDs are an example of such artificial sources.

LEDs, also known as light-emitting diodes, have the potential to emit visible light of various wavelengths. These diodes are made up of semiconductor chips that cause current to flow in one direction.¹¹ When the electrons inside the atoms of these chips are excited by electricity and hit a positively charged particle, they fall down energy levels and return to the atom. As a result of this process, a photon of visible light is emitted. Due to the law of conservation of energy, energy cannot be created or destroyed. It can only be converted into another form. As a result, the energy needed to excite these electrons plus additional kinetic energy is equal to the energy absorbed by the photon. So, the energy contained by the electrons released isn't lost but rather converted. This ensures that a greater fall releases more energy. So, the specific color emitted depends on how these energy levels are controlled.¹² In the case of blue light, the gaps between these energy levels are wider so that the electrons fall lower and release photons with higher energy.

These LEDs are not only present in lightbulbs but also in the screens of phones, televisions, and computers. When manufactured to emit light similar to the white light emitted by the Sun, these sources contain blue LEDs.¹³ To further understand why, one must look deeper into the materials contained within LEDs. A fluorescent material known as a phosphor coats these LEDs. This ensures that the light emitted by the LED hits this coating material and emits the desired colored wavelength of light. During the discovery of these processes, more efforts were directed at combining blue light with the complementary colors of a phosphor to produce a vibrant white light.¹⁴ Because this white lighting is similar to the natural lighting found outside, consumers gravitated toward these products. However, blue LEDs are not only desirable not only for aesthetic purposes but also for energy efficiency. Unlike LEDs, older sources of light such as incandescent lightbulbs, produce light through heating a filament with electricity. Only two percent of the emitted energy is visible light while ninety-eight percent is lost to heat.¹⁵ LEDs use ninety percent less energy than incandescent lightbulbs.¹⁶ As a result, LED lights containing blue light are sought

¹¹Spagnolo, G. S., Leccese, F., & Leccisi, M. (2019). LED as Transmitter and Receiver of Light: A Simple Tool to Demonstration Photoelectric Effect. *Crystals*, 9(10), 531. <https://doi.org/10.3390/cryst9100531>

¹²Spagnolo et al. LED as Transmitter and Receiver of Light

¹³Dain, S. J. (2020). The blue light dose from white light emitting diodes (LEDs) and other white light sources. *Ophthalmic and Physiological Optics*, 40(5), 692–699. <https://doi.org/10.1111/opo.12713>

¹⁴Nakamura, S. (2015). Nobel Lecture: Background story of the invention of efficient blue InGaN light emitting diodes. *Reviews of Modern Physics*, 87(4), 1139–1151. <https://doi.org/10.1103/rev-modphys.87.1139>

¹⁵Efficiency of LED vs. Incandescent Lights | Midland, MI - Official Website. (n.d.). <https://city-ofmidlandmi.gov/218/Efficiency-of-LED-vs-Incandescent-Lights>

¹⁶Lighting Choices to Save You Money. (n.d.). Energy.gov. <https://www.energy.gov/energysaver/lighting-choices-save-you-money>

after.

Another reason for the use of blue LEDs in technology is because of the process behind how electronic screens produce images. A typical screen consists of a combination of blue, red, and green LEDs joined close together.¹⁷ When activated at different intensities, the colors for specific images are created. For example, the color purple is created when red and blue LEDs are activated with green LEDs inactive. However, to change the activity of these lights, polarization is used. Polarization occurs because the waves of light vibrate in various directions. When slits are placed that only let certain light out depending on its direction. This process polarizes the light.¹⁸ Each pixel has a polarized glass layer behind it and one in front of it set at ninety degrees. Between these layers is a layer of liquid crystals that can rotate the light to allow it to pass through the polarized glass. However, when these crystals are not rotated no light passes through. This effectively produces a black screen. Thus, screens display images when certain light is let through. Because blue LEDs are used in conjunction with the other LEDs for this light, they are needed for clear resolution of the images created. When the monitor of a screen is set to emit white light, more of the blue LEDs are activated. Modern technologies such as computer screens, cell phones, and televisions use blue light for these purposes and subsequently act as artificial sources of blue light in addition to its natural sources. This has raised concerns about the safety of consuming blue light in one's everyday life.

With these concerns, misconceptions about blue light have proliferated. One misconception states that blue light is merely artificial. This claim is unfounded because it does not consider the fact that sunlight is a mixture of all colors of visible light. This means that natural light contains a significant amount of blue light. Additionally, the Sun contains a similar amount of blue light to cellphones. The Sun's visible light is 25% blue light while the light from cellphone screens is 30% blue light.¹⁹

Cataracts was also suggested to be caused by blue light. This disease references a condition that occurs as humans age. It occurs when the eye becomes cloudier due to proteins in the eye breaking down and clumping together. This condition is perceived by some to be caused by overexposure to blue light. This can be attributed to a paper that suggested the blue light

¹⁷Muthu, S. (2002, April). Red, green, and blue LEDs for white light illumination. *IEEE Journals & Magazine | IEEE Xplore*. <https://ieeexplore.ieee.org/abstract/document/999188>

¹⁸Foster, J. J., Temple, S. E., How, M. J., Daly, I. M., Sharkey, C. R., Wilby, D., & Roberts, N. W. (2018). Polarisation vision: overcoming challenges of working with a property of light we barely see. *The Science of Nature*, 105(3–4). <https://doi.org/10.1007/s00114-018-1551-3>

¹⁹De Gálvez, E. N., Aguilera, J., Solis, A., De Gálvez, M. V., De Andrés, J. R., Herrera-Ceballos, E., & Calderón, A. G. (2022). The potential role of UV and blue light from the sun, artificial lighting, and electronic devices in melanogenesis and oxidative stress. *Journal of Photochemistry and Photobiology B-biology*, 228, 112405. <https://doi.org/10.1016/j.jphotobiol.2022.112405>

shown on rats caused them to develop severe cataracts.²⁰ However, since its publishing then retraction, medical officials such as the American Academy of Ophthalmology have stated that Cataracts is more likely to be caused by Ultraviolet light.²¹

Ultraviolet (UV) light possesses much different characteristics than blue light as it ranges from 10 nanometers to 400 nanometers. This shortness in length ensures that it packs more energy within its wavelengths. When the Sun sends this light down to Earth, some of the light is scattered by nitrogen and oxygen molecules in the atmosphere, but other parts of the light successfully pass through the atmosphere.²² Unlike blue light, UV light cannot be seen due to absorption by the lens of the eye. However, because this light contains more energy than visible light, it can still be scattered within the cells of the body. Ultraviolet light is more likely to cause cataracts than blue light because of the proteins damaged as a result of its scattering. Despite blue light's significant amount of energy, in comparison to other forms of light, its energy is only destructive during overexposure to high doses.

Another claim addresses the fact that blue light contains more energy and damages the photoreceptor cells residing in the retina. With increased exposure to higher dosages of blue light, these cells release toxins that cause irreversible damage to eyesight and blindness. While these are valid causes of alarm, medical officials at the American Academy of Ophthalmology have stated that artificial sources of blue light do not provide such extreme dosages of blue light.²³

Because of its novelty, however, more studies are needed to determine what is deemed overexposure to blue light and whether that causes diseases. For example, a disease known as macular degeneration occurs when the retina is thinned due to blood vessels hemorrhaging and killing retinal cells. When light passes through the eye, the photoreceptors on the retina will not be present to capture it and therefore lead to blind spots in the vision. While risk factors include age and genetics, medical sites have not yet cited blue light as a cause for the disease.²⁴

²⁰Wang, Y., Zhang, M., Sun, Y., Wang, X., Song, Z., Li, H., & Liu, K. (2020). RETRACTED ARTICLE: Role of short-wavelength blue light in the formation of cataracts and the expression of caspase-1, caspase-11, Gasdermin D in rat lens epithelial cells: insights into a novel pathogenic mechanism of cataracts. *BMC Ophthalmology*, 20(1). <https://doi.org/10.1186/s12886-020-01565-z>

²¹Vimont, C. (2023, September 1). Should You Be Worried About Blue Light? American Academy of Ophthalmology. <https://www.aaopt.org/eye-health/tips-prevention/should-you-be-worried-about-blue-light>

²²Garipov, G., Khrenov, B. A., Panasyuk, M. I., Тулупов, В. И., Shirokov, A. V., Yashin, I. V., & Salazar, H. (2005). UV radiation from the atmosphere: Results of the MSU "Tatiana" satellite measurements. *Astroparticle Physics*, 24(4–5), 400–408. <https://doi.org/10.1016/j.astropartphys.2005.09.001>

²³Vimont. Should You Be Worried About Blue Light?

²⁴Boyd, K. (2023, November 13). What Is Macular Degeneration? American Academy of Ophthalmology. <https://www.aaopt.org/eye-health/diseases/amd-macular-degeneration>

Established risks concerning blue light discuss its relationship with sleep. Because blue light is found in the natural light emitted from the Sun, the human circadian rhythm is impacted by its presence. The circadian rhythm is defined by the behavioral and mental responses to light. These include hormonal regulation, digestion, and body temperature.²⁵ As a result, the human body partially relies on light to define whether it is time to rest or wake up every 24 hours. This can be attributed to the fact that sunlight is abundant during the day and absent during the night, so the human body has adjusted to these environmental cues. Photoreceptors in the eye minimally respond to red, yellow, and orange light in contrast to blue light. Because it contains higher energy, blue light is more efficient at signaling the photoreceptors in the eye. So during the day, this blue light improves alertness and boosts mood. However, it also decreases the production of melatonin, the sleep hormone, needed during the night.²⁶ So artificial sources of blue light, such as cell phones, may contribute to restlessness during the night.

Despite more research being needed on the precise impact of artificial blue light, some technologies have been developed to counteract its presence. One example of such technology is blue light-blocking glasses. These glasses use an anti-reflective coating or filter to polarize the lenses of the glasses.²⁷ This ensures that the specific wavelength of blue light is reflected off the glasses instead of transmitted through to the eye. Because these glasses effectively filter blue light away, they have been marketed to have many benefits. Some of the claimed benefits include improving sleeping cycles, supporting mental health, preserving macular health, and overall preventing eye strain.²⁸

However, these claims have received criticism because of the lack of evidence supporting them. For example, the claim to improve sleep scores was found to have variable results. Despite the fact that blue light has a negative effect on the body's circadian rhythms, blue light-blocking glasses have not proved their reliability in counteracting this. Three randomized controlled trials reported significant findings when testing whether their experimental group had improved sleep scores in contrast to their control arms.²⁹ However, three more studies reported insignificant differences between their intervention arms.³⁰ The glasses' claim to improve mental health may also be based on the body's circadian rhythm being disrupted. When tested in these clinical

²⁵Dong, K., Goyarts, E., Pelle, E., Trivero, J., & Pernodet, N. (2019). Blue light disrupts the circadian rhythm and create damage in skin cells. *International Journal of Cosmetic Science*, 41(6), 558–562. <https://doi.org/10.1111/ics.12572>

²⁶Dong et al. Blue light disrupts circadian rhythm

²⁷Singh, S., Keller, P., Busija, L., McMillan, P., Makrai, E., Lawrenson, J. G., Hull, C. C., & Downie, L. E. (2023). Blue-light filtering spectacle lenses for visual performance, sleep, and macular health in adults. *The Cochrane Library*, 2023(8). <https://doi.org/10.1002/14651858.cd013244.pub2>

²⁸Singh et al., Blue-light filtering spectacle lenses

²⁹Singh et al., Blue-light filtering spectacle lenses

³⁰Singh et al., Blue-light filtering spectacle lenses

trials for sleep, some who wore these glasses reported adverse events such as depressive moods, headaches, and lower moods.³¹ The glasses's claim to improve macular health is also unfounded. No clinical trials have reported evidence in support or rejection of these claims because there has yet to be a linkage between macular health and blue light. Finally, the claim that these glasses reduce digital eye strain has been largely disproven. This is because of the process at fault for digital eye strain.

Digital eye strain references a group of vision-related issues caused by technology. This is due to the fact that the lens must focus and re-focus to properly take in the light given by various pixels on an electronic screen. This repeated movement fatigues the eye muscles greatly which must contract and relax to properly focus light.³² Another reason behind these issues is the fact that the background and the text displayed on the screen are not contrasted well enough, forcing the eye to work harder to interpret them.³³ Additionally, when looking at screens humans are less likely to blink. While it's normal to blink around 16 times a minute, there is a large difference when humans stare at screens because the number of blinks drops to around 4 times per minute.³⁴ Additionally, staring at a screen encourages the eye to blink partially instead of fully. The negative impact of this change is the fact that the eye will remain largely unlubricated.

These effects from time on the screen lead to a host of problems. The eye will become itchy and dry due to lack of lubrication. Blurred vision will appear at random moments when the eye is trying to refocus. Headaches may occur due to the excessive illumination the brain is interpreting. Neck and back aches due to the poor posture occur when looking at screens as well as sensitivity to bright lights. While these conditions can occur when looking at any object up close, because of the prevalence of technology, they tend to be caused by digital objects.³⁵

The behaviors assumed when consuming digital media as well as the distance from these screens have a larger fault than the type of light emitted. So, when suggesting solutions to counteract this condition, providers do not recommend blue light-blocking glasses. Instead, providers may suggest solutions that target the behaviors causing these issues.

Some solutions include the 20-20-20 rule. This rule suggests that technology users take breaks every 20 minutes to stare at an object 20 feet away for 20 seconds.³⁶ This helps to combat the eye fatigue experienced from star-

³¹Singh et al., Blue-light filtering spectacle lenses

³²Coles-Brennan, C., Sulley, A., & Young, G. P. (2019). Management of digital eye strain. *Clinical and Experimental Optometry*, 102(1), 18–29. <https://doi.org/10.1111/cxo.12798>

³³Coles-Brennan et al., Management of digital eye strain

³⁴Coles-Brennan et al., Management of digital eye strain

³⁵Coles-Brennan et al., Management of digital eye strain

³⁶Dandan, O. A., Hassan, A., Shammari, M. A., Jawad, M. A., Alsaif, H. S., & Alarfaj, K. (2021).

ing at a screen closer than the distance the eye is normally used to accommodate.

An additional solution includes replacing contact lenses with eyeglasses. Contact lenses sit directly on top of the eye which decreases the image distance between the eye and the screen. Glasses, however, sit on the nose an additional distance away from the eye. This not only increases the image distance but also helps with lubricating the eye. Because contact lenses absorb the eye's tears, they can build up with bacteria and dry up the eye further.³⁷ So, using glasses instead of contact lenses when reading a screen effectively combats eye strain and dryness. Finally, adjusting the lighting given off by the screen, in comparison to the background behind it, may also aid in disrupting digital eye strain. This is due to the fact that bright computers used in dark backgrounds can cause the eye additional fatigue as it only accommodates for the average brightness of the surrounding areas rather than the screen.³⁸ By adjusting the light to contain less contrast with the background behind it, the eye will not work as hard to accommodate, causing less strain.

Overall, digital eye strain is a completely different issue than that caused by blue light glasses. So, when blue light-blocking products claim to protect the eye from digital eye strain, they are connecting two variables that do not impact each other. Rather than depending on these glasses to protect one's eye from the harmful effects of blue light, medical officials at the American Academy of Ophthalmology suggest consumers take active steps to avoid digital eye strain altogether.³⁹

It is recommended that consumers turn off their devices about 2 hours before bed as well as use nighttime settings during the evening.⁴⁰ These settings create a tint on digital screens so that they emit a longer wavelength of yellow light rather than blue light. These solutions ensure that screen time causing digital eye strain is decreased. They also ensure that the blue light's impact on the circadian rhythm is diminished since a different type of light with less energy takes its place during the evening. By limiting one's access to technology and instilling healthy practices for viewing digital media, these steps not only combat digital eye strain but limit exposure to blue light for concerned consumers.

Overall, modern technology continues to advance in ways that en-

Digital Eye Strain Among Radiologists: A Survey-based Cross-sectional Study. *Academic Radiology*, 28(8), 1142–1148. <https://doi.org/10.1016/j.acra.2020.05.006>

³⁷Farris, L. (1992). Contact Lenses and the Dry Eye : *International Ophthalmology Clinics*. LWW. https://journals.lww.com/internat-ophthalmology/Citation/1994/03410/Contact_Lenses_and_the_Dry_Eye.12.aspx

³⁸Östberg, O. (1980). Accommodation and visual fatigue in display work. *Displays*, 2(2), 81–85. [https://doi.org/10.1016/0141-9382\(80\)90052-9](https://doi.org/10.1016/0141-9382(80)90052-9)

³⁹Vimont. Should You Be Worried About Blue Light?

⁴⁰Vimont. Should You Be Worried About Blue Light?

courage consumers to spend more time on their screens. For example, algorithms on social media reward consumers for every interaction spent on the app. As technology becomes more intermingled with consumers' everyday lives, the effect of blue light and digital eye strain demonstrates that this relationship may negatively impact the body. The case of blue light emphasizes that research concerning the physical toll related to increased technology use is pertinent as is the availability of credible information dispelling misconceptions about potential solutions.

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The Dynamic Influence of the Nigerian Diaspora on Gender Roles in Nigeria

Ayomide Oloyede

Introduction

Dispersed throughout the world, the Nigerian diaspora is a dynamic force shaping Nigeria's cultural landscape. In addition to sending money home and contributing to the Nigerian economy, diaspora members serve as cultural ambassadors, playing a pivotal role in reshaping gender roles in their home country. This essay delves into the numerous ways in which the Nigerian diaspora alters gender norms, presenting examples that emphasize the distinct impacts of this global community. The Nigerian diaspora significantly shapes gender roles in Nigeria by acting as cultural advocates. These members spread different perspectives on gender equality, exemplified through educational empowerment, community activism, economic success, and cultural media, challenging traditional norms and fostering a more inclusive understanding of gender dynamics in the homeland.

Nigerian Diaspora History

The history of the Nigerian diaspora is rooted in a range of migratory patterns that have influenced the country's population around the world. From the late 19th century British colonization to now, Nigerians have searched for economic opportunities inside and outside Africa, leading to the creation of major population movements. Post-independence migration (1960s-1970s) witnessed internal and international migration, particularly to the UK and later, the United States, driven by the pursuit for education and employment. The Biafran Civil War (1967-1970) increased displacement, prompting migration to different parts of Africa, Europe, and North America. The 1970s oil boom brought prosperity but following economic challenges led Nigerians to seek opportunities abroad, contributing to the growing Nigerian diaspora.¹ Political turmoil and economic instability in the 1980s and 1990s, the "brain drain" began in Nigeria, with a new wave of skilled professionals leaving Nigeria, in search of better opportunities abroad, significantly contributing to the diaspora's growth.² This phenomenon leaves Nigeria with insufficient knowledge and education due to the skilled professionals and students leaving. In the late 20th century to the present, globalization and technology fueled diaspora expansion, with Nigerians contributing notably to various global sectors. The instability of Nigeria causes Nigerians to move, leading to the creation of the

¹Obi-Ani, Paul, et al. "A historical perspective of Nigerian immigrants in Europe." *Cogent Arts & Humanities*, vol. 7, no. 1, 2020, p. 1846262, <https://doi.org/10.1080/23311983.2020.1846262>, 3

²Ebalu Ogbenika, Gregory. "THE EFFECT OF BRAIN DRAIN AND MIGRATION ON NIGERIAN'S DEVELOPMENT." *Journal of African Studies and Sustainable Development*, vol. 2, no. 1, 3

Nigerian diaspora within the world.

Brief Background of Nigerian Gender Roles and Culture

Nigerian gender roles and culture are deeply embedded in the complex character of a nation marked by ethnic diversity and a rich history. Nigerian societies place an emphasis on respect for elders, highlighting the importance of intergenerational relationships and traditional values.³ In Nigerian societies it is a patriarchal structure and in the family unit the structure is very simple. The man is to be the head of the house, the woman is to submit to him, and the children are to obey them.⁴ The religious backgrounds, mainly Islam and Christianity, further influence cultural practices and gender expectations. Gender roles are not something that only occurs in the Nigerian home, it spreads to the development of Nigeria, positions of power and social stratification are based on sex.⁵ The social system reinforces traditional gender roles by placing women in domestic and reproductive roles and limiting their access to resources such as finances and land. According to the United Nations, only five out of the 73 presidential candidates for Nigeria in 2019 were women.⁶ Modernization and globalization have brought in changing dynamics, challenging historical norms as women increasingly enter the workforce. While progress has been made to address gender inequality through legal methods, challenges continue, especially with limited access to education and economic opportunities for women, as well as domestic violence and harmful cultural practices. As Nigeria continues to navigate social change, the idea and discussion of gender equality remains important to shaping the nation's ever-changing identity.

Educational Empowerment

Due to their frequent exposure to innovative educational institutions elsewhere, Nigerians living abroad who support educational empowerment in Nigeria can influence changes in education. Traditional gender norms are questioned by programs through methods such as awareness campaigns, scholarship programs, and mentorship opportunities. Giving young girls an opportunity to continue their education. The Girls Education Project III (GEP3) is an initiative to improve access to learning, especially for girls. With

³Idoko, Nicholas. "Role of Culture in Nigerian Marriage & Family Therapy." Professions in Nigeria, 19 Aug. 2023, professions.ng/role-of-culture-in-nigerian-marriage-and-family-therapy/.

⁴E., Sophia. "Gender Roles: The Cultural Revolution of the Nigerian Woman." Medium, Medium, 17 Feb. 2018, medium.com/@Rinax/gender-roles-the-cultural-revolution-of-the-nigerian-woman-b792846e2c9d.

⁵Ifegbesan, Ayodeji P., and Razaq O. Azeez. "Gender and perception of gender role in Nigeria: Evidence from wave 6 of the World Value Survey." *Journal of Education*, 2022, p. 002205742211104, <https://doi.org/10.1177/00220574221110478>.

⁶Eze, Promise. "How Nigerian Women Are Redefining Gender Roles." *African Liberty*, 26 Sept. 2022, www.africanliberty.org/2022/09/26/how-nigeria-women-are-redefining-gender-roles/.

ten years of implementation, it has resulted in 1.5 million girls going to school in Northern Nigeria.⁷ This access to education is important and helps close the gender gap in Nigeria. The impact of this program goes beyond just going to class, in fact a drop in early marriage and pregnancy rates was seen, changing the image surrounding the role of girls and women in society. Without the members of the diaspora advocating for gender role reform within education, these young girls would have not had the opportunity to be educated or continue their education beyond the basics. This educational empowerment changes how society views gender roles, especially in the context of women.

A notable figure in the Nigerian diaspora, Dr. Ngozi Okonjo-Iweala is a role model in the fight for women's education in Nigeria. Known for her ground-breaking achievements, she has passionately supported educational programs that empower girls and break the traditional gender roles. Okonjo-Iweala was the first female finance minister of Nigeria (twice under two different presidents) and the first female foreign minister.⁸ A seasoned economist who worked at the World Bank and then served as the first woman and first African to lead the World Trade Organization. Dr. Okonjo-Iweala has advocated for mentorship programs and scholarship programs that lower obstacles to study for girls by using her worldwide stature. Her efforts have not only given young girls and women in Nigeria real opportunity to educate themselves, but they also exemplify the diaspora's dedication to challenging conventional gender roles. Dr. Okonjo-Iweala is a key example of the diaspora's transformative power in tackling gender inequality and promoting a more welcoming educational environment for women by utilizing her knowledge and connections.

Community Activism

Community activism within the Nigerian diaspora serves as a powerful force for examining and reshaping gender roles in Nigeria. Through advocacy for equal educational opportunities, women are empowered to defy traditional gender roles. Without community activism, Iyeyemi Adediran, a 26-year-old Nigerian female would not be a long-haul truck driver for oil companies.⁹ A career that is male dominated is now available for Nigerian women to work in. The usage of community groups actively contributes to the dismantling of traditional gender stereotypes in Nigeria, creating a new image of women who are independent and worthy of the same roles as men.

⁷"Transforming Nigeria: HOW 1.5 Million Girls Found Their Way to School." United Nations, United Nations, unsdg.un.org/latest/stories/transforming-nigeria-how-1-5-million-girls-found-their-way-school. Accessed 10 Dec. 2023.

⁸Oyesola, Bimbola. "A Powerful Role Model for African Girls: D+C - Development + Cooperation." D+C, www.dandc.eu/en/article/ngozi-okonjo-iweala-first-woman-and-first-african-lead-world-trade-organization-wto. Accessed 10 Dec. 2023.

⁹Eze, "How Nigerian Women..."

With the usage of community activism, the Nigerian diaspora can challenge and transform gender roles in Nigeria, facilitating a more inclusive and equal Nigerian society.

The Nigerian diaspora demonstrates an impactful commitment to changing gender roles in Nigeria through active engagement in community activism. Organizations like the Nigerian Women in Diaspora Leadership Forum in London (NWIDLF) exemplify this commitment by leading initiatives that challenge traditional norms and advocate for gender equality. Through campaigns against harmful cultural practices, like female genital mutilation, promotion of women's rights, and attempts to address gender-based issues, these activists within the diaspora play an important role in shaping societal attitudes.¹⁰ By encouraging dialogue and action, the diaspora's community activism acts as a catalyst for change, pushing for legislative reforms and societal changes that promote inclusivity in Nigeria. Through their efforts, the diaspora actively contributes to breaking deeply rooted, traditional gender norms, fostering a more empowering and equitable environment for women in Nigeria.

Economic Success

Economic success within the Nigerian diaspora serves as a catalyst for transforming gender roles in Nigeria. Notable figures within the diaspora, such as business leaders and entrepreneurs, exemplify how financial prosperity can challenge traditional norms. One notable figure is Folorunsho Alakija, the vice chair of Famfa Oil, a Nigerian oil exploration company and a stakeholder of a prominent oilfield, Agbami Oilfield.¹¹ As a prominent member of the diaspora, Alakija has used her financial success to empower Nigerian women. Through the Rose of Sharon Foundation, a program that helps widows and orphans foster self-sufficiency and economic independence.¹² With this foundation in place, it actively challenges traditional gender roles by allowing these young women and girls to be able to rely on themselves. Alakija's success serves as an example for women in Nigeria to see and emulate but it also contributes to dismantling gender stereotypes and promotes a more inclusive idea of women's roles in Nigerian society. Economic empowerment within the diaspora leads to initiatives that give back to Nigeria, including women-led businesses, educational programs, and advocacy for equality. As

¹⁰Monehin, Akin. "Okonjo-Iweala and Three Things We Can Do for the Nigerian Girl-Child." The Guardian Nigeria News - Nigeria and World News, 3 Mar. 2021, guardian.ng/life/okonjo-iweala-and-three-things-we-can-do-for-the-nigerian-girl-child/.

¹¹"Folorunsho Alakija." Forbes, Forbes Magazine, www.forbes.com/profile/folorunsho-alakija/?sh=136081fa2ad9. Accessed 10 Dec. 2023.

¹²"Alakija's NGO Offers N3m Grant to Female Entrepreneurs." Philanthropy News Digest, Candid, 7 Dec. 2023, philanthropynewsdigest.org/news/other-sources/article/?id=14361199&title=Alakija%E2%80%99s-NGO-offers-N3m-grant-to-female-entrepreneurs.

diaspora members contribute to economic growth and development, their stories and successes become an important catalyst to changing deeply rooted gender roles. The impact of the economic successes of the Nigerian diaspora members, primarily women, not only changes the structure of women's roles in Nigerian society but it also lays the foundation for a more empowered and inclusive society for Nigeria.

Cultural Media

Members of the Nigerian diaspora can also utilize cultural media to help spark change within Nigeria regarding gender roles. The Nollywood Film Festival Week in Paris plays a significant role in tackling gender roles in Nigeria by including films that challenge traditional gender roles and promote equality within the society. Through this festival, Nigerian filmmakers have the opportunity to address and dismantle gender norms with the narratives of their films.¹³ In particular, female directors and actors are able to use this opportunity to tell stories that provide empowerment to women, advocate for gender equality, and challenge harmful stereotypes. By providing different perspectives on gender roles, the festival contributes to fostering a more inclusive idea of gender roles in Nigeria. The audience in Paris is able to watch these films and have their perception of traditional gender stereotypes changed. The reach of Nollywood goes beyond the festival's films in Paris, it reaches to Nigeria and provides a spark to criticize and reevaluate traditional gender roles. The societal attitudes of Nigerians are able to be influenced through the showcasing of the creative and important contributions women are making in the Nigerian film industry. Through the films the members of the Nigerian diaspora are able to foster gender equality in Nigeria.

Literature written by members of the Nigerian diaspora can also impact the reshaping of gender roles within Nigeria. Through their stories and works, these writers are able to tell their own story or provide characters who challenge oppressive gender roles. By introducing global feminist ideas, Nigerian readers are exposed to a wide array of perspectives on gender equality, which encourages reflection on the traditional gender roles. The works are able to serve as a platform for critiquing and changing patriarchal systems while also exploring the intersections of gender with social identity. The literature inspires readers to question and challenge the traditional expectations and values, creating a more inclusive idea of gender roles.

Chimamanda Ngozi Adichie is a member of the diaspora and a prominent figure in creating change in gender roles in Nigeria. She is a highly acclaimed writer and who is also well known for her TED talk "The Danger

¹³"The 8th Edition of the Nollywoodweek Film Festival Goes Global." Africanews, Africanews, 8 May 2021, www.africanews.com/2021/05/08/the-8th-edition-of-the-nollywoodweek-film-festival-goes-global/.

of a Single Story. Through her literary works, including “We Should All Be Feminists”, Adichie has become a global voice advocating for gender equality not only in Nigeria, but everywhere.¹⁴ Her literature sparks change in the traditional gender roles in Nigeria. Using her platform to amplify the voices of Nigerian women who long for gender equality and change in gender roles, she is a prominent example of how individuals of the diaspora can contribute to change in gender roles in Nigeria.

Conclusion

In conclusion, the Nigerian diaspora is a driving force that extends far beyond its economic contributions, the diaspora has greatly influenced the cultural fabric of Nigeria. Diaspora members play a crucial role in dismantling traditional gender roles within Nigeria, advocating for a more inclusive society. Through ways such as educational empowerment, community activism, economic success, and cultural media, traditional norms are challenged, and alternative perspectives are provided. The Nigerian diaspora is a catalyst for societal change in Nigeria, creating change even if the members might not currently reside in Nigeria, actively contributing to the ongoing ideas on gender dynamics in Nigeria, and fostering growth for a more progressive and inclusive future for all Nigerians.

¹⁴Reese, Hope. Chimamanda Ngozi Adichie: I Became Black in America, 29 Aug. 2018, daily.jstor.org/chimamanda-ngozi-adichie-i-became-black-in-america/.

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Overhead Costs Affect Donor Behavior: Fact or Fiction?

Corbin Walls

How often have you heard that nonprofit organizations should spend as little on overhead expenses as possible? Most donors share this exact sentiment. People feel as if the organization's revenues—their donations—ought to be put toward the programs operated by the organization and not to pay executive salaries, rents, or utilities. Now, ask yourself a different question: how many times have you searched for overhead information prior to donating to a nonprofit organization? For the vast majority, the answer to that question is none. The competing answers to these questions—that donors care about overhead costs but don't care enough to look for them—present a problem in the nonprofit sector.

While everyone would like programs to be supported as much as possible, it is vital that nonprofit organizations pay executive salaries, rents, and utilities. Without those expenses, there would not be any programs to fund. Donors, unfortunately, do not understand this necessity. This sentiment of the public has resulted in the perpetuation of Overhead Aversion Theory: simply put, high overhead costs correlate with lower revenues because donors will not support organizations which expend a large percentage of their budgets on overhead. Recently, however, the literature has begun to disagree with this long-held philosophy. Emerging research is showing that not only is overhead aversion not the surety we once viewed it as, but also that there are many ways to mitigate the negative effects on donors' willingness to support an organization of high overhead costs.

This paper contributes to that volume of literature. In this study, I evaluate the underlying assumption of Overhead Aversion Theory—that donors have access to overhead information—and explore the extent to which common donor motivators—a donor caring about an organization's mission, the organization effectively achieving its mission, organizational transparency, and organizational reputation—can mitigate overhead aversion.

In doing so, I find that Overhead Aversion Theory has, in fact, been romanticized by both the academic literature and the nonprofit sector. Moreover, by investing in overhead, or building capacity as other articles have described it, an organization can, in fact, increase its revenue, more effectively achieve its mission, and increase transparency, ultimately mitigating the negative effects of the few instances where overhead aversion does exist.

Theoretical Framework

Much of the nonprofit literature around overhead spending focuses on strategies for decreasing its negative effects on the willingness of individual donors to support an organization. The nonprofit literature overwhelmingly presents the idea that individual donors care deeply about overhead costs and

will change their donation patterns in order not to support overhead expenses. Many articles (Charles, et al., 2020; Keenan & Gneezy, 2016; Gneezy, et al., 2014; Kwanho & Mudita, 2021) have developed theories for mitigating this overhead aversion as a result. Despite the abundance of literature that discusses overhead aversion, its effects, and even strategies for mitigating it, there is little to no empirical research that asks donors if they truly cared about overhead aversion in their past donations.

The literature on which overhead aversion has been founded quantitatively analyzes Form 990s and compares overhead expenses to revenue streams. There have been four of these empirical quantitative studies that have tested a link between donations and overhead costs (Greenlee & Brown, 1999; Frumkin & Kim, 2001; Steinberg, 1983; Jacobs & Marudas, 2003) and they have produced mixed results.¹ Additionally, these studies vary largely in their analysis of the Form 990 data and have been criticized by other scholars. Namely, the studies do not use a large, recent national sample, they do not all find significance, they are not comparable due to differences in samples and models, and they do not account for the control variables suggested by the literature.² When retested using improved samples and consistent and corrected methodology, researchers found that overhead aversion depends greatly on sources of revenue—program fees vs. individual donations, for instance—and could not draw a blanket conclusion that overhead aversion exists within the sector.³

While overhead aversion theory was developed from these quantitative studies, there have since been qualitative studies that directly ask donors about their feelings toward overhead expenses that have affirmed the theory. Tian, et al. (2020), for instance, surveyed college students on their concern over high overhead costs and their findings firmly supported overhead aversion. Though, these qualitative studies are based upon experimental surveys that are designed under the assumption that donors are actually aware of an organization's overhead costs when they choose to donate. While the quantitative studies would mitigate this concern over awareness of overhead costs due to their analysis of actual behavior, these qualitative studies do not control for this overhead cost awareness.

Moving past the research establishing overhead aversion, there is an immense amount of literature discussing how organizations can avoid overhead aversion from individual donors. Most of these studies survey donors, but the surveys are similarly crafted with the assumption that overhead aver-

¹Tinkelman, D., & Mankaney, K. (2007). When is Administrative Efficiency Associated with Charitable Donations? *Nonprofit and Voluntary Sector Quarterly*, 36(1). 41-64. <https://doi.org/10.1177/0899764006293176>

²Tinkelman & Mankaney. When is Administrative Efficiency Associated with Charitable Donations?

³Tinkelman & Mankaney. When is Administrative Efficiency Associated with Charitable Donations?

sion exists; none of them ask donors if they truly care about overhead. Rather, these studies are conducted using experimental surveys and, largely, focus on the framing of overhead spending. For instance, Charles, et al. (2020) compare the willingness of donors to support an organization when they are promised that their dollars will not go toward overhead and when they are not provided this promise. Gneezy & Keenan (2016) and Gneezy, et al. (2014) examine the willingness of donors to support an organization under conditions such as the success of the organization and framing overhead spending as a necessary activity in order to build the capacity of the organization. Qu & Daniel (2020) explore whether it is the actual word ‘overhead’ that might provide apprehension from donors, and whether replacing overhead with its definition or an explanation of the purpose of overhead spending increase donors’ willingness to support an organization. Suk & Mudita (2021) analyze the effectiveness of displaying financial information that reveals overhead cost expenses when soliciting a donation in mitigating overhead aversion.

Each of these studies finds that the proposed strategies have some effect on overhead aversion. This literature has very practical implications for practitioners. It shows that freeing donors of the responsibility of overhead costs, communicating about the importance of overhead costs, avoiding the word ‘overhead’, and being transparent about overhead expenses are all effective strategies for making donors feel comfortable supporting an organization despite its overhead costs. Obviously, framing can be effective. In developing new strategies for framing, it is important that we look to donor motivations. Could simply operating on organization that is compatible with common donor motivations be enough to mitigate overhead aversion and eliminate the need for these communication strategies?

There is some research that supports this idea. Tian, et al. (2020) found that donors are willing to ignore high overhead costs and support an organization if the nonprofit is effective and transparent. Moreover, Bowman (2006) found that donors do care about overhead expenses, but only as one of many factors when evaluating a nonprofit. Bowman (2006) concluded that there is emphatically no empirical or objective basis for saying that a particular overhead ratio is too high and that donors should only care about changes in overhead ratios, for they indicate a change in the price of giving. These findings suggest that organizational characteristics other than overhead ratios and costs are just as, if not more, important when engaging donors. Thus, I turn to the donor motivation literature to identify organizational characteristics that might be capable of mitigating overhead aversion.

The donor motivation literature is rich. It has identified six key mechanisms that drive donors to support an organization. These are altruism, organizational reputation, donor reputation, psychological benefits such as the joy of giving and self-image, donor-nonprofit identification or mission match,

and efficacy.^{4, 5, 6, 7}

The lattermost of these motivators does in fact relate to overhead aversion. Donors who are more confident in an organization and perceive it to have high efficacy expect that their donations are less likely to be put toward fundraising costs and overhead.⁸ However, efficacy is not a motivator dependent upon overhead costs alone. Rather, it is the perception that a donation makes a real difference to the cause that it is meant to support.⁹ Thus, program efficiency and organizational transparency also play a role and could potentially satisfy efficacy even when overhead costs are high.

Moreover, many of these motivators are intrinsic to the act of donating or a donor's characteristics and not to an organization itself. Namely, altruism, an increase in the donor's reputation from supporting a good cause, and psychological benefits are all motivators that do not describe a nonprofit. An organization can appeal to these motivators in its communications, but it cannot change its operations to satisfy them. Organizational reputation, donor-nonprofit identification, and efficacy, however, are motivators that rely on the organization's operations and programs. Thus, these three motivators can be controlled in the survey and will be tested for mitigation of overhead aversion.

Following the above discussions of the assumptions behind overhead aversion theory, framing of overhead aversion, and donor motivations, I expect to see the following findings. First, I expect that when surveyed about their past donation behavior, donors will indicate that they do not search for overhead related information prior to donating. Second, I expect that descriptions of an organization having a prestigious organizational reputation, high mission achievement, and matching the values that a donor holds will mitigate overhead aversion by donors.

Methodology

In order to analyze the predictions laid out in the previous section, I distributed a survey asking respondents questions regarding their past donation behavior, their expectations of their own donation behavior in a hypothetical scenario, their opinions of overhead costs, and comparisons of low

⁴Bekkers, R., & Wiepking, P. (2011). A Literature Review of Empirical Studies of Philanthropy. *Non-profit and Voluntary Sector Quarterly*, 40(5), 924–973. <https://doi.org/10.1177/0899764010380927>

⁵Boenigk, S., & Helmig, B. (2013). Why Do Donors Donate? *Journal of Service Research*, 16(4), 533–548. <https://doi.org/10.1177/1094670513486169>

⁶Peasley, M. C., Coleman, J. T., & Roynes, M. B. (2017). Charitable motivations: the role of prestige and identification. *The Service Industries Journal*, 38(5–6), 265–281. <https://doi.org/10.1080/02642069.2017.1370457>

⁷Ribar, D., & Wilhelm, M. (2002). Altruistic and Joy-of-Giving Motivations in Charitable Behavior. *Journal of Political Economy*, 110(2), 425–457. <https://doi.org/10.1086/338750>

⁸Bekkers and Wiepking. A Literature Review of Empirical Studies

⁹Bekkers and Wiepking. A Literature Review of Empirical Studies

overhead costs to other donor motivators. As previously discussed, donors' views on overhead aversion and their ability to access that information is largely understudied. Thus, it was important to survey donors on their opinions of overhead costs, their utilization of overhead cost information when donating in the past, and the value they place on low overhead costs in comparison to other donor motivators. From this donor insight, accurate conclusions can be drawn about individual donor behavior. The details of the data collection and measurement are discussed below.

Data

Survey Description & Distribution

The survey was designed using Qualtrics. It contained four demographic questions—race and ethnicity, age, gender identification, and education level—three topical multiple-choice questions, four topical 5-point Likert scale questions, one topical rank-order question, and five topical feeling thermometer questions.

The survey was distributed using a snowball-sampling method; selection of respondents was based on convenience. The online survey was sent to respondents via social media, mass email to both undergraduate and graduate students at the University of Oklahoma, and personal communication. Three different scripts were respectively crafted and approved by the University of Oklahoma's Institutional Review Board.

Response Rate & Demographics

When survey response collection was closed, it had received 314 responses. However, after removing incomplete responses, the usable number of cases was 242. The race/ethnicity question allowed respondents to select multiple answers identities; of the 242 respondents, 71.56% identified as White or Caucasian, 9.88% identified as American Indian or Native Alaskan, 5.39% identified as Hispanic or Latinx, 5.09% identified as African American, 5.09% identified as Asian, and 0.60% identified as Native Hawaiian or Pacific Islander. Additionally, 2.40% selected responded with "other," and responses to this question included Indian, African, and Middle Eastern.

Of the 242 respondents, 30.79% identified as male, 66.56% identified as female, and 2.65% identified as Non-Binary or Gender Non-Conforming. Additionally, the mean age of respondents was 32.72, with the bottom quartile ending at 24 years of age and the upper quartile beginning at 43.25 years of age.

When respondents were asked about their education levels, 2.95% reported that they did not graduate high school, 5.90% reported that they had graduated high school or obtained a GED, 35.41% reported having completed some college, 7.55% reported having either graduated from a trade, vocational, or technical school or obtained an Associate's Degree, 27.54% reported having

obtained a Bachelor's Degree, 17.38% reported having obtained a Master's Degree, and 3.28% reported having obtained a Doctoral Degree.

Measurements

Concepts

The survey questions were crafted with the intent of capturing respondents' past efforts to search for overhead costs, their expectations of their own future donation behavior, their adherence to Overhead Aversion Theory, their ability to find a nonprofit's overhead cost information, and how they value low overhead costs in comparison to other donor motivators. The following table provides a brief description of the questions that were used to capture these concepts.

Table 1.

Variables Used to Measure Concepts

<p>Past efforts to search for overhead costs</p>	<p>Respondents were first asked if they had donated to nonprofit organizations in the past 5 years and all respondents who indicated that they had donated in the past five years were asked if they had searched for overhead costs when donating to nonprofit organizations in the past 5 years. Respondents who had and who had not searched for overhead costs when donating were asked the mirroring questions regarding their adherence to Overhead Aversion Theory and their ability to find overhead cost information, but those who had searched for overhead costs were asked the questions in the context of their donation behavior.</p>
<p>Donor expectations of their future donation behavior</p>	<p>Respondents who indicated that they had either not donated to a nonprofit in the past 5 years or had not searched for overhead cost information when donating were asked the questions regarding their adherence to Overhead Aversion Theory in the context of a hypothetical donation.</p>

Adherence to Overhead Aversion Theory	Respondents were asked, either in the context of their past donation behavior or a hypothetical donation, how strongly they agree that high overhead costs either had or would negatively affect their decision to donate.
Ability to find overhead cost information	Respondents were asked, either in the context of their past donation behavior or a hypothetical donation, how strongly they agree that it had been or would be difficult to find information relating to overhead costs and what resources they had or would utilize to find information relating to overhead costs.
Value of low overhead costs in comparison to other donor motivators	Respondents were asked to rank how influential five different donor motivators are when motivating them to donate to a nonprofit organization. Additionally, respondents were asked to rate their willingness to donate on a feeling thermometer ranging from 0 to 100 in five different scenarios: when an organization has 10%, 20%, 30%, 40%, and 50% higher overhead costs than its peers. Respondents were performed that in each of these five scenarios, the organization they were being asked to donate to advances a cause they care about, is more effective in achieving its mission, more transparent, and more reputable than its peer organizations.

Data Preparation

Responses to the above-described survey were exported into Microsoft Excel. In cleaning the data, all incomplete responses were deleted. Additionally, in response to the race/ethnicity, age, and gender identification questions, one respondent selected the “other” option and provided the following responses, respectively: “a little bit of everything,” “old enough,” and “Ford

F-150.” The observation for this respondent was consequently deleted.

Variables were then transformed to aid in analysis. As the race/ethnicity question allowed for multiple responses, each value was transformed into its own dichotomous variable. The question regarding education level was transformed into a numeric, 7-point ordinal variable. The four topical 5-point Likert scale questions were all additionally transformed into a numeric, 5-point ordinal variable. Similar to the race/ethnicity question, the topical question asking what resources respondents either had or would utilize to find information relating to overhead costs allowed for multiple responses; this question had four provided values and an “other” option requesting specification. These four values were Charity Navigator, GuideStar, the organization’s Form 990, and the organization’s website. Each of these four values was transformed into a dichotomous variable, representing whether or not the respondent indicated that they had or would use that specific resource.

As the questions regarding adherence to Overhead Aversion Theory and respondents’ ability to find information relating to overhead costs were split according to their indication of past donation behavior, the responses for each of these questions were combined into an additional variable that contained a value for every observation.

Analysis

In addition to descriptive statistics and frequencies, two statistical tests were used to analyze the survey responses: gamma statistics and chi-square tests. Gamma statistics were produced using STATA while descriptive statistics, frequencies, and chi-square tests were analyzed using R Studio.

Descriptive Statistics & Frequencies. For all variables, descriptive statistics and frequencies were identified using R Studio.

Gamma Statistics. Four gamma statistics were identified using STATA. The variables of the four following tests were: education level as an independent variable and the combined variable which asked respondents how strongly they agreed that high overhead costs had or would negatively affect their willingness to donate as a dependent variable, age as an independent variable and the combined variable which asked respondents how strongly they agreed that high overhead costs had or would negatively affect their willingness to donate as a dependent variable, education as an independent variable and the combined variable which asked respondents how strongly they agreed that it had been or would be difficult to find information relating to overhead costs as a dependent variable, and age as an independent variable and the combined variable which asked respondents how strongly they agreed that it had been or would be difficult to find information relating to overhead costs as a dependent variable.

Chi-Square Tests. Four chi-square tests were run using both the ques-

tion which asked respondents if they had donated in the past five years and the question which asked respondents if they had searched for information relating to overhead costs when donating in the last five years as independent variables. A chi-square test was run for both of these independent variables using each of the above-described dependent variables (e.g., overhead costs negatively affecting willingness to donate and difficulty in finding overhead cost information).

Multiple Regression Analyses. Two multiple regression analyses were conducted using R Studio. Both tests used the six dichotomous race/ethnicity variables as independent variables. One test used the combined variable which asked respondents how strongly they agreed that high overhead costs had or would negatively affect their willingness to donate as a dependent variable and the other used the combined variable which asked respondents how strongly they agreed that it had been or would be difficult to find information relating to overhead costs as a dependent variable.

Findings

Past efforts to search for overhead costs

A large majority of respondents—82%—indicated that they had donated to a nonprofit organization within the last 5 years (Figure 1). Of those respondents who indicated that they had donated to a nonprofit within the past 5 years, only 30% claimed that they had searched for information relating to overhead expenses prior to donating (Figure 2).

Figure 1.

Self-Reporting of Prior Donor Activity

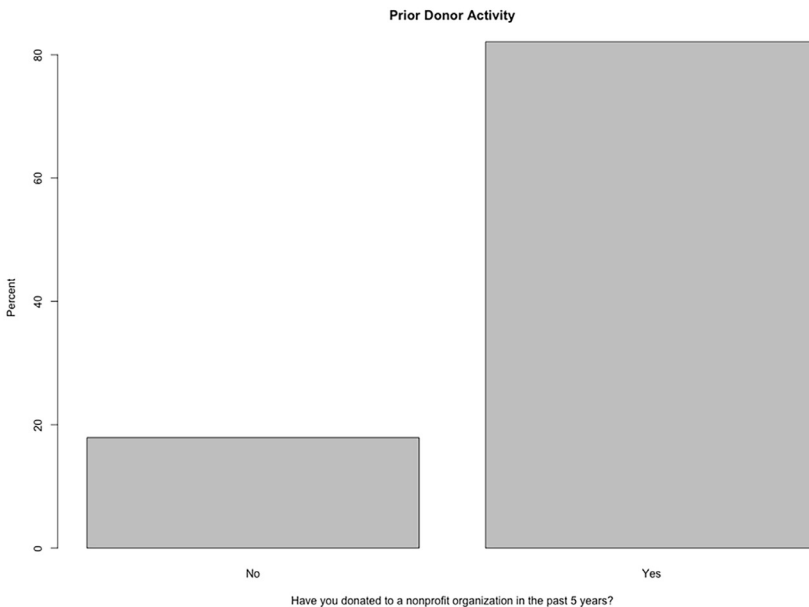
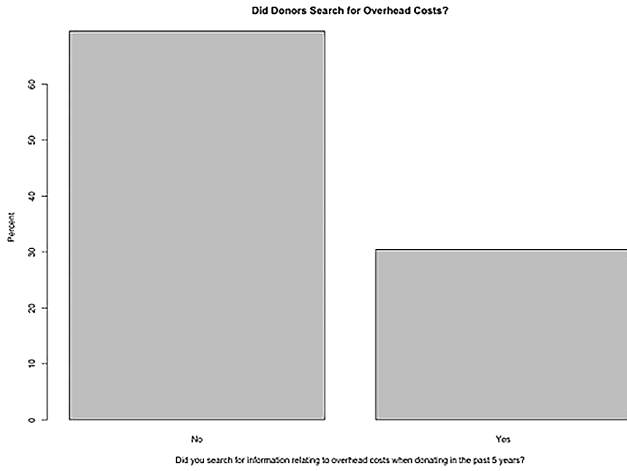


Figure 2.

Did Donors Search for Overhead Costs



Support for Overhead Aversion Theory

Despite the fact that a relatively small percentage of the respondents (30%) indicated they searched for overhead cost information, it is interesting to see how likely such information would matter. Respondents who indicated they had donated and searched for information relating to overhead costs in the last 5 years (n=60) were asked to what extent they agreed that high overhead costs did negatively affect their willingness to donate. Table 2 indicates that a large majority of respondents (75%) either somewhat agreed or strongly agreed that high overhead costs had deterred them from donating.

Table 2.

Adherence to Overhead Aversion Theory in Past Donations

Response	Response Frequency
Strongly disagree	1.667
Somewhat disagree	10.000
Neither agree nor disagree	13.333
Somewhat agree	35.000
Strongly agree	40.000

In comparison, respondents who indicated that they had either not donated in the past 5 years or not searched for information relating to overhead costs in the past 5 years were asked to what extent they agreed that high overhead costs would negatively affect their willingness to donate to a nonprofit organization when donating in the future. Table 3 indicates that a majority of respondents (56%) either somewhat or strongly agreed that high

overhead costs would deter them from donating.

Table 3.

Adherence to Overhead Aversion Theory in Hypothetical Donations

Response	Response Frequency
Strongly disagree	7%
Somewhat disagree	17%
Neither agree nor disagree	19%
Somewhat agree	40%
Strongly agree	16%

Notably, the frequency for somewhat or strongly agreeing that high overhead costs negatively affect willingness to donate is nearly 20% higher for individuals who had searched for overhead costs when donating in the past. Another interesting difference between the two groups is the strength with which they agreed with the statement supporting overhead aversion theory; the response frequency for the strongly agree option in the past donation behavior respondent pool was 25% higher than in the expectations of future behavior pool.

Relatedly, the relationships between two demographic factors (e.g., age and education) and overhead aversion behavior were examined, and it was found that both age and education have a positive and statistically significant relationship with adherence to Overhead Aversion Theory. Table 4 displays the gamma statistics and their p-values.

Table 4.

Independent Variable	Gamma Statistic	Approximate P-Value
Age	.294	<.001
Education	.166	.018

In contrast to age and education, the results of a regression analysis of the relationship between race/ethnicity and overhead aversion were not statistically significant.

A chi-square test was conducted to determine whether donors who have searched for overhead costs think differently about overhead costs than donors who have not. The results suggest that they do and that the difference in donative behavior is statistically significant (chi-square statistic of 15.853 and a p-value of <0.001). While the chi-square test does not indicate the direction of this association, the difference in frequencies between the two groups discussed above supports the conclusion that individuals who search for overhead costs are more likely to adhere to Overhead Aversion Theory than those who do not.

Ability to find overhead cost information

While the findings provide some support for Overhead Aversion Theory, they also support the conclusion that the majority of donors do not have access to overhead cost information prior to donating. Table 5 indicates that the majority of respondents (59%) reported that they either had found or would find it difficult to locate information relating to overhead costs.

Table 5.

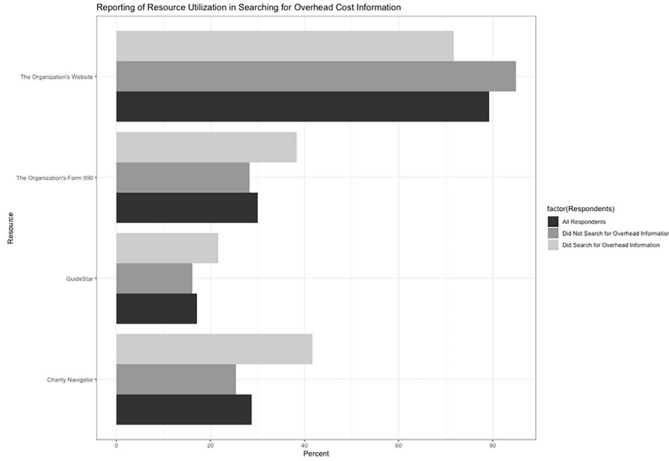
Self-Reporting of the Difficulty in Finding Overhead Cost Information

Response	Response Frequency
Strongly disagree	4%
Somewhat disagree	20%
Neither agree nor disagree	17%
Somewhat agree	46%
Strongly agree	13%

The relationship between demographic variables (e.g. age, education, and race/ethnicity) and the and difficulty in finding overhead information was examined, but none of these relationships were statistically significant.

All respondents were additionally asked what resources they had or would utilize, depending upon their indication of having searched or not searched for overhead cost information prior to donating. Figure 3 shows that, across all three groups, the most prevalent resource used to find overhead cost information is the organization's website, and it is the only resource that more than half of respondents indicated they either had or would use to find overhead information. The second highest frequency of resource utilization was for the use of Charity Navigator in in the group which had searched for information relating to overhead costs.

While respondents who had searched for overhead information did report utilizing the Form 990, GuideStar, and Charity Navigator at a higher rate than the other groups, the differences of utilization between the different groups for these three resources is relatively small. The largest gap was in the utilization of Charity Navigator between those who had searched for overhead information and those who had not, though that difference is only 15%.

Figure 3.*Self-Reporting of Resource Utilization when Searching for Overhead Cost Information***Value of low overhead costs in comparison to other donor motivators**

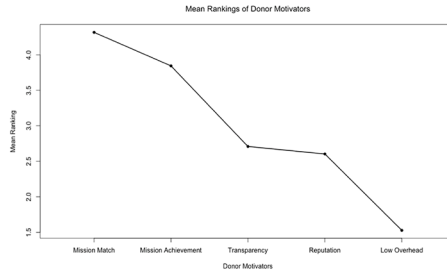
In addition to evaluating their adherence to Overhead Aversion Theory and their ability to find overhead cost information, respondents indicated how greatly they value low overhead in comparison to mission match, effectiveness in achieving the mission, transparency, and organizational reputation. Figure 4 indicates that the two most important donor motivators are those which are directly related to the mission, followed by the two motivators that characterize the organization’s relationship with the public—transparency and reputability. Overwhelmingly, low overhead was the least valued donor motivator. Not only did low overhead receive the lowest mean score, but it also had the second-lowest standard deviation with not a single respondent giving it a value higher than 3 (Table 6).

Table 6.*Mean Scores of Donor Motivator Rankings*

Donor Motivator	Mean Value	Std. Deviation
Mission Match	4.316456	1.0955724
Mission Achievement	3.843882	0.9325190
Transparency	2.708861	1.0352094
Reputation	2.603376	1.0470242
Low Overhead	1.527426	0.9634677

Figure 4.

Graph of the Mean Scores of Donor Motivator Rankings



Respondents were additionally asked to rate their willingness to donate to a nonprofit organization which advances a mission that the respondent cares about, is more effective in achieving its mission, is more transparent, and is more reputable than its peer organizations when the organization had increasing levels of overhead costs. Table 6 and Figure 5 indicate that willingness to donate and overhead cost percentage in comparison to peer organizations are negatively related. When the hypothetical organization was described as having 10% and 20% higher overhead costs than its peers, the mean willingness rating remained in the upper half of potential ratings.

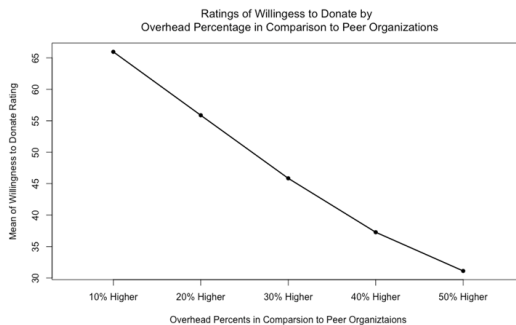
Table 5.

Mean Donor Willingness Rating by Increasing Overhead Expense

Overhead Comparison Category	Mean Donor Willingness Rating	Std. Deviation
10% Higher	66	25.83996
20% Higher	56	25.75258
30% Higher	46	27.04961
40% Higher	37	27.48699
50% Higher	31	29.08593

Figure 8.

Graph of the Mean Donor Willingness Rating by Increasing Overhead Expense



Discussion and Conclusion

In analyzing the above findings, I draw the following conclusion: while overhead aversion does exist when donors have access to overhead cost information, the inaccessibility of overhead cost information, combined with the ability of other donor motivators to mitigate overhead aversion, supports the conclusion that organizations will not suffer from investing in overhead.

When Overhead Costs are Available, Overhead Aversion Exists

Despite the inaccessibility of overhead information, when overhead information is presented to donors, it does negatively affect their willingness to donate to a nonprofit organization. This can be seen in the high frequencies across all groups for agreeing that high overhead costs negatively affect willingness to donate.

Additionally, overhead aversion is heightened by level of education and age. Neither of these variables, however, influence the ability to find overhead information. Thus, older individuals and individuals with higher education levels are not necessarily more prone to finding information relating to overhead costs, but their willingness to donate is more negatively affected by higher overhead costs. This does provide some concern, as individuals with higher education levels and of older age more commonly have higher incomes. Thus, larger donors could potentially be more responsive to overhead cost information.

Overhead Aversion is Rarely Applicable

The prevalence of overhead aversion under the condition of access to overhead cost information, however, should not concern nonprofit professionals. The findings of this study indicate that most donors do not expend the effort to search for information relating to overhead costs, and, when they do, the majority are not able to access the information. Of the 30% of donors who searched for overhead information, no more than 42% reported utilizing resources that would provide an analysis of or access to overhead information (the Form 990, Guidestar, or Charity Navigator). This evidence supports the conclusion that, unless an organization posts the overhead cost information on its website or is highlighted in news reports exposing high overhead spending, less than 13% of potential donors will gain access to overhead information prior to donating.

Moreover, even if donors find information relating to overhead costs, this study suggests that the negative effects of high overhead costs on willingness to donate are mitigated by high performance on other donor motivators. Respondents consistently ranked low overhead as the least important factor when compared to mission match, effective achievement of the mission, transparency, and reputability when choosing to donate. Moreover,

when confronted with a trade-off between these four donor motivators, respondents were more willing to donate than not until the organization reached overhead costs that were 30% higher than peer organizations. While higher overhead costs did correlate with lower willingness to donate even when the organization satisfied these other donor motivators, the organization reach a considerably high level of overhead expense before this discouraged donors from supporting the organization. Thus, if an organization advances a cause the donor cares about and does so effectively, transparently, and reputedly, then donors will be less responsive to high overhead costs. These findings directly support other studies exploring the framing of overhead costs alongside other donor motivators.^{10, 11, 12, 13}

The practical implications of these conclusions are twofold: organizations ought to focus more on reporting evaluative information of their programs and should not be concerned by investing in overhead.

As discussed above, donors care far more about the mission of an organization and its effectiveness in pursuing that mission than they do about overhead costs. By investing more time and more finances in producing evaluations of programs, an organization can appeal to the motivators which donors truly care about. Moreover, nonprofit organizations ought to invest in their executive staff and other capacity-building expenses. To be effective in achieving the mission, transparent, and reputedly, these investments are necessary^{14, 15, 16}. Nonprofit employees are systematically underpaid, but intentionally reversing this standard will prove beneficial to the organization, its mission, and its clients. This study indicates that the long-perpetuated idea of overhead investment inevitably threatening revenues is false due to the difficulty of finding overhead cost information and the mitigative effects of high performance, a result of overhead investment.

¹⁰Keenan, E. A., & Gneezy, A. (2016). "Understanding and Overcoming Overhead Aversion in Charity", in *NA - Advances in Consumer Research* Volume 44, eds. Page Moreau and Stefano Puntoni, Duluth, MN : Association for Consumer Research, Pages: 128-132.

¹¹Gneezy, U., Keenan, E. A., & Gneezy, A. (2014). Avoiding overhead aversion in charity. *Science*, 346(6209), 632–635. <https://doi.org/10.1126/science.1253932>

¹²Tian, Y., Hung, C., & Frumkin, P. (2020). Breaking the nonprofit starvation cycle? An experimental test. *Journal of Behavioral Public Administration*, 3(1). <https://doi.org/10.30636/jbpa.31.93>

¹³Bowman, W. (2006). Should Donors Care About Overhead Costs? Do They Care? *Nonprofit and Voluntary Sector Quarterly*, 35(2), 288–310. <https://doi.org/10.1177/0899764006287219>

¹⁴Chikoto, G. L., & Neely, D. G. (2013). Building Nonprofit Financial Capacity: The Impact of Revenue Concentration and Overhead Costs. *Nonprofit and Voluntary Sector Quarterly*, 43(3), 570–588. <https://doi.org/10.1177/0899764012474120>

¹⁵Wing, K., & Hager, M. (2016). Getting What We Pay For: Low Overhead Limits Nonprofit Effectiveness. *Policy Commons*. <https://policycommons.net/artifacts/636109/getting-what-we-pay-for/1617415/>

¹⁶Lecy, J. D., & Searing, E. A. M. (2014). Anatomy of the Nonprofit Starvation Cycle. *Nonprofit and Voluntary Sector Quarterly*, 44(3), 539–563. <https://doi.org/10.1177/0899764014527175>

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“Black History is Black Horror”: An Analysis of the Evolution of Black Horror and Thematic Connections to the Harlem Renaissance

Julie Dawkins

Introduction

The horror genre is unique and iconic in filmmaking. In part because horror movies are cheap to make and can generate large profits – meaning they are low-risk and high-reward – horror has become a space for experimentation, exploration, and of course, graphic violence and cheap thrills.¹ It has evolved over the years from the suspenseful-yet-censored black-and-white films of the Hays Code era to the violent slashers of the 70s to the plethora of horror today that ranges from psychological thriller to horrifying torture porn. As it has developed, so have its themes, cliches, and importantly, its diversity and representation of non-white, non-male characters.

Today, we are in a renaissance of Black horror films ushered in by the release of *Get Out* by Jordan Peele in 2017. Due to both the movie’s brilliance and its profit margins (it was made for under \$5 million and made \$176 million), its release prompted Hollywood to rush funding into films exploring themes of race and racism in America, with racism frequently serving as the primary antagonist.² However, long before the modern renaissance, Black individuals have existed in horror – as villains and victims on the screen or as creators behind the scenes. Black horror in the United States is woven throughout history, from slavery to Jim Crow to representations on screen.

Black horror has evolved throughout the 20th and 21st centuries from Blaxploitation films into the prestige Black horror renaissance of today. These films grapple with themes of extreme violence, fetishization, beauty standards, and stereotypes. All Black horror films, by nature of having Black creators or Black actors, contend with the history of racism and Black history – particularly Black history within the United States.

Historical Context of Black Horror: Black People in White Worlds

A quote by Tananarive Due, a Black writer and contributor to the documentary *Horror Noire: A History of Black Horror* (2019), captures the intense relationship between Black individuals and horror as a genre: “Black history is black horror.”³ The nature of the Black experience worldwide is

¹James B. Weaver and Ron Tamborini, *Horror Films: Current Research on Audience Preferences and Reactions* (Routledge, 2013), 59.

²Robin R. Means Coleman and Mark H. Harris, *The Black Guy Dies First: Black Horror Cinema from Fodder to Oscar* (New York: Saga Press, 2023), 132.

³“What Black Horror Has Been, And What It Can Be: Tananarive Due On Shudder’s HORROR NOIRE,” *FANGORIA*, accessed November 29, 2023, <https://www.fangoria.com/original/tananarive-due-on-shudders-horror-noire/>.

one of horror – be it through occupation and colonization, the kidnapping and selling of Black people during the Atlantic slave trade, or the raping of Black women in order to continue the supply of slaves in the United States. To justify this dehumanization and murder, white society had to create narratives surrounding Black people. Film became one of the means by which racist stereotypes propagandized white society, and it is a particularly effective means because “visual media...has a power like no other to shape beliefs.”⁴ As a visual art form, movies strongly impact our perceptions of race, stereotypes, and violence.

The Birth of a Nation (1915) was a Ku Klux Klan propaganda film that near-singlehandedly revived the movement. In the movie, a Black man (played by a white man in blackface) attempts to rape a woman; she commits suicide out of shame, and he is lynched by the KKK.⁵ This was one of the first portrayals of a common stereotype plaguing Black men in horror cinema: the monstrous, desirous man who pursues white women.⁶ A plethora of stereotypes in white film and white horror would emerge, and continue to this day: the “Magical Negro” who has mysterious otherworldly powers to assist the white protagonist; the “Sacrificial Negro” who dies for the white protagonist; and, of course “the Black guy dies first,” which technically isn’t grounded in film statistics, but does reflect the fact that Black characters are much less likely to make it to the end of a horror movie than their white counterparts.⁷

Of course, not all portrayal of Black individuals in white horror is negative. Some characters are truly groundbreaking. In nearly any article or book about Black horror, the movies *Night of the Living Dead* (1968) and *Candyman* (1992) arise in conversation, despite having white writers and directors.⁸ The two films nevertheless are significant for their prominent Black actors. In *Living Dead*, he is one of the protagonists, Ben (and notably, last man standing, though he too succumbs to the atrocious survival rate of Black characters in the film’s ironic bleak ending); in *Candyman*, the eponymous Candyman is the villain.

Night of the Living Dead was cast colorblind, meaning Ben was not

⁴Means Coleman and Harris, *The Black Guy Dies First: Black Horror Cinema from Fodder to Oscar*, 48.

⁵Means Coleman and Harris, 63-64.

⁶Kevin Pyon, “Between Psychoanalysis and History: The Cultural Legacy of Toni Morrison in Modern Black Horror,” *Women’s Studies* 52, no. 2 (February 17, 2023): 255, <https://doi.org/10.1080/00497878.2022.2162054>.

⁷Means Coleman and Harris, *The Black Guy Dies First: Black Horror Cinema from Fodder to Oscar*, Chapter 2: The “Other” Through the Eyes of Others: Black Horror Stereotypes.

⁸See: Kevin Pyon, “Between Psychoanalysis and History: The Cultural Legacy of Toni Morrison in Modern Black Horror,” *Women’s Studies* 52, no. 2 (February 17, 2023): 246–65, <https://doi.org/10.1080/00497878.2022.2162054>; Jessica Baker Kee, “Black Masculinities and Postmodern Horror: Race, Gender, and Abjection,” *Visual Culture & Gender* 10 (October 1, 2015): 47–56; Clifford Thompson, “The Past and the Iceberg: Black Horror Films, Then and Now,” *Cinéaste* 46, no. 2 (2021): 36–40; Means Coleman and Harris, *The Black Guy Dies First: Black Horror Cinema from Fodder to Oscar*.

written to be a Black character. However, casting him as such adds a racialized subtext to the movie, regardless of the surface text. The portrayal of a Black man as a fully-fleshed and complex character was radical in the 1960s, and his conflict with the other prominent male figure – a middle-aged white man – becomes subtly racially coded due to his being Black. As Kee articulates in describing a conflict in which Ben insists they should not flee to a cellar where the white man wants to go, “the symbolic space of social repression [i.e., the cellar, which is enclosed within the ground] where the White patriarch finds safety is quite literally a “death trap” for Black men.”⁹ What would be a simple argument about survival cast with two white actors becomes a battle with the White patriarchy. Finally, though Ben survives the zombies throughout the film, it ends when he is mistaken for a zombie by a group of armed white men, shot, and added to a pyre where his body burns. The picture of a Black man burning in a pyre murdered by a fearful and angry white mob is not new in American imagery; it strikingly resembles the racialized violence of men burned in lynchings. Ben’s ending was written before he was cast as a Black man, but it takes on new subtextual meaning with a Black actor.

Candyman is an iconic Black villain. Though in a villainous role (and thus at risk of falling into the “evil Black man” stereotype), two aspects of horror and the film itself must be considered. Firstly, in modern horror, being placed in a villainous role is not the damning propaganda of a century ago; rather, as Means Coleman notes, “[one] measure of progress for Black people in horror that flies against what you would intuitively label as “advancement” is our capacity for villainy. Horror, after all, is arguably more about the villains than about the heroes.”¹⁰ Secondly, though Candyman is a villain, he is also a victim. He is the vengeful spirit of a Black man lynched for his consensual relationship with a white woman; white racism is thus the ultimate creator of violence. The film can be criticized for its role in playing into some stereotypes: Candyman is portrayed as a pimp, a complex visual symbolizing “American society’s contradictory desire and fear of Blackness,” and the movie centers around a white woman and her fetishizing fascination with Candyman (i.e., Blackness).¹¹ Despite this, it is also a nuanced depiction of Black trauma (albeit come alive as a violent ghost). Sonia Luther, a visiting lecturer at the University of Pittsburgh in film and media studies, commented that “Candyman was one of the first horror films to talk about racism as horror, or segregation as horror and the racial implications of history.”¹² Despite its white creator, it deserves discus-

⁹Kee, “Black Masculinities and Postmodern Horror,” 51.

¹⁰Means Coleman and Harris, *The Black Guy Dies First: Black Horror Cinema from Fodder to Oscar*, 468.

¹¹Pyon, “Between Psychoanalysis and History,” 256-258.

¹²culturedesk and Lucas DiBlasi, “‘Black History Is Black Horror’: Panel Discusses Legacy of Black Slasher Film ‘Candyman,’” *The Pitt News* (blog), March 19, 2021, <https://pittnews.com/article/164327/arts-and-entertainment/black-history-is-black-horror-panel-discusses-legacy-of-black-slasher-film-candyman/>.

sion for its role in contributing to the larger canon of Black horror, evidenced by its 2021 remake helmed by the Black director Nia DaCosta and produced by Jordan Peele.

Black Filmmakers and the Evolution of “Black Horror”

The definition of “Black horror” is inherently flexible due to the nature of filmmaking. A plethora of individuals contribute to films at every stage of its production. Thompson ponders this question in his discussion: “Must its director be Black? Can it have a non-Black director but take on Black themes? Might it have African Americans as its main characters but not be particularly concerned with race?”¹³ In the interest of exploring Black art and the Black voice – how Black artists choose to represent themselves and their stories, not how they have been historically marginalized and portrayed in white horror – the following analysis will focus on films with heavy creative involvement by Black individuals (i.e., a writer or director).

Black horror created by and for Black individuals is best epitomized in the Blaxploitation era of the 1960s and 1970s. “Blaxploitation” refers to films with primarily Black characters and Black-focused plotlines, akin to the “race movies” of the time of Oscar Micheaux.^{14, 15} Kesha James argues that Black horror is an explicit response to social upheaval and that the Blaxploitation films of this era are responsive to the Civil Rights movement of the time.¹⁶ Movies that emerged during this time include *Blacula* (1972), a film that presents a Black man fated with a vampire’s bite; he just happens to make quite a few members of the LAPD his victims, a narrative choice designed to fight against establishment-level racism through visual catharsis for Black individuals whose fear of police was a real-life horror. A multitude of Blaxploitation horror films – not all critically acclaimed – followed, including titles such as *Blackenstein* (1973) and *Dr. Black and Mr. Hyde* (1976). What they had in common was their ability to “emphasize[] Black Americans’ concerns, fears and anxieties, thus challenging the hegemonic assumptions that remain prevalent within the American horror genre.”¹⁷

Black horror faded in the 1980s as slasher films became the horror gold standard. Because slasher films primarily center around the disruption of suburbia – and therefore, the clichés of whiteness within suburbia – Black

¹³Thompson, “The Past and the Iceberg: Black Horror Films, Then and Now,” 37.

¹⁴Means Coleman and Harris, *The Black Guy Dies First: Black Horror Cinema from Fodder to Oscar*, 51.

¹⁵William Lyne, “No Accident: From Black Power to Black Box Office,” *African American Review* 34, no. 1 (2000): 39, <https://doi.org/10.2307/2901183>, 58.

¹⁶Kesha Shalyn James, “The Horrors of Whiteness: Rhetoric, Race, and Black Popular Culture” (Ph.D., United States -- Georgia, University of Georgia, 2022), <https://www.proquest.com/docview/2725988702/abstract/EE90C474324E4098PQ/1>, 14.

¹⁷James, 16.

horror and Black individuals within white horror from this era are challenging to find.¹⁸ Though Black-centered horror emerged sporadically in the 90s and 2000s, it is the recent influx of Black horror in the late 2010s and early 2020s that marks the contemporary era.¹⁹

The Creation of Black Art: Harlem Renaissance Writers and Film Creators

All Black artists experience a commonality intrinsic to their art: the experience of being Othered. Jessica Kee describes the process of abjection as “mark[ing] self/Other, inside/outside, and clean/unclean... abjection is ultimately linked to disgust and taboo [through] what disturbs identity, system, order.”²⁰ The Black experience of being subject to abjection or Othered is also a process of being constantly visible: where white men “appear to exist without properties, unmarked, universal, just human,” the Black creator is always cognizant of race.²¹ Toni Morrison creates two frameworks to explore, in this context, the literary history of “racial slavery: the ‘racial unconsciousness’ of white authors and the racial ‘conscious [ness]’ of Black authors.”²² This conflict between the portrayal of the self and being the self is the heart of Du Bois’s theory on double consciousness. The need, as he describes, of “always looking at one’s self through the eyes of others,” and thus always comparing oneself to white standards or fearing how one is representing the race, permeates the Black community, including its artists.²³ Thompson theorizes that the constant need to “devote time and head space...to the aggravations of racism” has spawned the “iceberg” theme of 21st-century Black horror: that all the microaggressions experienced daily by Black individuals are the tip of an iceberg which films like *Get Out* (2017) and *Antebellum* (2020) expose in graphic, horrific twists about white treatment of Black people.²⁴ Black artists also grapple with the nature of being seen as Black and that shaping the perceptions of their art. Langston Hughes expresses in the opening of his essay “The Negro Artist and the Racial Mountain” that “[one] of the most promising of the young Negro poets said to me once, ‘I want to be a poet—not a Negro poet.’”²⁵ On the flip side of this coin – the cognizance of being a

¹⁸Means Coleman and Harris, *The Black Guy Dies First: Black Horror Cinema from Fodder to Oscar*, 69.

¹⁹Thompson, “The Past and the Iceberg: Black Horror Films, Then and Now,” 38-39.

²⁰Kee, “Black Masculinities and Postmodern Horror,” 48.

²¹Richard Dyer, *White: Essays on Race and Culture* (London, UK: Routledge, 1997), 38.

²²Pyon, “Between Psychoanalysis and History,” 250.

²³W. E. B. Du Bois and Brent Hayes Edwards, *The Souls of Black Folk*, Oxford World’s Classics (Oxford [England]; New York: Oxford University Press, 2007), 8.

²⁴Thompson, “The Past and the Iceberg: Black Horror Films, Then and Now,” 39.

²⁵Langston Hughes, “The Negro Artist and the Racial Mountain,” text/html, Poetry Foundation (Poetry Foundation, 1926), <https://www.poetryfoundation.org/>, <https://www.poetryfoundation.org/articles/69395/the-negro-artist-and-the-racial-mountain>.

Black artist, and being seen as a Black artist – Means Coleman criticizes the Black director of the horror film *Bad Hair* (2020), stating that he “feels the need, as a Black genre director, to deliver a mike-droppingly woke hot take on racism, so he ties in a connection to slave narratives and a vague, confusing semi-explanation of the source of the cursed hair that does more damage to the narrative than if it were just left a mystery.”²⁶ More than a century past Du Bois’s writing, Black artists are still caught within the veil and double consciousness. Further, themes between the Harlem Renaissance texts and the plot of contemporary Black horror remain strikingly similar.

Themes in Black Horror: 21st Century Film & Parallels to the Harlem Renaissance

A marked shift occurred between the 20th and 21st centuries within Black horror movies. In 20th-century Blaxploitation horror, the villains were typically Black, victims of some sort of horror in their own right (a la a vampire biting an African prince who then becomes Blacula), and experience some sort of death-like or transcendent transformation into the inhuman.²⁷

The 21st century, on the other hand, has more in common structurally and thematically with the texts from Black writers from a hundred years prior: Black horror in the 21st century is much more likely to have Black protagonists rather than Black villains, and the antagonist – rather than the sympathetic and victimized (if violent) Black villains of the 21st century – tends to be elements of structural racism itself.²⁸ If horror is a reactionary genre responding to the social circumstances of its time, the present-day renaissance is a response to the “Obama-era lie of a post-racial America” and the police brutality that prompted the Black Lives Matter movement of the 2010s.²⁹

Perhaps the most obvious parallel between eras is the presence of violence. Though this is to be expected as a staple of Black horror, the prevalence in texts from the Harlem Renaissance speaks to violence or the threat thereof as a daily element of Black life. Jean Toomer’s novel *Cane* and Du Bois’s *Souls of Black Folk* both tell narratives of lynchings. In *Cane*, the character Tom is burned alive; in *The Souls of Black Folk*, the lynching is implied through the mob of men rushing to murder John.^{30,31} The image of white men inflicting violence upon Black men is well documented in American history. Further, in *Cane*, Toomer opens his narrative “Kabnis” with an almost-Gothic

²⁶Means Coleman and Harris, *The Black Guy Dies First: Black Horror Cinema from Fodder to Oscar*, 193.

²⁷Thompson, “The Past and the Iceberg: Black Horror Films, Then and Now,” 36-37.

²⁸Thompson, 39-40.

²⁹Means Coleman and Harris, *The Black Guy Dies First: Black Horror Cinema from Fodder to Oscar*, 151-152.

³⁰Du Bois and Edwards, *The Souls of Black Folk*, 166.

³¹Jean Toomer, *Cane* (New York: University Place Press, 1923), 67.

psychological scene. Kabnis kills a noisy chicken with his bare hands, then falls to his knees and prays to God in a near-ecstatic revelation. He hears wood scraping, and jokes as if to reassure himself that “the ghosts down this way haven’t got any chain to rattle, so they drag trees.”³² He later runs in terror from what he believes to be a white mob coming to lynch him. These scenes within “Kabnis” – the fear of ghosts and the fear for one’s life – are classic horror elements, and the latter is an element of everyday life for many Black individuals.

The intersectionality between race and gender is also subject to examination in Wallace Thurman’s *The Blacker the Berry and Bad Hair* (2020), directed by Justin Simien. *Bad Hair* follows Anna, a Black woman who gets a weave in order to hide her natural hair and conform to white beauty standards. The literal horror within *Bad Hair* is that the hair is supernaturally murderous – but, as Thompson points out, “the true horror...is the real-life process of getting a weave, submitting to the pain of this supposed improvement.”³³ Similarly, Emma Lou, the protagonist of *The Blacker the Berry*, experiences the brutal reality of being a Black woman in a white supremacist society: dark skin is undesirable to the point that it is socially, economically, and most significantly, deeply psychologically harmful to be a dark-skinned Black woman. Emma Lou harms herself in attempts to lighten her skin, using bleaching creams and even “[eating] an arsenic wafer,” actively poisoning herself to conform to beauty standards. Means Coleman explains the crux of the behavior of both women, explaining that they are experiencing the “lure of repressing one’s Blackness in order to succeed in a world dominated by standards of Whiteness—a pressure that, when it comes to beauty in particular, has historically fallen hardest on Black women.”³⁴ Colorism and the need to conform to white standards is still highly relevant today; for example, only in recent years have a fraction of Black women been able to wear their hair naturally in the workplace without being considered “unprofessional.”

Finally, class dynamics arise under the lens of the Harlem Renaissance and in Black horror. In the remake of *Candyman* (2021), rather than a white academic protagonist, the plot follows a Black couple whom the director Nia DaCosta herself describes as “Black gentrifiers.”³⁵ This couple live in an expensive high-rise that was built in the former site of public housing, a statement on how class violence can occur within racial boundaries. The relationship between race and class is explored in a multitude of Harlem Renaissance texts, but notably in Nella Larsen’s *Passing*. The main character,

³²Toomer, 165.

³³Thompson, “The Past and the Iceberg: Black Horror Films, Then and Now,” 40.

³⁴Means Coleman and Harris, *The Black Guy Dies First: Black Horror Cinema from Fodder to Oscar*, 343.

³⁵Pyon, “Between Psychoanalysis and History,” 261.

Irene, is white passing, but unlike her foil character Clare, she does not live as a white woman. Instead, class is the most defining aspect of Irene's life. As a respectable middle-class Black woman who is married to a doctor, she values her status and states that "above everything else she had wanted, had striven, to keep undisturbed the pleasant routine of her life."³⁶ The phenomenon of Black middle-class individuals disassociating with their Blackness in order to be seen as respectable and assimilate into white society is a theme throughout a multitude of texts. In *Candyman*, rather than representing an attempt at assimilation into whiteness, the protagonists reflect how race and class intersect – and the ways in which they do not, as in this instance it is a Black couple gentrifying a historically Black neighborhood and class is the primary axis of oppression.

Above all else, the new era of Black horror, though confined in some ways by its genre, captures something essential: the need for good representation. This is captured in historical writing most succinctly in Carter Woodson's *The Miseducation of the Negro*. He writes that the education system "teaches the [Black individual] that he has no worthwhile past, that his race has done nothing significant since the beginning of time...if you can thereby determine what he will think, you will not need to worry about what he will do."³⁷ Black representation in horror, to be fair, is not the same as teaching Black history (except symbolically). Still, the vast expansion of Black representation in horror – both as protagonists and villains – is a win because "the power of representation is that the more of it there is, the less weight the occasional negative image carries."³⁸ Black representation as survivors, "final girls," and characters with more depth than the multitude of racial stereotypes that proliferate the entire horror genre is important to the sense of self and identity of Black individuals who watch films, as well as the white audience whose perception of Black culture is shaped by movies.

Challenges and Criticisms of Black Horror: Trauma Porn

Because violence against Black people is so prevalent in history, portrayals of it on-screen – even, or perhaps especially in a genre designed to have gore and high body counts – becomes a complex topic. Black horror movies are subject to accusations of "trauma porn," meaning the "[exploitation] of racial violence for profit" (an example would be recorded videos of Black individuals murdered by police)³⁹. James points out that "Black Americans have a longstanding history of portraying Black pain as a rhetorical maneuver"

³⁶Nella Larsen, *Passing* (Alfred A. Knopf, Inc, 1929), 187-188.

³⁷Carter G. Woodson, *The Miseducation of the Negro* (Virginia: Khalifah's Booksellers and Associates, 1933), 192.

³⁸Means Coleman and Harris, *The Black Guy Dies First: Black Horror Cinema from Fodder to Oscar*.

³⁹Means Coleman and Harris, 204.

to fight white racism, which is arguably the position of many modern Black horror films that position white individuals and racism itself as its villains.⁴⁰ Still, criticisms of the portrayal of Black pain – which can risk desensitization to said violence and “function as a pedagogical tool that not only educates others on how to see Black folks but also how Black folks see themselves” – are valid and important to consider in the context of Black horror, which is by necessity violent.⁴¹ Nevertheless, Means Coleman makes an astute point when she states that ultimately, the reaction to violent images within a film is typically determined to be either trauma porn or appropriate “simply by how good the movie is.”⁴² An example of this phenomenon is in the film *Antebellum* (2020). With a whopping 31% on Rotten Tomatoes (i.e., not highly regarded), this movie opens with a devastatingly brutal and lengthy scene displaying white violence on a plantation, a scene that earns it the indictment that the film “depicts slavery’s evils with ghoulish excess, a move that doesn’t educate, engage or challenge audiences.”⁴³ This violence, perhaps, could be forgiven had the film itself said something more interesting or engaged with the violence beyond simply portraying it for its shock value. Alas, explicitly racialized violence against Black individuals without a purpose is perhaps the definition of trauma porn.

Conclusion

The genre of Black horror is rich with a complex history, intersecting at times with portrayals in white horror. It has recently hit its stride in the current Black horror renaissance, with several box office successes proving that Black horror is a universally enjoyed genre. The themes that Black horror explores parallel those of the texts within the Harlem Renaissance in striking ways, indicating two things. Firstly, society has progressed in the last one hundred years – and it has not, in many ways. And secondly, Black history and Black horror are inextricably intertwined. Black art connects across time and will likely continue to do so.

⁴⁰James, “The Horrors of Whiteness,” 13.

⁴¹James, 12.

⁴²Means Coleman and Harris, *The Black Guy Dies First: Black Horror Cinema from Fodder to Oscar*, 205.

⁴³Cassie da Costa, “‘Antebellum’ Is Hollywood Tragedy Porn,” *The Daily Beast*, September 2, 2020, sec. entertainment, <https://www.thedailybeast.com/antebellum-turns-the-horrors-of-slavery-into-hollywood-entertainment>.

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The Debasement of the African Female Athlete

Grace Trigler

On September 1st, 2011, Annet Negesa, a decorated female runner from Uganda, crossed the line to begin her last lap of the women's 800 m event at the World Championship in Daegu, South Korea. A few seconds later, the then nineteen-year-old turned the corner for the last 200 meters, and really began to show the world what she was made of. She gracefully broke away from the middle of the pack, making the last push look impossibly easy. After just 2 minutes and 2.75 seconds, just 0.02 seconds ahead of the next competitor, Negesa earned first place in her heat.¹ This race was the beginning of a series of winning top three spots in subsequent international competitions and the title of 'Athlete of the Year' of Uganda for young Negesa. Her incredible athletic ability, thus, secured her a spot to represent Uganda at the 2012 London Olympics. While Negesa would train relentlessly with top coaches and even make the trek all the way to Europe in preparation for her Olympic debut, regrettably, she would never get to realize her dreams of racing for Uganda in London. Unfortunately, it would be the testosterone blood testing results from the competition in Daegu, the event that marked the beginning of her road to the Olympics, which would derail not only her dreams of competing in the Olympics, but also her entire athletic career.²

Annet Negesa's experience with gender testing and international athletic organizations brought to light the blatant racism and sexism present in the regulation of international female athletics. Based on my analysis of Negesa's experiences and further research into the regulations and athletic organizations that enforce them, the testosterone regulations, which barred Negesa and many others from displaying their abilities on international stages, disproportionately affect African female athletes. Through the disregard of highly disputed science to continue female testosterone regulation, unethical treatment of those subjected to gender testing, and hypocrisy of organizations and committees in charge of the international athletic regulations, international sport governing bodies endorse and systematize the unattainable western standard, thus unjustly impacting the experiences and successes of African female athletes.

Just months before Negesa's race in the 2011 World Championship in Daegu, World Athletics, formerly known as the I.A.A.F., introduced the first regulations on the eligibility of females with hyperandrogenism. These regulations defined an eligible athlete as a "female with hyperandrogenism

¹"800m Women Heats Heat 5 IAAF World Championships Daegu 2011." YouTube, 1 Sept. 2011, www.youtube.com/watch?v=1c61BJ-EmMU.

²Nyayieka, Ivy et al. "Testosterone Rules: Annet Negesa and Maximila Imali, the Elite Athletes Fighting for Acceptance." CNN, 21 July 2021, edition.cnn.com/interactive/2021/07/sport/athletics-testosterone-rules-negesa-imali-running-as-equals-dsd-spt-intl-cmd.

who is recognized as a female in law... provided that she has androgen levels below the male range, or if she has androgen levels within the male range, she also has an androgen resistance which means that she derives no competitive advantage from such levels.”³ While World Athletics can define strict eligibility criteria, it fails to provide unambiguous, scientific evidence to support it. Before stating its rules for eligibility, World Athletics briefly states that their decision is “a culmination of an 18 month long review by an IAAF expert working group who have studied issues relating to the participation of female athletes with hyperandrogenism in athletics... working in close coordination with the IOC Medical Commission... and also participating in a series of international expert meetings held on the subject in 2010.” Although they made sure to employ the use of the authority principle of persuasion through their use of ‘experts’ and collaboration with the well-known International Olympic Committee, or IOC, World Athletics failed to provide specific scientific facts to explain the implementation of these criteria. It is probable that the justification for the eligibility criteria is vague not only because it allows for governing bodies to twist the rules when they see fit, but also because of the controversial nature of the science behind testosterone’s role in athletic performance.

Testosterone is a hormone that is known to increase protein and muscle synthesis, and supplemental testosterone has been shown to enhance athletic performance, demonstrated by cases such as Lance Armstrong’s. It is important to note that this information is accepted by many renowned scientists across the globe. However, the role that naturally occurring testosterone plays in speed and power performance is highly contested among the science community. The studies done on those with high natural testosterone levels have revealed interesting results. For example, some studies demonstrate a correlation between higher testosterone and increased performance, some have found that higher testosterone is linked to inferior performance, and some have found no correlation at all.⁴ Despite the lack of consistent, scientific support for their criteria, World Athletics consultants still concluded that there is a relationship between blood testosterone and athletic performance. However, the data that led to their justification of the relationship was not at all convincing for endocrinologist and professor, Peter Sonksen and many others in his field. The continuous enforcement of these criteria against scientific recommendation allows the World Athletics to target female athletes from the global south, where there is a higher occurrence of individuals with DSDs in resource-limited settings.⁵ The targeted athletes are also often unaware of their condition and the reasoning behind

³“IAAF to Introduce Eligibility Rules for Females with Hyperandrogenism | NEWS | World Athletics.” worldathletics.org, www.worldathletics.org/news/news/iaaf-to-introduce-eligibility-rules-for-female.

⁴Nyayieka et al., “Testosterone Rules”

⁵Chanoine, Jean-Pierre, et al. “Incidence of Disorders of Sexual Development in Neonates in Ghana: Prospective Study.” *BMJ*, May 2019, pp. 636–38. adc.bmj.com/content/archdischild/104/7/636.full.pdf.

why their eligibility is questioned in the first place, contributing to the disproportionate and detrimental effects these regulations impose on African female athletes.

The continued use of disputed eligibility criteria is evidence enough of the corruption occurring among sport governing bodies and officials; however, the corruption of these organizations extends far beyond their eligibility requirements. World Athletics requires the use of their own approved medical experts and specialist centers when an athlete is subjected to further examination or treatment for verification of eligibility.⁶ While this may be justified by the notion that they are trying to create an environment that would produce fair, consistent results using the same doctors and centers on each athlete, it also fosters an environment of corruption and deceit if its conditions are abused by those in charge.

Following the decision on her ineligibility, Negesa was sent to a designated specialist center in Nice, France for further evaluation. It was here that she would begin to uncover the reality of the abuse of power and corruption that the medical environment created by the World Athletics fostered. After her examination in Nice, she was told by an athletics official to stay in her home to avoid news reporters and questions about her absence in the 2012 Olympics. She remained at home, confused and depressed about her ineligibility, for months.⁷ This request was not regarding her own well-being and safety; it was instead a measure to protect the World Athletics reputation and hide their misconduct. After returning from Nice, Negesa elected to go through with surgery in Kampala, Uganda in hopes of competing again. Not only did this surgery not allow her to compete, the lack of communication from her doctor in France led to inadequate postoperative care and irreversible damage to her athletic ability. Dr. Bermon, the doctor from Nice and the former director of the World Athletics Health and Science Department, failed to consult with the doctor in Uganda to advise them of the proper hormone therapy post-surgery that would have prevented some of the damage. World Athletics actively denies that Dr. Bermon ever met with Negesa or was involved in her treatment, and Dr. Bermon continues to refuse to comment on the case.⁸

The lack of transparency following the exposure of Negesa's mistreatment is yet another example of the abuse of authority World Athletics actively takes part in and how they continue to get away with it. The corrupt system of

⁶“Eligibility Regulations for the Female Classification.” World Athletics, World Athletics, 1 Nov. 2019, www.worldathletics.org/about-iaaf/documents/health-science.

⁷“They’re Chasing Us Away from Sport.” Human Rights Watch, 7 Dec. 2020, www.hrw.org/report/2020/12/04/theyre-chasing-us-away-sport/human-rights-violations-sex-testing-elite-women.

⁸Abdul, Geneva. “This Intersex Runner Had Surgery to Compete. It Has Not Gone Well.” The New York Times, 16 Dec. 2019, www.nytimes.com/2019/12/16/sports/intersex-runner-surgery-track-and-field.html.

examinations and treatment that the World Athletics has created preys on African female athletes like Negesa. Because of the systems in place such as this, Black female athletes fear the scrutiny and attention that comes with excelling beyond the rest of the competition.⁹ Therefore, African female athletes are forced to conform to the Western ideal out of fear of putting a target on their backs and thus are forced to compromise their own ability and well-being if they want to succeed in international athletics.

In addition to the unjustified enforcement of eligibility regulations and corruption of the organization involved in their creation and enforcement, World Athletics and its consultants also fail to provide athletes who undergo gender testing and treatment with proper, ethical care. Negesa chose to participate in the surgery that would end her running career after being misinformed by the doctors in charge of her case. Negesa was told that the surgery would not only allow her to compete in the 2012 Olympics, just months after her surgery, but the doctor performing her surgery led her to think that the surgery would be simple by comparing it to an injection.¹⁰ However, she woke from her surgery to find incisions on her stomach which were not consistent with an injection. Following her surgery, she did not receive any follow-up information or care for seven years after her procedure took place. Consequently, the doctors also failed to provide her with the proper hormone therapy necessary to recovery from the procedure, thus Negesa suffers from muscle weakness and osteoporosis rendering her unable to compete.¹¹

Because Negesa and other female athletes are misled, they are not able to give informed consent to the examinations and procedures suggested by the World Athletics ‘experts,’ which is extremely unethical even outside of the medical field. In a normal, ethical doctor-patient relationship, the doctor would be unwilling to perform tests and procedures without the patient’s informed consent. However, the relationship between doctor and patient in the system created by World Athletics is practically non-existent. The patients in this system receive no information or right to autonomy surrounding their medical care. The doctors only provide the treatment requested by the athletic organization and only report the medical information back to the organization, not the patient. Although the World Medical Association has urged doctors against implementing gender testing and subsequent treatment, the doctors in charge of the care of athletes who are affected by the testing and treatment are not regulated by medical authorities and are instead operating under instruction from the athletic governing bodies they provide services

⁹Ryan, Hannah. “How Misogynoir Is Oppressing Black Women Athletes.” CNN, 3 Aug. 2021, edition. [cnn.com/2021/08/02/sport/misogynoir-black-women-athletes-cmd-spt-intl](https://www.cnn.com/2021/08/02/sport/misogynoir-black-women-athletes-cmd-spt-intl).

¹⁰“Annet’s Story: Women in Sport Face Abusive Sex Testing.” Human Rights Watch, 4 Dec. 2020, www.hrw.org/video-photos/video/2020/12/03/annets-story-women-sport-face-abusive-sex-testing.

¹¹Abdul. “This Intersex Runner”

for.¹²

According to an MD's study on disorders of sexual development, the most important aspects of successful care of patients with DSD are providing multidisciplinary individualized health care and shared, informed decision-making.¹³ Both guidelines for care of DSD patients are grossly ignored by World Athletics, further emphasizing the lack of ethical care for the athletes they interact with and the discriminatory motivations behind the eligibility criteria and treatment of female athletes with DSDs. These practices are allowed to continue in this system due to their targeting of female athletes from low resource areas who have not had much exposure to western medical treatment in a similar environment. Thus, the athletes are misinformed even before treatment begins and are manipulated into thinking that they are receiving proper treatment that they should not question. Therefore, the use of unethical practices by doctors under World Athletics endorses the disproportionate affect their regulations and treatment have on African female athletes.

My analysis of the World Athletics' failure to provide appropriate patient care, corruption of governing officials and systems implemented, and lack of scientific backing to justify their practices and regulations, reveal that international sport governing bodies' regulations aim to disproportionately impact African female athletes and prevent them from dominating specific sporting events, such as middle-distance running. Regrettably, we cannot reverse the damage done to Negesa and other athletes who have already been through the gender testing and eligibility verification practices under the World Athletics. Instead, we can focus on enacting change to ensure no other female athlete has to endure the same fate. Because the lack of scientific evidence to support the eligibility regulations does not impact the World Athletics ability to continue to enforce them, it is important that the issue is approached from a different angle. Based on information Dr. Witchel provided in her study on DSDs, an efficient way to reduce the rate at which these rules impact African females and the mistreatment of those impacted would be to dismantle the privatized system of medical care World Athletics and other international sport federations have created. If the medical care for the athletes was more individualized and involved more collaboration between different specialists, not only would the athletes have a more positive experience, but they would also be more informed and involved in their care and treatment. We should empower Black female athletes and reduce their risk of exposure to a situation in which they

¹²Stewart, Philippa. "Interview: Cut Down on the Cusp of Glory." Human Rights Watch, 4 Dec. 2020, www.hrw.org/news/2020/12/04/interview-cut-down-cusp-glory. "They're Chasing Us Away from Sport." Human Rights Watch, 7 Dec. 2020, www.hrw.org/report/2020/12/04/theyre-chasing-us-away-sport/human-rights-violations-sex-testing-elite-women.

¹³Witchel, Selma Feldman. "Disorder of Sex Development." *Best Practice & Research Clinical Obstetrics & Gynaecology*, vol. 48, Apr. 2018, pp. 90–102. ScienceDirect, www.sciencedirect.com/science/article/abs/pii/S1521693417301955?via%3Dihub.

could be negatively impacted by the international sports community through active support of dismantling the current systems that endorse conformity to unrealistic and non-inclusive Western ideals.

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Stewart, Philippa. “Interview: Cut Down on the Cusp of Glory.” Human Rights Watch, 4 Dec. 2020, www.hrw.org/news/2020/12/04/interview-cut-down-cusp-glory.

“They’re Chasing Us Away from Sport.” Human Rights Watch, 7 Dec. 2020, www.hrw.org/report/2020/12/04/theyre-chasing-us-away-sport/human-rights-violations-sex-testing-elite-women.

Witchel, Selma Feldman. “Disorder of Sex Development.” *Best Practice & Research Clinical Obstetrics & Gynaecology*, vol. 48, Apr. 2018, pp. 90–102. ScienceDirect, www.sciencedirect.com/science/article/abs/pii/S1521693417301955?via%3Dihub.

Assay-Based Analysis of Several Proteins Isolated from a PE Degrading Strain Identified as *Rhodococcus Qingshengii*

Josiah Morgan

Abstract

Plastic accumulation is a well-known problem, dangerous to both the environment and to human health. Unfortunately, most modern methods of plastic disposal are difficult or generate harmful byproducts. Many microorganisms have been identified that are capable of plastic biodegradation. At the Institute for Environmental Genomics, an isolated strain of *Rhodococcus* has been found to be capable of relatively efficient polyethylene degradation. Through proteomic study several enzymes native to the strain were identified. These enzymes were cloned into DE3 *E. coli* via Gibson assembly for heterologous expression. Through several crude degradative assays, a number of enzymes have exhibited the ability to oxidize polyethylene. These results are promising and may lead to a superior method of plastic disposal.

Introduction

Plastic pollution is an increasingly pressing environmental issue that needs immediate response and remediation.¹ Since its conception in 1869, 9200 million tons of plastic have been produced, 60-67% of which is now plastic waste.^{2, 3, 4} In 2016 an estimated 48 million metric tons of plastic waste was polluted into the environment, this statistic is predicted to double by 2025 and has been aggravated by the COVID-19 pandemic.^{5, 6} Plastic waste exposed to environmental weathering undergoes natural breakdown into smaller particles, known as microplastics (5mm-0.1um) and nanoplastics (>0.1um).^{7, 8, 9} These

¹David Azoulay PV, Yvette Arellano, Miriam Gordon, Doun Moon, Kathryn Miller, Kristen Thompson. Plastic & Health: The Hidden Costs of a Plastic Planet. Kistler A, editor: Center for International and Environmental Law; 2019.

²Walker TR, Fequet L. Current trends of unsustainable plastic production and micro(nano)plastic pollution. *TrAC Trends in Analytical Chemistry*. 2023;160:116984.

³Med I. The Plastic Pollution Crisis 2022 12/2/2023]. Available from: <https://www.iucn.org/story/202207/plastic-pollution-crisis>.

⁴Science-History-Institute. History and Future of Plastics2023. Available from: <https://sciencehistory.org/education/classroom-activities/role-playing-games/case-of-plastics/history-and-future-of-plastics/>.

⁵Patrício Silva AL, Prata JC, Walker TR, Duarte AC, Ouyang W, Barcelò D, et al. Increased plastic pollution due to COVID-19 pandemic: Challenges and recommendations. *Chem Eng J*. 2021;405:126683.

⁶MacLeod M, Arp HPH, Tekman MB, Jahnke A. The global threat from plastic pollution. *Science*. 2021;373(6550):61-5.

⁷Med I. The Plastic Pollution Crisis

⁸Zhang K, Hamidian AH, Tubić A, Zhang Y, Fang JKH, Wu C, et al. Understanding plastic degradation and microplastic formation in the environment: A review. *Environ Pollut*. 2021;274:116554.

⁹National-Geographic-Society. Microplastics2023. Available from: <https://education.nationalgeographic.org/resource/microplastics/>.

smaller particles can persist for over 100 years and are increasingly pervasive; they can be found in agricultural soil, many foods, the human body, and even in the air.^{10, 11} Due to the hydrophobic nature of plastic, particles of plastic readily absorb hydrophobic organic contaminants as well as heavy metals, making the presence of these particles in the human body especially concerning.¹² It is also common for biofilms to form on the surface of plastic particles.¹³ Micro/nanoplastics commonly enter the body through ingestion or inhalation, and have been theorized to be absorbed via the lymphatic system and thus distributed throughout the body and potentially accumulating in secondary organs.^{14, 15, 16} Micro/nanoplastics have also been shown to be present in breast milk and are able to cross the placental barrier.¹⁷ Once inside the body plastic particles have been shown to increase oxidative stress and the diffuse some of the chemicals that they may have absorbed.¹⁸ The biofilms that may form on plastic particles may help the colonizing bacteria survive the acidic conditions of the stomach, leading to disruption of the bodily microbiome.¹⁹

Aside from human health, micro/nanoplastics have a global impact, contributing to climate change and serious ecological damage.²⁰ Aquatic plastic pollution is detrimental to oceanic and freshwater organisms.^{21, 22, 23} The ingestion of plastic particles in animals has been shown to lead to gastrointestinal blockage, inhibited enzyme secretion, low levels of steroid hormones, and difficulty in procreation.^{24, 25} While recycling is the desired solution to

¹⁰Azoulay et al. *Plastic & Health*

¹¹Wright SL, Kelly FJ. *Plastic and Human Health: A Micro Issue?* *Environ Sci Technol.* 2017;51(12):6634-47.

¹²Wright and Kelly. *Plastic and Human Health*

¹³Wright and Kelly. *Plastic and Human Health*

¹⁴Wright and Kelly. *Plastic and Human Health*

¹⁵Mowat AM. Anatomical basis of tolerance and immunity to intestinal antigens. *Nat Rev Immunol.* 2003;3(4):331-41.

¹⁶Volkheimer G. Hematogenous dissemination of ingested polyvinyl chloride particles. *Ann N Y Acad Sci.* 1975;246:164-71.

¹⁷Volkheimer. Hematogenous dissemination

¹⁸Wright and Kelly. *Plastic and Human Health*

¹⁹Wright and Kelly. *Plastic and Human Health*

²⁰Tony R. Walker LF. Current Trends of Unsustainable Plastic Production and Micro(nano)plastic pollution. *TrAC Trends in Analytical Chemistry.* 2023;160.

²¹Chawla S, Varghese BS, A C, Hussain CG, Keçili R, Hussain CM. Environmental impacts of post-consumer plastic wastes: Treatment technologies towards eco-sustainability and circular economy. *Chemosphere.* 2022;308(Pt 1):135867.

²²Cássio F, Batista D, Pradhan A. Plastic Interactions with Pollutants and Consequences to Aquatic Ecosystems: What We Know and What We Do Not Know. *Biomolecules.* 2022;12(6).

²³Dris R, Imhof H, Sanchez W, Gasperi J, Galgani F, Tassin B, et al. Beyond the ocean: contamination of freshwater ecosystems with (micro-)plastic particles. *Environmental Chemistry.* 2015;12(5):539-50.

²⁴Webb HK, Arnott J, Crawford RJ, Ivanova EP. Plastic Degradation and Its Environmental Implications with Special Reference to Poly(ethylene terephthalate). *Polymers.* 2013;5(1):1-18.

²⁵Susanti NKY, Mardiasuti A, Wardiatno Y. Microplastics and the Impact of Plastic on Wildlife: A

plastic waste, it is often demanding and costly.²⁶ Aside from being challenging to recycle, plastics are very recalcitrant and resistant to breakdown.²⁷

Plastic can be destroyed using physical means such as incineration, pulverization, and photo-oxidative treatment, but these often result in more harm than good by generating dangerous byproducts.^{28,29} Chemical treatments can also degrade plastic but create hazardous products and are not feasible for large scale plastic disposal.^{30, 31, 32} The most promising method of plastic disposal is biodegradation.^{33, 34} It has been observed that many microbial organisms may be able to degrade and digest plastics, converting the polymers to metabolic products.^{35, 36}

One of the most arduous plastics to biodegrade is Polyethylene (PE), which makes up around 35% of plastic waste.^{37, 38} As such, the Institute for Environmental Genomics elected to locally isolate and study microbes capable of degrading PE. A strain identified as *Rhodococcus qingshengii* was isolated and proved to be able to degrade PE with relatively high efficiency as is shown in Xuanyu Tao's article published in September 2023.³⁹ Several proteins from *Rhodococcus qingshengii* were identified with PE degradation via a time series proteomics test. In order to study these proteins, the specific gene sequences were cloned into Rosetta DE3 *E. coli* and heterologously expressed. The crude lysate of a clone containing the multicopper oxidase *peg1726* and the supernatant of a clone containing the esterase *peg6607* were incubated together and separately at 30°C with sterile PE powder for 7 days. The resulting powder was then analyzed via FTIR and only the combined incubation showed functional group changes. The powder displayed C-O ester

Literature Review. IOP Conference Series: Earth and Environmental Science. 2020;528(1):012013.

²⁶Merrington A. 9 - Recycling of Plastics. In: Kutz M, editor. Applied Plastics Engineering Handbook (Second Edition): William Andrew Publishing; 2017. p. 167-89.

²⁷Moharir RV, Kumar S. Challenges associated with plastic waste disposal and allied microbial routes for its effective degradation: A comprehensive review. *Journal of Cleaner Production*. 2019;208:65-76.

²⁸Moharir. Challenges associated with plastic waste

²⁹Al-Salem SM, Lettieri P, Baeyens J. Recycling and recovery routes of plastic solid waste (PSW): A review. *Waste Management*. 2009;29(10):2625-43.

³⁰Moharir. Challenges associated with plastic waste

³¹Al-Salem and Lettieri. Recycling and recovery routes.

³²Lin YH, Yang MH. Tertiary recycling of commingled polymer waste over commercial FCC equilibrium catalysts for producing hydrocarbons. *Polymer Degradation and Stability*. 2009;94(1):25-33.

³³Moharir. Challenges associated with plastic waste.

³⁴Ru J, Huo Y, Yang Y. Microbial Degradation and Valorization of Plastic Wastes. *Front Microbiol*. 2020;11:442.

³⁵Ru and Yang. Microbial Degradation and Valorization.

³⁶Gilan I, Hadar Y, Sivan A. Colonization, biofilm formation and biodegradation of polyethylene by a strain of *Rhodococcus ruber*. *Applied Microbiology and Biotechnology*. 2004;65(1):97-104.

³⁷Moharir. Challenges associated with plastic waste

³⁸Tao X, Ouyang H, Zhou A, Wang D, Matlock H, Morgan JS, et al. Polyethylene Degradation by a *Rhodococcus* Strain Isolated from Naturally Weathered Plastic Waste Enrichment. *Environmental Science & Technology*. 2023;57(37):13901-11.

³⁹Tao et al. Polyethylene Degradation by a *Rhodococcus* Strain

and C-O alcohol stretches, suggesting enzymatic oxidation.

I was then tasked with continuing this research the following semester. I planned to study two additional proteins, the peroxidase peg4145 and the esterase peg4886, hypothesizing these proteins would have similar oxidative effects. I also investigated the possibility of purifying each protein to see if it would increase activity. I carried out two major experiments. Firstly, I attempted to purify the four proteins and use them in another degradation assay. Unfortunately, only peg4145 was able to be purified. The purified peg4145 did not introduce any oxidation to PE powder upon incubation at 60rpm 13 days at 30°C . Secondly, I elected to incubate a crude lysate of a clone for peg4145 in combination with the supernatant of a clone for peg6607 to see if a similar reaction would occur as in the previous crude enzyme assay. A clone for peg1726MBP showed increased expression in the lysate, and so an identical incubation in combination with the supernatant of a clone for peg6607 was performed. This resulted in FTIR data suggesting that the incubations introduced C-O stretching to the PE powder.

The data collected over the course of this semester is somewhat inconclusive, but points to the fact that esterase peg6607 may be a vital part the initial steps of polyethylene degradation in *Rhodococcus qingshengii*.

Methods

Sigma-Aldrich mini-prep Gram-Positive Genomic DNA Extraction from *Rhodococcus qingshengii*

Firstly, 100mg of lysozyme was added to a 2mL microcentrifuge tube alongside 1mL of Sigma-Aldrich Gram-positive lysis solution and was mixed thoroughly. This was then mixed with 2mL of Gram-positive lysis solution in a 15mL falcon tube. An 2mL overnight culture of *Rhodococcus q.* grown in LB media was then centrifugated at 1600xg for 2 minutes in order to harvest the cells. The supernatant was removed from the pelleted *Rhodococcus q.* and 300µL of the freshly prepared Sigma-Aldrich lysis solution was added. This was mixed via gentle pipetting and then incubated at 37°C for 35 minutes. After this incubation, 5µL (25 ng) of RNase A was added to the mixture and allowed to incubate at room temperature for 2 minutes. Then 30µL of proteinase K was added to the solution and was mixed thoroughly via vortex. Following this, 300µL of Sigma-Aldrich lysis solution C was then added to the sample and mixed via pipette. This was incubated at 55°C for 15 minutes. While this incubated, a collection 2mL microcentrifuge tube was prepared by adding a nucleic acid binding column filled with 500µL of column prep solution and centrifugating the tube at 1200xg for 1 minute. The flow through was then discarded. 300µL of 100% EtOH was added to the incubated sample. Then 500µL of the sample was added to the nucleic acid binding column. The collection tube containing the column was centrifugated at 8000xg for 1

minute. The flow through was discarded and the remaining sample solution was made to flow through the column in an identical manner. 500 μ L of wash solution 1 was then added to the column and centrifugated at 8000xg for 1 minute and the flow through was discarded. 500 μ L of wash solution concentrate was then added to the column and centrifugated at 1200xg for 3 minutes and the flow through was discarded. The empty column and collection tube was then centrifugated at 16000xg for 1 minute to ensure no remaining liquid in the column. The binding column was then transferred to a final 2mL DNA collection microcentrifuge tube. 50 μ L of elution buffer was then added directly to the center of the binding column and incubated at room temperature for 5 minutes. This was then centrifugated at 12000xg for 1 minute. The flow through was then pipetted back into the column and incubated for 5 minutes at room temperature. This was centrifugated at 17200xg for 2 minutes. The flow through containing the genomic DNA of *Rhodococcus q.* was then collected and frozen at -20°C. This process was done in duplicate, resulting in 100 μ L of gDNA solution.

Creation of Clones for Gene of Interest Heterologous Expression

In order to express the proteins of interest, DE3 Rosetta *E. coli* was used as a host for heterologous expression. The vector of choice for peg4145, peg6607, and peg4896 was pET-28A. This plasmid confers an antibiotic resistance gene towards kanamycin, and all media was prepared with 0.05mg/mL of kanamycin to select only for clones containing the desired plasmid. The vector of choice for peg1726 was pMAL-c6t, which fuses Maltose Binding Protein (MBP) to peg1726 for increased secretion. Clones containing pMAL-c6t require 0.2% glucose to survive. This plasmid confers an antibiotic resistance gene towards ampicillin, and all media was prepared with 0.1mg/mL of ampicillin to select only for clones containing the desired plasmid. Each gene was altered to contain a his-tag, useful for protein purification. Each vector contains a promoter that strongly induces cloned protein expression when in the presence of Isopropyl β -D-1-thiogalactopyranoside (IPTG). The heterologous expression vectors were created using Gibson Assembly.

Firstly, the desired gene and expression vector were amplified via PCR using the corresponding primers and NEB Phusion High-Fidelity DNA Polymerase. The general reaction mixture and thermocycling parameters are listed at the end of this thesis. The PCR products were then purified using a QIAquick PCR Purification kit. At this point 50 μ L of chemically competent DH5a *E. coli* was thawed on ice in a 2mL microcentrifuge tube. The PCR products were then measured via nanodrop and then added together with nuclease free ddH₂O at a 1 vector/ 6 insert molar ratio to 0.02–0.5 pM total DNA for the 20 μ L reaction mixture including 10 μ L 2x NEB Gibson Assembly Master Mix. This mixture was incubated at 50°C for 15 minutes. The

2μL of the Gibson assembly mixture was then added to the 200μL of thawed DH5a *E. coli*. This was then incubated on ice for 30 minutes, heat shocked in water at 42°C for 30 seconds, and incubated on ice for 2 minutes. At this point 950μL of SOC rich media without antibiotic was added to the microcentrifuge tube containing the DH5a *E. coli* and Gibson assembly mixture. This mixture was then incubated at 37°C at 200rpm for 1 hour. Different amounts of culture were then plated onto LB Agar Media plates containing the antibiotic of interest. The plates were incubated overnight at 37°C. For the clones containing pET28-A expression vectors, 3 colonies were selected and grown overnight in 6mL of LB. 1mL of these plasmids was combined with 0.5mL of 50% glycerol and stored at -80°C as a glycerol stock. The plasmids of these cultures were extracted using a NEB Plasmid Miniprep kit.⁴⁰ The extracted plasmids were then ran on an agarose gel to confirm via size. For clones containing pMAL-c6t-peg1726MBP, 10 colonies were selected for colony PCR. Part of each selected colony was then mixed into 15μL of ddH₂O sterile water. A standard PCR using 1μL of sample and the other components listed in the appendix with Rapid Taq DNA polymerase was then conducted using the gene of interest' primers and results were observed on agarose gel. Assuming the results were suitable, the remaining 14μL of water containing the colony were added to 6mL of LB in a culture tube and grown overnight at 200rpm 37°C. To create glycerol stocks, 1mL of these cultures were mixed with 0.5 mL of 50% glycerol and stored at -80°C. The plasmids were then extracted from the remaining culture using a NEB Plasmid Mini-prep kit.⁴¹

The extracted plasmids were then transformed into chemically competent Rosetta *E. coli* using a protocol identical to the one described above. Three colonies of each set of clones were inoculated into respective 6mL LB culture tubes and grown overnight at 200rpm 37°C. To create glycerol stocks, 1mL of these cultures were mixed with 0.5 mL of 50% glycerol and stored at -80°C. The remaining cultures were then used for a NEB Plasmid Mini-prep and the extracted plasmids were sent to plasmid-saurus for sequencing.⁴² Upon confirmation of the correct sequence, clones were selected for further use in heterologous protein expression.

Preparation of Sterile PE Powder

0.5g of PE powder was measured on a weigh boat and poured into a 50mL falcon tube. 20mL of 70% ethanol was added to the tube. The tube was rotated at 60rpm for 1 hour. The tube was then centrifugated at 13000xg for 10 minutes to pellet the PE powder. Under a fume hood, a sterile pipette

⁴⁰Biolabs NE. Monarch Plasmid DNA Miniprep Kit Protocol 2023 [Available from: <https://www.neb.com/protocols/2015/11/20/monarch-plasmid-dna-miniprep-kit-protocol-t1010>].

⁴¹Biolabs NE. Monarch Plasmid DNA

⁴²Biolabs NE. Monarch Plasmid DNA

was used to gently remove the majority of the ethanol. The samples were left under a sterile fume hood for 72 hours to dry and then were capped and ready for use.

Protein Purification and Degradative Assay of Purified peg4145

Crude lysate assays are not favorable because of the presence of many unknown proteins from the heterologous expression host. In order to test each enzyme in isolation, purification is necessary. Each gene of interest in this study was purified using a nickel (his-tag) purification column. All media contained the correct antibiotic and glucose concentrations for selection and growth. For this section, all non-growing samples were kept on ice. In previous experimentation, it was noted that the proteins peg1726MBP and peg4145 are found in the greatest concentration in whole cell lysate, while the proteins peg4896 and peg6607 are excreted from the cell and found primarily in the supernatant. Knowing this, the cultures of heterologous expression clones that contained peg4896 and peg6607 were processed to obtain the whole cell lysate, while with peg4896 and peg6607 only the supernatant was harvested.

Previously, large-scale cultures of Rosetta DE3 *E. coli* pMAL-c6t-peg1726MBP and pET-28A-peg4145 were prepared and the pellets were frozen at -80° . To prepare these cultures, each clone was inoculated into 3 culture tubes containing 6.6mL of LB. These were grown overnight at 200rpm 37°C , and then added to 0.5L of LB media in and grown at 200rpm 37°C to an OD of 0.6. At this point, IPTG was added to a concentration of 0.3mM to induce high expression of the protein of interest. The cultures were then incubated for an additional 3 hours. The 0.5L cultures were then added to individual 1L centrifuge tubes and centrifugated at 10000xg for 10 minutes at 4°C . 470mL of each supernatant was discarded. The remaining 30mL of each supernatant was used to resuspend the pelleted bacteria. The resuspended culture was transferred to a 50mL falcon tube and centrifugated for 10 minutes at 10000xg 4°C . The supernatant of each culture was then discarded and the pellets were stored at -80°C .

When ready to purify, a sterile steel spatula was used to scrape out a 1.3cm (thumbnail size) circle of each culture which was then resuspended in cold lysis buffer (see appendix). Each pellet was mixed thoroughly using a pipette. The resuspended cultures were each sonicated at 40% intensity for 8 minutes of 1 second of sonication to 2 seconds of rest. After lysis via sonication, the samples were centrifugated at 12000xRPM for 30 minutes to separate any cell debris from the supernatant containing the protein of interest. The lysate was collected, and the pelleted cell debris was discarded.

To prepare cultures of the clones containing Rosetta DE3 *E. coli* containing pET-28A-6607 and pET-28A-4896, culture tubes containing 2mL were inoculated from glycerol stocks. These small cultures were grown over-

night at 200rpm 37°C. 1mL of the overnight cultures were then used to inoculate 50mL of LB in a 300mL flask. These cultures were grown for approximately 1.5 hours at 200rpm 37°C until at an OD of 0.6. At this point IPTG was added to the culture so that the IPTG concentration was 0.3mM to induce high expression of the protein of interest. This was grown for an additional 2 hours at 200rpm 37°C. 30mL of each culture was then transferred to an individual 50mL falcon tube and centrifugated at 10000xg for 10 minutes. The supernatant containing the protein of interest was collected and the pelleted cells were discarded.

To purify the proteins of interest from their respective solutions, a nickel-NTA column was used with the various buffers listed in the appendix. An undergraduate named Abby Ren optimized this protocol, which was repeated for every sample with a new column. Firstly, a refrigerated nickel-NTA column was secured in place so that it was suspended in the air with both the top and bottom ends available. The column was opened and the solution inside began to drain. Once the liquid reached the 4mL mark of the column, 15mL of lysis buffer A was added to the column. It is vital that the column does not run dry, and so every solution was added when the previous reached the 4mL mark. The next solution added was the protein sample of the respective protein. This was ran through twice and collected. Every solution that was ran through past this point was collected. 6mL of each solution was ran through once. In order, the solutions used were: elution buffer B, buffer C, buffer D, buffer E, Buffer F, 1M imidazole, ddH₂O, and dilution buffer.

Upon collection of all samples, 170µL of each sample was taken and put into an individual 1.5mL microcentrifuge tube with 30µL of Laemmli Buffer. These were then heated to 100°C for 3 minutes. 15µL of each sample was loaded into an SDS page gel to determine which elution contained the most purified protein. The gel was electrophoresed at 85V until the sample reached the bottom. The gel was then stained with Coomassie blue to reveal protein location. Unfortunately, only peg4145 appeared to have been successfully purified and was most present in the buffer E elution. The remaining peg4145 buffer E sample was then placed into a ultrafiltration concentration 30kDa filter tube and centrifugated in a swing centrifuge at 3600xg 4°C. 25mL of dilution buffer was added to decrease imidazole concentrations and spun down to 1mL.

Prior to this experiment, the protocol had been repeated exactly for another sample of peg4145 that had been highly eluted in buffer D. This was concentrated in an identical manner, with 21mL of dilution buffer. 1mL of 100% glycerol was added to stop the sample from freezing. This sample was stored at -20°C for several weeks.

The protein concentration of both samples, the peg4145 that was stored in -20°C and the freshly purified peg4145, was measured using a Ther-

moFisher nanodrop using a preprogrammed application. 0.01452mg of fresh peg4145 was added individually to 3 50mL falcon tubes containing sterile PE powder alongside 20mL of dilution buffer. 0.06798mg of the peg4145 stored at -20°C was added individually to 3 50mL falcon tubes containing sterile PE powder alongside 20mL of dilution buffer. 3 50mL falcon tubes containing 20mL of dilution buffer and sterile PE were prepared as a control. These samples were incubated for two weeks shaking sideways at 60RPM 30°C. The tubes were flipped over every two days to ensure all powder was exposed to the solution.

Crude Protein Assay of peg6607, peg4145, and peg1726MBP

In order to test the activity of peg1726MBP and the combination of peg4145 and peg6607, another crude assay was performed. All media was prepared with the respective antibiotic and glucose concentrations for selection and growth of the desired clones. The experimental groups are as follows: a control containing only dilution buffer, a sample containing the supernatant of a culture of induced (treated with IPTG) Rosetta E. coli containing pET-28A-peg6607 with the lysate of an uninduced (untreated with IPTG) culture of Rosetta E. coli containing pMAL-c6t-peg1726MBP, a sample containing the supernatant a culture of induced Rosetta E. coli containing pET-28A-peg6607 with the lysate of an induced culture of Rosetta E. coli containing pMAL-c6t-peg1726MBP, a sample containing the supernatant of a culture of induced Rosetta E. coli containing pET-28A-peg6607 with the lysate of an uninduced culture of Rosetta E. coli containing pET-28A-peg4145, and a sample with the supernatant of a culture of induced Rosetta E. coli containing pET-28A-peg6607 with the lysate of an induced culture of Rosetta E. coli containing pET-28A-peg4145. All samples were prepared and analyzed in triplicate. The following table represents a simplified sample list.

Control containing no protein.
peg1726MBP Uninduced Lysate + peg6607 Induced Supernatant
peg1726MBP Induced Lysate + peg6607 Induced Supernatant
peg4145 Uninduced Lysate + peg6607 Induced Supernatant
peg4145 Induced Lysate + peg6607 Induced Supernatant

Firstly, each strain was revived from glycerol stocks in 6mL of LB media and grown overnight. This was prepared in duplicate for peg6607, as was the rest of the experiment. The following morning, 3mL of the overnight culture was added to 50mL of LB in a 300mL flask, two for each overnight culture for a total of 8 flasks. This was grown at 200rpm 37°C until reaching an OD of 0.6. To induce high expression of the proteins of interest, IPTG was then added to a concentration of 0.3mM for all of the flasks containing the clone for peg6607, and 1 flask each for the clones containing peg1726MBP and peg4145. This left two cultures unexposed to IPTG, and therefore unin-

duced. These cultures contained the clones with the gene for peg1726MBP or peg4145. All cultures continued incubation for an additional two hours. From this point forward, all samples were kept on ice. 30mL of each culture were then transferred to respective 50mL falcon tubes and centrifugated at 10000xg 4°C for 10 minutes. The supernatant of the clones for peg6607 was collected and the pelleted cells were discarded. The supernatant of the clones for peg4145 and peg1726MBP was discarded and the pelleted cells were re-suspended in 3mL of lysis buffer. The resuspended pellets were each sonicated at 40% intensity for 8 minutes of 1 second of sonication to 2 seconds of rest. After lysis via sonication, the samples were centrifugated at 12000xRPM for 30 minutes to separate any cell debris from the supernatant containing the protein of interest.

Upon collection of all samples, 170µL of each sample was taken and put into an individual 1.5mL microcentrifuge tube with 30µL of Laemmli Buffer. These were then heated to 100°C for 3 minutes. 15µL of each sample was loaded into an SDS-Page gel to ensure the presence of the protein. The SDS-Page gel was electrophoresed at 85V until the sample ran to the bottom of the gel. This was then stained with Coomassie blue to reveal protein location. The gel indicated that all proteins were present.

27mL of dilution buffer was added to the samples of cell lysate. At this time samples were added to 50mL falcon tubes containing sterile PE powder in triplicate as listed below.

Control: 20mL dilution buffer
10mL peg1726MBP Uninduced Lysate + 10mL peg6607 Induced Supernatant
10mL peg1726MBP Uninduced Lysate + 10mL peg6607 Induced Supernatant
10mL peg1726MBP Induced Lysate + 10mL peg6607 Induced Supernatant
10mL peg4145 Uninduced Lysate + 10mL peg6607 Induced Supernatant
10mL peg4145 Induced Lysate + 10mL peg6607 Induced Supernatant

The samples were then incubated sideways for 14 days at 60RPM 30°C. The tubes were flipped over every two days to ensure all powder was

exposed to the solution.

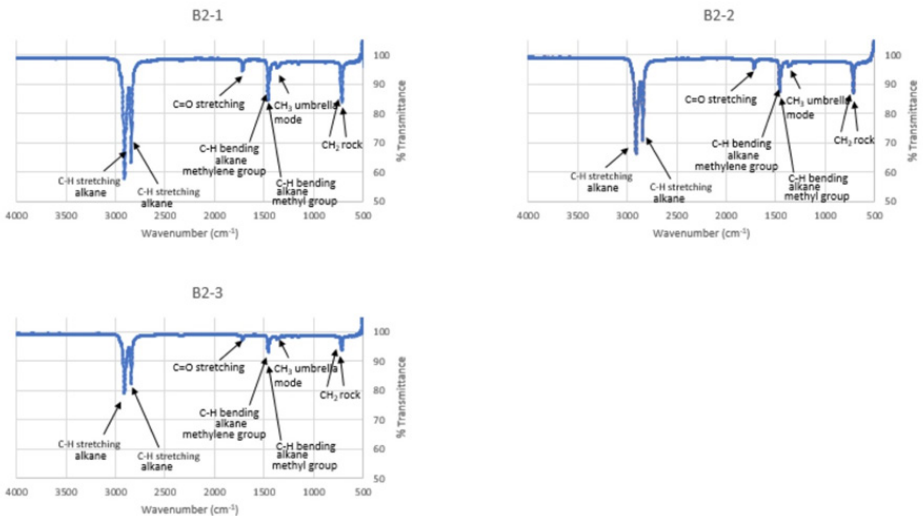
Collection of Plastic Powder

Samples were poured onto sterile 0.2 μ m filters to separate the solution from the PE powder. The solution was collected. The plastic was rinsed out of the filter into a new 50mL falcon tube using a 3% SDS solution. These were rotated for 24 hours at 60rpm to remove any remaining biological debris. These samples were then poured onto new sterile 0.2 μ m filters. Samples were rinsed vigorously with sterile ddH₂O. The filters with the PE powder were then placed under a sterile fume hood to dry for 48 hours. Upon drying, the PE powder was tapped from the filters onto a clean weigh boat. The plastic powder was then poured from the weigh boat into a respective 50mL falcon tube and sent to the lab of Dr Xuejun Zhu for FTIR analysis.

Results and Discussion

Results of Protein Purification and Degradative Assay of Purified peg4145

FTIR results of one sample of fresh purified peg4145



No samples showed any signs of oxidation or degradation as reported by Huanrong Ouyang. This suggests that the purified peg4145 does not have oxidative activity. This could be due to the solution in which it was incubated in, as dilution buffer is devoid of many possible cofactors that would be present in a complex medium.⁴³ It is also possible that the purification process may have resulted in a loss of oxidative activity for peg4145.⁴⁴ As was seen

⁴³Brühlmann D, Jordan M, Hemberger J, Sauer M, Stettler M, Broly H. Tailoring recombinant protein quality by rational media design. *Biotechnol Prog.* 2015;31(3):615-29.

⁴⁴Du M, Hou Z, Liu L, Xuan Y, Chen X, Fan L, et al. (1)Progress, applications, challenges and prospects of protein purification technology. *Front Bioeng Biotechnol.* 2022;10:1028691.

previously in Tao 2023, peg1726 needed to be incubated in combination with peg6607 to exhibit degradative activity, and so it is not unreasonable to predict that peg4145 may need the presence of another enzyme to be active in degrading PE powder.⁴⁵

The failed purification of peg6607, peg4896, and peg1726MBP may be due to experimental error or it may be that each protein needs a different purification protocol. The method should be repeated once more for these proteins before changing the protocol on an individual basis.

Results of the Crude Protein Assay of peg6607, peg4145, and peg1726MBP

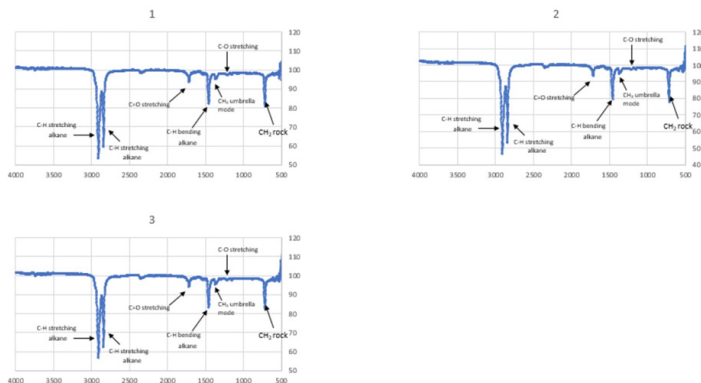
Summary of Results as indicated by FTIR

Sample	C-O Stretching Ex-pected	C-O Stretching Ob-served
Control 1 (no enzyme)	No	No
Control 2 (no enzyme)	No	No
Control 3 (no enzyme)	No	No
6607 Induced 1726MBP Uninduced 1	No	Yes
6607 Induced 1726MBP Uninduced 2	No	Yes
6607 Induced 1726MBP Uninduced 3	No	Yes
6607 Induced 1726MBP Induced 1	Yes	No
6607 Induced 1726MBP Induced 2	Yes	Yes
6607 Induced 1726MBP Induced 3	Yes	Yes
6607 Induced 4145 Uninduced 1	No	No
6607 Induced 4145 Uninduced 2	No	No
6607 Induced 4145 Uninduced 3	No	No
6607 Induced 4145 Induced 1	Yes	Yes

⁴⁵Tao et al. Polyethylene Degradation by a Rhodococcus Strain.

6607 Induced 4145 Induced 2	Yes	Yes
6607 Induced 4145 Induced 3	Yes	No

Example of FTIR Data: Sample 2 of 6607 Induced 1726MBP Induced



The results of this experiment are surprising yet interesting. In Tao 2023, the crude lysate of peg6607 incubated with PE in the absence of peg1726 did not exhibit any oxidative activity.⁴⁶ The FTIR data here shows us that peg 6607 may need only the very small amount of peg1726MBP that would be expressed basally from the uninduced plasmid to exhibit oxidative activity, however this needs to be repeated to confirm this assumption. It is likely this result could have occurred due to experimental error. This experiment confirms that peg1726MBP retains activity despite the fusion to maltose binding protein. The FTIR data suggests that peg6607 does not exhibit oxidative activity when incubated in the low concentrations of peg4145 that would be expressed basally from the uninduced plasmid. However, it seems that peg6607 and peg4145 when incubated together with PE powder do exhibit oxidative activity. The control shows no oxidative activity as expected. During incubation, the non-control samples appeared to grow bacteria, as the solution became very turbid. I believe this is due to a few remaining cells in the supernatant of Rosetta E. coli pET-28A-peg6607 that must have grown. This may have had unexpected effects on the results, but it is unlikely as E. coli does not digest PE naturally.

Conclusion

Further purification and incubation experimentation should be performed to confirm the results of these experiments and to investigate the po-

⁴⁶Tao et al. Polyethylene Degradation by a Rhodococcosus Strain.

tential of purification further. It is entirely possible that purified peg4145 may exhibit oxidative activity when in the presence of peg6607 or when in a complex medium such as LB. It is also possible that the purified peg4145 did not exhibit oxidative activity because the cells containing it were frozen at -80°C for some time.

It is possible that peg1726MBP may exhibit oxidative activity incubated as the sole protein in the mixture, and so another incubation with peg1726MBP as the sole protein should be performed. Another experiment with only the whole cell lysate containing peg1726MBP should be performed. The results suggesting the oxidative activity of peg4145 in combination with peg6607 are very promising. The experiment should be repeated with the whole cell lysate containing peg4145 as the sole solution. Overall, it was confirmed that peg4145 and peg1726MBP likely exhibit oxidative activity towards PE.

The research performed for this thesis can contribute to further understanding the means by which *Rhodococcus q.* degrades PE, further emphasizing its candidacy for the consolidated bioprocessing of polyethylene. The experience this thesis conferred will be very helpful in my career as a scientist.

Acknowledgements

Aifen Zhou and Xuanyu Tao served as my primary mentors, and were vital to this thesis. Abby Ren optimized the purification protocol. Huanrong Ouyang and Justin Smolen performed the FTIR. All experiments were done in entirety by me, Josiah S Morgan.

Appendix

PCR Primers, Mixture Component Concentrations, and Thermocycling Parameters

pET-28A-4145 Reverse Primer	TAACTTTAAGAAGGAGA-TATAACC
pET-28A-4145 Forward Primer	CACCACCACCACCACCACTGA
peg4145 Reverse Primer	TCGACCGGTTCGACGTGAAC-CACCACCACCACCACCACTGA
peg4145 Forward Primer	TAACTTTAAGAAGGAGATATAC-CATGTCCGATAGTTGCCCGGTT
pET-28A-6607 Reverse Primer	TAACTTTAAGAAGGAGA-TATAACC
pET-28A-6607 Forward Primer	CACCACCACCACCACCACTGA
peg6607 Reverse Primer	GCTCACTCCCTGGGCGTC

peg6607 Forward Primer	ATGCGTGCTCGAATTTTCAAGC
pET-28A-4896 Reverse Primer	TAACTTTAAGAAGGAGA-TATACC
pET-28A-4896 Forward Primer	CACCACCACCACCACCACTGA
peg4896 Reverse Primer	GGGTACTCCCGATATTCGGC
peg4896 Forward Primer	ATGGGGATTTCGAACATGCGTG
pMAL-c6t Reverse Primer	AGAACCTGTACTTCCAGATG
pMAL-c6t Forward Primer	TAAATAAGCTTCAAATAAAAC-GAAAGG
peg1726-MBP	TGCGATATCGGGTGGTGACG
peg1726-MBP Forward Primer	TGGACGAGTCACACAAGATCC

Component	50 μ L Reaction	Final Concentration
Nuclease Free Water	to 50 μ L	
NEB 5x Phusion Buffer	10 μ L	1x
2.5mM DNTP's	4 μ L	200 μ M
10 μ M Forward Primer	2.5 μ L	0.5 μ M
10 μ M Reverse Primer	2.5 μ L	0.5 μ M
Template DNA	1 μ L	<250ng
Phusion DNA Polymerase	.5 μ L	1unit/50 μ L PCR

Stage	Temperature	Time
Initial Denaturation	98°C	30 Seconds
Replication 30 Cycles	98°C	10 Seconds
	3°C above the T_m of the lower T_m primer	30 Seconds
	72°C	30 Seconds/kb
Hold	72°C	7 Minutes
Refrigeration	4°C	Until Collected

Purification Buffer Compositions

Buffer Name	Composition
Binding/Lysis Buffer A	20 mM Tris-HCl pH 8.0, 150 mM NaCl, and 10 mM imidazole
Elution Buffer 1 (Wash Buffer) B for sample B	10 mM Tris-HCl pH 8.0, 150 mM NaCl, and 10 mM imidazole

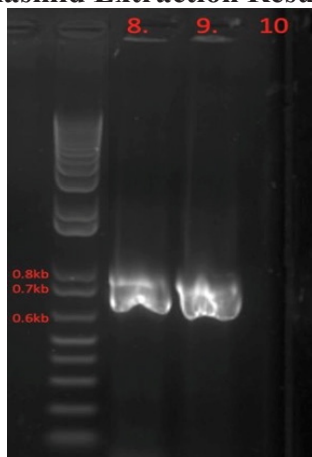
Buffer C for sample C	20 mM Tris-HCl pH 8.0, 150 mM NaCl, and 50 mM imidazole
Buffer D for sample D	20 mM Tris-HCl pH 8.0, 150 mM NaCl, and 100 mM imidazole
Buffer E for sample E	20 mM Tris-HCl pH 8.0, 150 mM NaCl, and 250 mM imidazole
Buffer F for sample F	20 mM Tris-HCl pH 8.0, 150 mM NaCl, and 500 mM imidazole
Sample G	1 M imidazole
Sample H	ddH ₂ O
Dilution Buffer	20 mM Tris-HCl pH 8.0 and 150 mM NaCl

gDNA Extraction Results

Sample	ng/ μ L	A260/280	A260/230
gDNA extraction #1	99.2	1.81	1.00
gDNA extraction #2	141.0	1.99	1.54

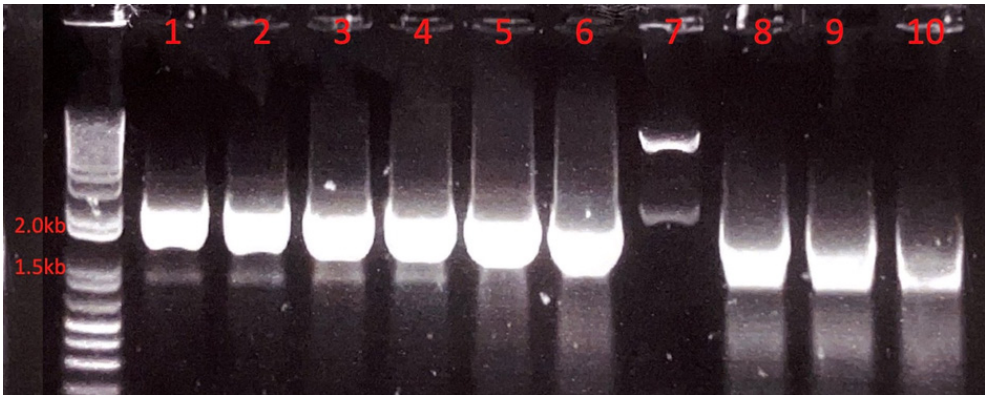
Sample #2 was selected for further use due to its high concentration and purity.

Plasmid Extraction Results



This is an agarose gel containing the extracted plasmids of 3 colonies of DH5a E. coli containing pET-28A-peg6607. The gene of interest is 1014bp in length and pET-28A is 5369bp in length, this means the combined plasmid should be 6383bp in length, approximately 0.64kb, as can be seen here.

Colony PCR Results

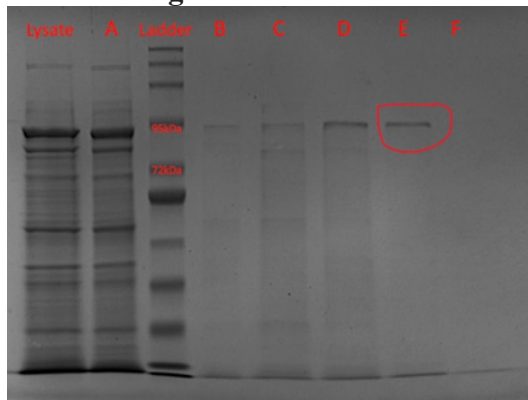


Here is an agarose gel containing the amplified gene of interest from 10 colonies of DH5a E. coli pMAL-c6t-peg1726MBP. The desired gene size is 1.7kb.

SDS-Page Dye Buffers

Staining Buffer	1g Coomassie brilliant blue R250 450mL ethanol 100mL acetic acid 455mL ddH ₂ O water
Destaining Buffer	100mL ethanol 70mL acetic acid 830mL ddH ₂ O

SDS-Page Gel of Purified 4145



The expected size of peg4145 is 81kDa, and can clearly be seen in elution E.

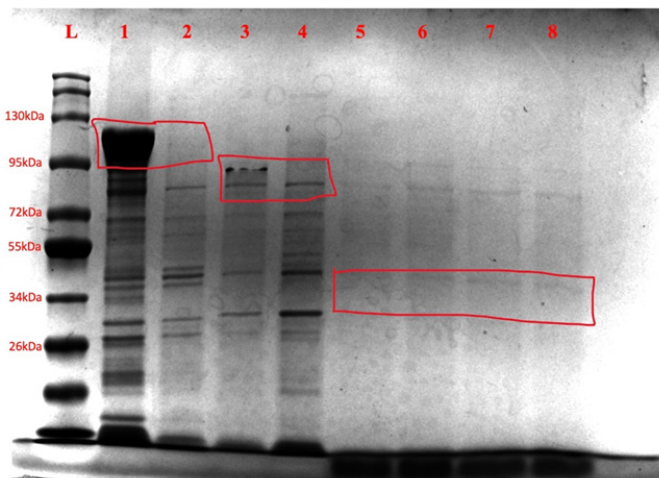
SDS-Page Gel of Samples for Crude Assay

1. peg1726MBP Induced Lysate
2. peg1726MBP Uninduced Lysate
3. peg4145 Induced Lysate
4. peg4145 Uninduced Lysate
- 5-8. peg6607 Induced Supernatant

peg1726MBP expected size = 106kDa

peg4145 expected size = 81kDa

peg6607 expected size = 35 kDa



In the previous crude assay peg6607 had been incredibly faint. In this experiment the band is also very faint. Despite this, the experiment was continued and showed evidence of oxidation. It is possible peg6607 appears so faint because the samples of peg4145 and peg1726MBP were somewhat concentrated from the sonication process.

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Death and Personhood in Hyderabad: End of Life Care in India's Palliative Care Institutions

Meena Ramadugu

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I extend my heartfelt gratitude to Sparsh Hospice for granting me the opportunity to conduct ethnographic research at their institution. Their generosity, openness, and support were instrumental in enabling this study. I am immensely thankful for the cooperation and assistance provided by the staff and administration at Sparsh, which significantly enriched this research endeavor. A special thanks to the directors, Dr. Vivekanand and Sri Shashidhar K., for their invaluable insights and contributions to this study.

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Abstract

India is a country of diversities, home to hundreds of languages, cultures, and religious groups. In this environment, discussions on the ethics of end-of-life care and voluntary assisted suicide become even more convoluted. The practice of palliative care is defined as an “interdisciplinary medical caregiving approach aimed at optimizing quality of life and mitigating suffering among people with serious, complex, and often terminal illnesses”.¹ In the status quo, palliative care services in India have extremely limited coverage, particularly in rural areas and regions of low socioeconomic conditions. This study aims to understand the cultural and social factors which may contribute to scarcity in palliative care, including but not limited to Indian ideas of a “dignified death” and the conceptions of “personhood” which might influence an individual’s self-fulfillment at the end-of-life stage. This paper will compile literature review and participant interviews to examine the views of the general Hyderabad population on the dying process, as well as the perspectives of terminally ill patients and their familial care providers, palliative care providers, and other stakeholders in the discussion of palliative care. Given that, to date, much of medical anthropological ethnographic research has been focused on Euro-American contexts, the expectation of this research paper is to provide insight into an understudied and essential area of study. In a country of over 1.4 billion people, elucidating the ethical complexities of death

¹Didyala, Amrita. “Elderly Population Rises, So Do Needs | Hyderabad News - Times of India.” *India-times*, *Indiatimes*, 1 Mar. 2022, <<https://timesofindia.indiatimes.com/city/hyderabad/elderly-population-rises-so-do-needs/articleshow/89909745.cms>. >

and dying is crucial to improving end-of-life care in palliative institutions.

Introduction

Hyderabad, India, a bustling city with over 10.8 million residents, faces a looming demographic shift as its elderly population is expected to surge.² This shift brings forth pressing ethical dilemmas surrounding end-of-life care and euthanasia in a nation marked by complex sociocultural, economic, and religious influences. While there is a growing consensus among Indian palliative care providers that terminally ill patients should have the autonomy to choose their method of dying, the legal landscape has only recently caught up, with a landmark 2018 Supreme Court case recognizing "living wills" and affirming the right to die with dignity.³ Amidst these cultural and legal transformations, the traditional Indian familial structure, once centered around intergenerational living, is evolving due to urbanization and Westernization, necessitating increased palliative care services to address potential psychological distress among the elderly. Attitudes toward death and personhood in Hyderabad vary significantly based on individual religious, class, and cultural backgrounds, with diverse beliefs ranging from Hindu concepts of karma and moksha to a rich mosaic of ethnic influences.⁴ Bureaucracy and corruption in Hyderabad hospitals have also shaped healthcare experiences, especially for the economically disadvantaged, while private healthcare facilities capitalize on resource scarcity. Palliative care remains a privilege of the affluent, highlighting disparities in access.

This research paper aims to explore these issues, particularly examining socioeconomic disparities in access to palliative care and the ethics surrounding who is deemed a "person" deserving of a dignified death.⁵ Additionally, it seeks to shed light on the multifaceted Indian perspective on death, challenging Western notions of personhood ending with death and offering insight into the Indian pragmatic view that death marks the end of one journey and the start of another. As India grapples with evolving attitudes towards death and aging, it is imperative to recognize the commonalities in the patient-centered view of a "good death" and "personhood". Literature review of ethnographic research in Hyderabad offers a unique opportunity to unravel the intricate layers of how culture, society, and religion converge to shape

²Didyala, Amrita. "Elderly Population Rises, So Do Needs".

³Devina Srivastava, "The Right to Die with Dignity: The Indian Supreme Court Allows Passive Euthanasia and Living Wills" (OxHRH Blog, 11 April 2018), <<https://ohrh.law.ox.ac.uk/right-to-die-with-dignity-a-fundamental-right-indian-supreme-court-allows-passive-euthanasia-and-living-wills>> [22 March 2023].

⁴Lakhan, Shaheen E. "Hinduism: life and death." *Bmj* 337 (2008).

⁵Degnen, C. (2018). *Dismantling the Person?: Death and Personhood*. In: *Cross-Cultural Perspectives on Personhood and the Life Course*. Palgrave Macmillan, New York. https://doi.org/10.1057/978-1-137-56642-3_8

end-of-life experiences. This research paper aims to enrich our understanding of the social, cultural, and religious dimensions associated with end-of-life care, especially in the context of Hyderabad's changing socio-cultural landscape. As medical science advances and life expectancy increases, navigating the ethical terrain of terminal suffering and end-of-life care remains a vital consideration in modern-day biomedical institutions.⁶

The center where the fieldwork for this study was conducted is called, “Sparsh” (meaning “touch” in Telugu), a non-profit center for palliative care for terminally ill patients. It is a five-story building, with the first four floors housing patients (including a pediatric ward), and the fifth floor used as the administrative offices. The institution has 82 open beds available, although only 62 out of these 82 are in use. The hospice center is funded using charitable donations from wealthy patrons, as well as money from renting commercialized space within the complex. The first three floors of the center are non-profit, and patients come from rural, lower socioeconomic backgrounds. The fourth floor is used for patients of higher socioeconomic status, who are able to pay for “premium” treatment (effectively a VIP ward). Money from the VIP ward is also used to fund the rest of the institution.

The goal of Sparsh is to “alleviate pain without curing”, and to offer all its patients a personalized, dignified departure. To that end, the staff at this center are trained in the ‘biopsychosocial’ model of treatment, first conceptualized by American psychiatrist George L. Engel as a way to offer a more comprehensive, trans-disciplinary approach to healthcare. This three-pronged model addresses the interconnections between biology, psychology, and socio-environmental factors. In the Sparsh Hospice Center, the staff have adapted this concept to the Indian scenario by adding a spiritual component, nativizing its Western roots so as to better provide care for the pluralistic and diverse patient population encountered in this center. Over the course of my five weeks of fieldwork in this research site, I was able to gain insight into several key areas of interest in this approach. These themes will be covered in section II of this paper.

Section II: Key Sociocultural Themes to Consider

Religion and Spirituality

In Hyderabad, attitudes towards death and dying vary based on the unique religious and cultural background of the individual. These many different cultures contribute to contrasting concepts of the idea of a “good/dignified death”.⁷ While the major religion of a particular region varies based

⁶Singh, S.; Sharma, D.K.; Aggarwal, V.; Gandhi, P. Attitude of doctors toward euthanasia in Delhi. *Asian J. Oncol.* 2015, 1, 49–54.

⁷Tuli, M. (2012). Beliefs on parenting and childhood in India. *Journal of Comparative Family Studies*; Special Issue: The Indian Family: A Revisit, 43(2), 81–92.

on the state and extent of colonial influences, Hinduism is a major religion in many parts of India. The Hindu views on life after death include belief in “karma”, which is that the deeds of the living have consequences in future reincarnated lives and on the soul, and also the idea of “moksha” which translates to “release” from the cycle of death and rebirth.⁸ These two concepts are central to any discussion related to death for anyone who practices Hinduism, and thus, relate to how Hindus imagine and strive to achieve a “dignified death” when faced with terminal illness. Furthermore, Hyderabad (while being a Hindu majority) is incredibly diverse and home to many different religions, including Islam, Buddhism, Zoroastrianism, Jainism, and Christianity. Each religion has its own idea of death and the afterlife, and India itself is a secular country so there is no “national religion”. Along with religion, the demographics of Hyderabad is a fusion of Persian, Mughal, Turkic, Punjabi, Yemeni, Bengali, Marwari, Malayali, Gujarati, Marathi, Sindhi, Iranian, Pathan, Kannadiga, and Telugu culture.⁹

Hyderabad is a fascinating case study for seeing how different religious and cultural beliefs manifest in a non-profit palliative care unit, with patients from all backgrounds. About 64% of the population in Hyderabad is Hindu, with Islam as the second most populous religion (30%). While Hindus are scattered throughout the city, Muslims have a substantial presence in and around the Old City. Other religious communities together make up about 6% of the total population. The patient body at Sparsh Hospice is religiously diverse, with the majority of patients being Hindu, Muslim, Christian, and atheist. This diversity presents unique challenges for palliative care providers, as each religion has its own belief system and respective rituals in the context of end-of-life. Consequently, many of the nurses and social workers (and to a lesser extent, the physicians) must learn cultural competency skills on the job, as a scarcity of resources and time prevents formal training of these staff members.¹⁰

Several of the patient cases which I observed during my fieldwork in this research site provided fascinating insights into the ways that palliative care providers handle such situations. In one of these examples, a 57 year old woman who was diagnosed with stage IV cervical cancer and identified as Hindu, wanted to return to her village to perform a ritual (known as a puja) for a local God in order to appease him. She believed her illness was a result of offending the God, since she had been unable to perform the puja the

⁸Thrane, Susan. "Hindu end of life: Death, dying, suffering, and karma." *Journal of Hospice & Palliative Nursing* 12.6 (2010): 337-342.

⁹Raman, Shibu, and Nicola Dempsey. "Cultural diversity and spatial structure in the Indian urban context." *Journal of Urban Design* 17.3 (2012): 425-447.

¹⁰Pentaris, Panagiotis, and Louise L. Thomsen. "Cultural and religious diversity in hospice and palliative care: A qualitative cross-country comparative analysis of the challenges of health-care professionals." *OMEGA-Journal of Death and Dying* 81.4 (2020): 648-669.

previous year. Despite repeated counseling sessions with social workers and dissuasions from her family, due to her precarious health condition, she was determined to return home. Subsequently, this patient was discharged and returned to her village to perform puja against medical advice. Following her re-admittance to the institution, she passed away within hours. The attending physician's position on this case was that, while returning to the village was physically not in the patient's best interests, it was in her best interests mentally and spiritually. This provides an interesting example of how Sparsh as an institution views patients' autonomy and the idea of "closure" as a multi-faceted abstract concept that is person-specific. This case studies provides evidence of the complex nature of providing end-of-life care in a multiethnic city with such a wide spectrum of religious practices and beliefs.

Personhood and Autonomy

Previous research has found that the concept of patient autonomy can be found lacking in countries where resource scarcity and population demand prevent such considerations. In situations where biomedical care providers are in shortage and time is of the essence, protocols instituted to prevent ethical oversight can break down.¹¹ Even in Western societies where systems have been imputed to ensure patient consent and avoid exploitation, biomedical disregard for patients' wishes can occur. One example of this is "medical paternalism", which occurs when health care providers make decisions without regard for a patient's right to self-determination. Such incidents undermine the personhood of the patient in question by violating their bodily autonomy. In the field of archaeology, personhood has widespread implications, with numerous researchers exploring how cultural variables define the concept of a "person" as a state of being, often examining this through the perspective of material culture and human remains. Drs. Jenny Hockey and Allison James, both socio-cultural anthropologists, have written extensively about social identity in the end-of-life stage. Their book, "Social Identities across the Life Course" illustrates how societal perceptions of aging shape individuals' self-awareness and behavior.¹² The authors critique age-related societal expectations, analyze the evolution of family-based identities to individualistic ones, and advocate for a more integrated understanding of personal and social identity within the context of bodily influence. The examination of "relational identity" within the family unit resonates with global palliative care practices, especially in India where elderly relatives often reside with their children. This arrangement prompts unique dynamics, challenging the personal identi-

¹¹Tambo, Ernest. "Non-conventional humanitarian interventions on Ebola outbreak crisis in West Africa: health, ethics and legal implications." *Infectious diseases of poverty* 3.1 (2014): 1-12.

¹²Hockey, Jenny, et al. "Problematising ageing and identity." *Social identities across the life course* (2003): 3-21.

ty of elders, who are often viewed through the lens of caregiving and obligation, diverging from the traditional expectation of children being cared for by their parents (13).¹³

In the Indian context, patient autonomy does not play the same role as it does in the West. While the Constitution of India (Article 21) enshrines a patient's legal rights to bodily self determination, in practice other values may supersede patient autonomy. One example of this is the lack of disclosure regarding diagnosis and prognosis for many of the patients who were institutionalized at Sparsh, often at the behest of family members and kin. In India, it is common practice for the family to provide direction regarding the care of a patient, even in circumstances where the patient is mentally sound and cognizant.¹⁴ The reasoning for this is grounded in the cultural fabric of Indian society, namely the virtue of 'filial piety'. In Indian culture, children of aging patients have a moral obligation to provide the best possible care and comfort for their family members.¹⁵ Consequently, in situations where knowledge about a terminal diagnosis may cause emotional distress for the patient, the family opts to not tell them in an effort to protect them. Of the 43 patients I spoke to, only 13 were aware that they had a terminal illness (cancer), and only 4 had actually thought about what they would want their death to be like. These 4 were all on the upper VIP floor. In the majority of the 43 cases, the patients themselves were nonverbal (due to complications like brain metastasis), and I had to ask the family about their thoughts on what the patient would want, and what they themselves wanted for the patient. One of the interesting concepts which emerged was the idea of patients existing in a liminal stage, where they are simultaneously visible and invisible. While I will discuss these findings in greater length in the discussion section of this paper, I'd like to mention one specific phenomenon which is another example of patient autonomy being undermined, in this case inadvertently.

In India, food holds significant cultural importance. Not only does it have ritual purpose in religious contexts, but within the family unit it is used as a way to solidify bonds and show care between individuals.¹⁶ In palliative care, a patient's need for food and water is significantly reduced due to a sedentary, low energy-consuming lifestyle. Oftentimes, terminally ill patients no longer have an appetite, and develop anorexia. In India, where public

¹³Chadda RK, Deb KS. Indian family systems, collectivistic society and psychotherapy Indian J Psychiatry. 2013;55:S299-309

¹⁴Chittem, Mahati, Sravanthi Maya, and Shweta Chawak. "Nondisclosure of a cancer diagnosis and prognosis: recommendations for future research and practice." Indian journal of cancer 58.2 (2021): 158-164.

¹⁵Smith GP 2nd. Recognizing personhood and the right to die with dignity. J Palliat Care. 1990 Summer;6(2):24-32. PMID: 2376803.

¹⁶Kantor, Hayden S. "Building beyond the bypass road: Urban migration, ritual eating, and the fate of the joint family in Patna, India." American Anthropologist 120.2 (2018): 212-223.

awareness about the premise behind palliative care practices is lacking, the patients' family can be unaware that the patient will not be able to improve in condition and is rather being made comfortable in the dying process. Consequently, family members become concerned when the patient loses appetite and develops anorexia. This results in many patients being force fed despite not wanting to eat or drink, which can cause aspiration and lung damage. This is an example of how, in certain instances, prioritizing a patient's well being over their autonomy can inadvertently lead to greater harm for the individual.

The Family Institution

India and its complex, pluralistic society presents a unique opportunity to gain insight into the effects of a number of cultural universals (i.e. religion or gender roles) in a single environment. At its core, India is a collectivistic society in which individuals interact within an interdependent network of familial and social interactions.¹⁷ The family is a key social institution, and intra-familial relationships are guided by societal norms regarding child-rearing and providing for the elderly.¹⁸ While traditionally, the Indian familial structure emphasizes intergenerational relationships, with the elderly living with their children as they age, rapid urban influences and the advent of Westernized modern households have initiated many changes in gender and class equations. The changing role of family in modern society necessitates a greater need for palliative care services and facilities, as the breakdown of the traditional family structure might contribute to psychological and mental distress for the elderly.¹⁹ As such, understanding the factors contributing to scarcity in palliative care services is crucial to developing solutions for disparities in lack of access.

During my conversation with one of the physicians at the center, he highlighted an intriguing point about the impact of the feminist movement in India. He noted that this movement has played a role in reshaping the conventional family structure. Historically, women were primarily responsible for childcare while men held financial authority within the family. However, with evolving times, women have gained autonomy in pursuing employment and advocating for their preferences. Consequently, this societal shift has rendered the once-prevalent joint-family dynamics outdated, making way for the emergence of nuclear family setups over the last fifty years.²⁰ The access to care in India is further impacted by societal gender norms, affecting the fairness and equality in healthcare provision.

¹⁷Tuli. Beliefs on parenting and childhood in India.

¹⁸Chadda and Deb. Indian family systems.

¹⁹Vatuk, Sylvia. "To be a burden on others": dependency anxiety among the elderly in India." *Divine passions: The social construction of emotion in India* (1990): 64-88.

²⁰Fernandes, Leela. "Beyond public spaces and private spheres: gender, family, and Working-class politics in India." *Feminist studies* 23.3 (1997): 525-547.

“In villages and cities, another major barrier medically is the stigma for women. 99% of the cancer cases we get here (Sparsh) for women are either cervical or breast cancer. The biggest problem is that when we attempt to do mammograms, or breast examinations, or pap smears, the girls don’t allow us because they fear their husbands’ or families’ responses, or they themselves feel it is wrong to allow someone to examine those areas of their bodies. They are so scared that they don’t let anyone see until they are already stage III or IV. That’s why so many of the patients we get, over ninety-percent I’d say, are stage IV because we have no preventative screening for women.”

The impact of societal conditioning on females significantly influences their inclination towards screening and seeking treatment.²¹ Oftentimes, a woman's decision to visit a hospital is subject to the approval of multiple male figures in her household—her father, uncle, grandfather, and other male members—who might downplay the severity of her concerns. Consequently, women constitute a larger portion of patients at Sparsh, typically arriving at advanced stages of illness, sometimes even reaching a hospice care stage due to delayed medical attention. This delay leads to cases where they present with advanced conditions like brain metastasis, resulting in considerably poor prognosis. Moreover, women typically assume the role of primary caregivers within families. When men fall ill, it is often the women who care for them. However, the critical question remains: Who provides care for these women when they themselves are unwell?

One of my observations during my fieldwork regarding the dynamics at Sparsh was that familial caregiving predominantly falls on women. At Sparsh, it is required that a family member be present at all times, as the patient’s primary caregiver. When a female patient is institutionalized, it is commonly her daughter or sister who assumes the primary caregiving role. Conversely, for male patients in institutional care, it is often their wife, and occasionally their daughter or another female relative, who steps in as the primary caregiver. This gender-based caregiving trend highlights the consistent role of women as the primary support system for their family members in healthcare settings.²²

Stigma and Guilt

In India, a prevalent misconception about cancer is that it is communicable, contributing to widespread stigma. This misunderstanding, coupled

²¹Mechanic, David. "Sex, illness, illness behavior, and the use of health services." *Social Science & Medicine*. Part B: Medical Anthropology 12 (1978): 207-214.

²²Gott, Merryn, Tessa Morgan, and Lisa Williams. "Gender and palliative care: a call to arms." *Palliative Care and Social Practice* 14 (2020): 2632352420957997.

with a general lack of awareness about the disease and frequent misdiagnosis, often leads families to bear a sense of guilt regarding the late-stage diagnosis of their loved ones.²³ At Sparsh, the team conducts screenings in rural areas, reaching 300,000 individuals in a village and usually detecting 30-40 cases of cancer at an early stage. However, despite these efforts, there's a significant challenge in attracting people for screenings due to pervasive stigma rooted in both cultural beliefs and lack of awareness. Many still hold the misconception that cancer is contagious, fearing isolation and social exclusion if diagnosed, causing a phenomenon known as "social death". In India, the inherently collectivistic society usually means that many people consider a "good death" to be not dying alone, preferring biological death to precede social death. This is a cross-cultural similarity between India and many other societies across the world.

The pervasive stigma surrounding cancer as an illness in India plays a significant role in the ability of physicians and staff to provide palliative care. One of the services available at Sparsh Hospice is home care visits. The staff at Sparsh actually aim to keep patients in home care for as long as possible, only institutionalizing the patient as a last resort. Their reasoning for this is that patients feel more comfortable while having their support system and being in familiar surroundings, so it is preferable to allow them that mental and emotional stability.²⁴ When discussing the challenges of providing home care to dozens, if not hundreds of patients, I was told that beyond the logistical issues, the greater challenge is to provide personalized care to the different needs of each unique patient.

"In some cases, patients in the Old City district of Hyderabad don't want it to be known that cancer doctors are visiting them, because they fear social isolation from their communities. To accommodate their wishes, Sparsh staff and doctors visit their homes in plain clothes and avoid openly carrying equipment, and also travel in unmarked vehicles."

Fear plays a substantial role in the stigma behind cancer diagnoses. People's limited knowledge about cancer revolves around its severity and potential fatality. This fear is so profound that individuals are often terrified of receiving a cancer diagnosis, sometimes resigning themselves to the idea of illness but avoiding confronting the possibility of cancer at all costs. Several of the patients' family members expressed sentiments along the lines of "more than the sickness, he was half-dead when he heard that it was cancer." Con-

²³Mallath, Mohandas K., et al. "The growing burden of cancer in India: epidemiology and social context." *The lancet oncology* 15.6 (2014): e205-e212.

²⁴Jocham, Hubert R., et al. "The effect of palliative care in home care and hospital on quality of life." *Journal of Hospice & Palliative Nursing* 11.2 (2009): 119-126.

sequently, families might choose not to disclose the diagnosis to their loved ones, believing it is kinder to let them live their remaining time in peace, oblivious to the severity of their condition.

Socioeconomic Factors

As mentioned previously, the fourth floor of Sparsh consists of donor rooms who help pay for the non-profit lower floors. In most cases, affluent families pay for a live-in attender and keep terminally ill family members at home. Most of the individuals who were on the fourth floor were patients whose children had moved overseas, and were unable to keep their parents at home.

Moreover, socioeconomic factors significantly contribute to the lack of education and awareness surrounding palliative care in India, often resulting in overtreatment.²⁵ Palliative care, being a relatively new concept in the country, has yet to be seamlessly integrated into the healthcare system. Consequently, doctors frequently overlook alternatives for terminally ill patients, persisting with treatments even when the patient has surpassed the point of medical intervention.²⁶ The concept of providing comfort-based care is often absent from medical practices. As a result, patients and their families, typically guided by relatives, friends, or well-wishers (sometimes even neighbors), only discover places like Sparsh when the patient is already in the advanced stages of illness. By the time they reach Sparsh for admission, they are often on the brink of death. This unfortunate reality manifests in the institution facing an average of 4-5 deaths each day. Particularly with women, the stigma surrounding the female body results in lack of preventative gynecological examinations (such as pap smears and clinical breast exams). Consequently, census data reveals that women comprise a greater proportion of the patient body than men, and many women arrive with stage IV cervical, ovarian, and breast cancers.

According to the center director, the root cause of this phenomenon is the recovery-centered approach in Indian medical practice. In the medical system in India, it is common for doctors not to explicitly communicate to patients that further treatment may not be beneficial. Instead, they persist with ongoing treatments and interventions, even when the patient's body may not withstand these measures. This pattern is particularly encouraged in corporate hospitals where financial incentives drive continued treatments. This term underscores the perception that profit-driven motives in some medical institutions prioritize continuous treatment over candid discussions about the limitations of further interventions or the transition to palliative care.²⁷

²⁵Bhattacharyya, Gouri Shankar, et al. "Overview of breast cancer and implications of overtreatment of early-stage breast cancer: an Indian perspective." *JCO global oncology* 6 (2020): 789-798.

²⁶Castelino, Lovely Joylen, et al. "Good clinical practices: an Indian perspective." *Research journal of Pharmacy and Technology* 11.7 (2018): 3209-3215.

²⁷Chakravarthi, Indira. "The emerging 'healthcare industry industry in India: a public health perspective." *Social Change* 43.2 (2013): 165-176.

“It's a challenging scenario in palliative care when patients arrive at such advanced stages of illness, nearly at the end of life, and yet haven't even contemplated the concept of death. This situation complicates the role of palliative care providers, as patients are primarily preoccupied with the intense physical pain they're experiencing. We can't begin to ask them about the psychological or the spiritual aspects, when there are other concerns to be prioritized. Consequently, many patients often endure mental suffering until the very end, despite our attempts to institute things like the 'biopsychosocial model' or counseling sessions to prevent this.”

In such cases, palliative care providers often focus on addressing the biological aspects of care directly with the patient, aiming to alleviate their physical distress. However, due to the patient's predominant focus on their pain, addressing the psychological and spiritual aspects becomes incredibly challenging. Therefore, these facets are often directed towards the patient's family, recognizing that the patient's mental and spiritual well-being might be better supported and understood through their familial connections.

The shift away from diagnosing death has led to the gradual erasure of the concept of death itself in Indian society. The rise of advanced medical technology has fostered a belief that virtually every ailment is treatable, creating the illusion of invincibility within the human body. Consequently, the discourse around death has dwindled significantly within hospitals and among doctors, which has, in turn, influenced families to avoid discussions about mortality.²⁸ Around 40-50 years ago, death was acknowledged as a natural part of life, and families were accustomed to providing comfort and care to loved ones who were in the last stages of their lives. It was an accepted reality, and the entire family would rally together to support the person in their final days. However, the modern medical approach to death has enshrouded the concept in mystery, removing it from the realm of normalcy.²⁹ This cultural shift contributes to the perpetuation of "false hope," where patients and their families choose to disregard their illness despite evident symptoms such as visible tumors or intense pain, clinging to a hope that medical advancements can cure even the most apparent conditions.

Section III: Research Discussion

The aim of this study was to delve into the contrasting perspectives on what constitutes a "dignified death" versus a "bad death" within the societal framework of Hyderabad, alongside an exploration of the implementation of

²⁸Dugdale, Lydia S., ed. *Dying in the twenty-first century: Toward a new ethical framework for the art of dying well*. MIT Press, 2015.

²⁹Dugdale, Lydia S. "The lost art of dying: reviving forgotten wisdom." (2020).

palliative care practices in this region. What stood out as particularly unique about Sparsh, distinct from other institutions I've worked in previously, was its innovative approach to addressing the challenges inherent in providing palliative care in this specific setting. Sparsh has ingeniously adapted the Western concept of palliative care to suit the Indian context by infusing cultural elements into its practices. For instance, the mornings begin with traditional Carnatic music performances, and the institution embraces the celebration of various religious festivals, ensuring inclusivity. Furthermore, Sparsh fosters diverse interest groups—such as a classical Bharatnatyam dance ensemble—to facilitate patient engagement and activity while allowing them to pursue personal hobbies. However, what truly sets Sparsh apart is the unwavering dedication of its staff to meet the needs of their patients. Going above and beyond, staff members exhibit extraordinary commitment to their profession, whether it is procuring a plush panda toy for a young cancer patient in the pediatric ward or personally funding transportation for rural patients who cannot afford ambulance services. The institution frequently extends invitations to celebrities and renowned media personalities to raise the spirits of the patients. The profound level of personalized care and the dedication of Sparsh's staff to fulfill every patient's wish struck me as remarkable. This contrasts with the approach in numerous American medical centers, where emotional engagement between physicians and patients is often discouraged to maintain professional detachment and prevent emotional burnout.³⁰

To draw from the example provided previously regarding the female patient who wanted to return to her village to perform a ritual, the staff provided transportation in order to achieve a symbolic and ambiguous form of closure for patients post-death. Another poignant instance involved a patient who wanted their last rites to be performed according to the Hindu tradition, but had no family members who knew the practices. The staff at Sparsh actually traveled to holy sites across the country to immerse the ashes of the patient, in order to provide closure to the patient. This is a fascinating example of how, even if unable to provide emotional or psychological support to a patient in life, the staff ensure that after death the patient has attained spiritual closure. Another way they accomplish this is by providing bereavement support to the patient's family. Understanding that cancer affects entire families, Sparsh extends support beyond the patient's care. To prevent distressing outcomes like family members' potential mental health struggles following a patient's passing, the institution provides free meal vouchers to ensure the family's well-being and regular counseling sessions to offer ongoing support. Sparsh acknowledges and addresses the wider impact of cancer on families, demonstrating their steadfast commitment not only to the patient's end-of-life journey but also to supporting

³⁰Rotenstein, Lisa S., et al. "Prevalence of burnout among physicians: a systematic review." *Jama* 320.11 (2018): 1131-1150.

their families through the challenging aftermath of losing a loved one.

I've had people ask me, since my research began, if patients on the so-called "VIP" floor are treated better and with better amenities compared to patients on lower floors. While I did notice that patients on the VIP floor received more time and attention from physicians in particular, I never felt like patients on the lower floors were neglected. On the contrary, these patients actually received more attention from social workers, on account of them needing simplified but in-depth explanations of medical terminology. This actually brings me to my next point, regarding personhood and lack of disclosure of a patient's diagnosis.

Of the 43 patients I spoke to, only 13 were aware that they had a terminal illness, and only 4 had actually thought about what they would want their death to be like. These 4 were all on the upper VIP floor. In the majority of the 43 cases, the patients themselves were nonverbal, and I had to turn my questions to family about their thoughts on what the patient would want, and what they themselves wanted for the patient. In such situations, as an American coming from a Western perspective of medicine, my first reaction to seeing patients who were unaware of their own diagnosis was that it was unethical. In the United States, patient autonomy reigns supreme, such that even if a patient's family seeks information about their diagnosis, multiple bureaucratic steps must be navigated for the release of this information. In the world of HIPAA and advance care directives (ACD), the idea of a patient not knowing themselves that they were dying seemed incredibly alien to me. It still is. But when I take a step back and look at it from a morally relativistic standpoint, I realize that India is a collectivistic society, in which the family is responsible for safeguarding its members. Along the vein of filial piety, the family has a societal and moral obligation to provide the best treatment, care and comfort to their aging loved ones. This "best care" might not even be biomedical, but rather spiritual or emotional. Many children who did not want to tell their parents about their diagnosis were motivated by a genuine desire to protect them from the fear and distress which would come with such knowledge. From a palliative care provider's perspective, the reasons why doctors and social workers do not disclose the extent of a patient's condition is three-fold.

The first is the late stage in which the patients arrive, which results in many people dying within days, weeks, sometimes even hours. The lack of time means that there is no easy way to build up to a disclosure. The second is lack of education. Many of the patients from lower socioeconomic classes do not understand the progression of cancer as an illness, or what "hospice" is. Many of the patients' families that I spoke to had the misconception that they were in a hospital, and the patients were getting treated. While I did see the social workers using simple, layman's terms to try and explain concepts like metastasis and morphine withdrawal (and they did an excellent job) and resis-

tance, oftentimes the patients' families would require multiple explanations and still would not completely understand. The third reason is that the concept of patient autonomy in India is highly ambiguous. One of the things mentioned in a palliative care training class that I attended (which was intended for staff), was that Indian culture does not recognize patient autonomy. And while Sparsh does an excellent job of combatting this, oftentimes because of the above factors, they are not able to actually provide support to the patients themselves. Instead they support the family. They acknowledge that they intentionally focus on the family, because in their own words, "*Cancer isn't just a sickness of the patient, it's a sickness in the whole family. So the treatment and comfort care shouldn't be applied to just the patient, but rather to the whole family*".

One of the directors of the center mentioned in our conversation that when a person dies, if you do not create a support system for the family members that are left behind, outcomes such as suicide of the family members out of survivor's guilt or sorrow are often seen. As an institution, Sparsh aims to prevent this. At times, I felt that they spent an incredible amount of time and energy supporting the patients' families, and not enough time on the patients themselves. It almost felt like the patient's family was a substitute for the patient themselves, due to the lack of an opportunity to provide real, material care for a patient. This is largely because, as previously stated, the patients arrive in such poor condition that there are few services to provide, besides administering a morphine drip and daily check-ins during rounds. In the biopsychosocial model, physicians and nurses only had the ability to address the biological aspect of care. This presents a unique challenge to the provider, to somehow find a way to provide social, psychological and spiritual support in the absence of the patient subject themselves.

The idea of intentional non-disclosure is one I am still wrestling with. On one hand, I do see why not informing the patient may aid healing, and actually provide a more peaceful and dignified passing. At the same time, this belief presumes that this choice is guided by an altruistic compassion for the patient's peace of mind. And while in many occasions this is true, and patients' families ask to not disclose in the interest of safeguarding the patient's mental and emotional state (and indeed, they are likely the ones best equipped to inform the doctors/staff about the patients' probable wishes), there are also times where it isn't. Particularly in the fragmented family system of the status quo, there are many occasions in which children do not think of their parents beyond their financial prospects. Even excluding the internal family dynamics, there is a financial aspect. In some cases, families do not tell patients about their diagnosis because it might mean more expensive treatments, and they'd rather resort to comfort care instead of trying to treat something that the family already sees as a lost cause. Here the question arises; is it ethical

for patients from underserved backgrounds to have fewer options offered to them, because the family decides that they cannot afford it? And for all of these situations, there is no real way for any healthcare professional to predict what's going on behind the scenes. So while a family might request for non-disclosure in the patient's "best interests", I found myself having reservations about the absence of a consistent protocol, and the reliance on gut instinct to assess the sincerity of a family's decisions. The protocol exists in order to prevent situations where vulnerable people might be exploited by those who do not hold their best interests at heart. One example of this is a family which one of the staff members mentioned, who had internal disputes regarding the disclosure of a terminal cancer diagnosis to the family patriarch. Some members of the family wanted to disclose because they thought it might change the individual's last will and testament, which they felt had an unfair and inequitable distribution of the individual's assets. Others in the family did not want to disclose, because they were being benefited by the will's current asset distribution, and they did not want anything to change.

Moreover, as previously mentioned, all 3 of the people who were aware of their diagnosis and had thought about their spiritual and emotional closure during their dying process were on the fourth floor. This raises ethical questions about the socioeconomic strata and background which allows these patients to actually sit and think about their own death. Why is it that patients in lower floors did not actually have a thought process of a dignified death? They were all either unaware of their diagnosis, or they were nonverbal and in such poor condition that I was unable to ask them, or in rare examples, they were aware of their diagnosis, but did not want to think about the possibility of dying. Further research is necessary to understand the complex social underpinnings which influence the internal thought processes of terminally ill patients.

Section IV: Conclusions

As an anthropology student conducting this research, my role was not to impose judgment based on preconceived ethical universals, but rather to observe the practices of physicians, nurses, and social workers providing end-of-life care to terminally ill cancer patients. Through my findings, I aim to raise pertinent questions guiding future research at Sparsh and in palliative care, seeking to enhance patient care. I plan to revisit Sparsh for further research, intending to delve deeper into staff experiences, their decision-making in end-of-life care, and the challenges they face—mentally, emotionally, and physically.

While this study primarily focused on understanding patients' experiences with palliative care and the dying process, my future research aims to explore staff experiences comprehensively. Additionally, I aim to investi-

gate the concept of physician-assisted suicide or voluntary euthanasia, which emerged during this study but was not the primary focus. Despite its exclusion in this paper, I hope to explore this topic in greater depth in subsequent research. I aim to further explore patient perspectives on death, seeking deeper insights into Indian attitudes toward aging and mortality. While my current study provided valuable insights into patient treatment within biomedical and palliative care settings, it did not yield substantial information on Indian patients' perceptions due to the nature of the interviews that I was conducting, and the fact that many patients were unaware of their diagnosis. In many Western societies, death is often considered a taboo topic, which is considered socially unacceptable to discuss openly. My own experiences in India lead me to believe that the Indian attitude towards death and aging is rather pragmatic and matter-of-fact, that death is seen as simply the end of one journey and the beginning of another. However, very little social science has actually delved deeper into how Indians view death as a phenomenon. I hope to shed some light on this topic with future research in this field.

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The Unfair Advantage: How Cash Bail Systemically Discriminates against Lower-Income Individuals and a Comparative Analysis of New Jersey’s Effective Cash Bail Elimination

Kaitlyn Ryne Wadley

The American Civil Liberties Union has documented stories of victims impacted by our broken bail system for several years. Jessica Preston is one of many whose lives have been impacted by cash bail. In March 2016, Jessica was arrested in Macomb County, Michigan, for driving with a suspended license; she was eight months pregnant at the time. It wasn’t her first run-in with the law. She was asked to make a life-changing decision: Spend 14 days in jail until her case can be heard in court or pay \$10,000. Like many low-income individuals, she couldn’t come up with the \$10,000, and she was put behind bars. Jessica’s pregnancy was already considered a high-risk pregnancy, and after being jailed for five days, her condition was exacerbated when she went into labor. Jail personnel ignored her repeated claims that she was going into labor, and they refused to call an ambulance. Jessica gave birth to her son on a mat that sat atop the “filthy” jail house floors. If Jessica weren’t low-income, her and her son’s lives would not have been put at risk. However, that’s simply not how the bail system works. Jessica’s offense was a minor one, but because she was poor, she was forced to stay in jail.¹ Her story is a reflection of hundreds of thousands of stories that have dramatically increased in occurrence since the U.S. bail system’s inception in 1789, especially with its commercialization in 1896.

Money bail is supposed to be a mechanism to ensure an individual’s reappearance in court. However, what if that mechanism, instead, discriminates against low-income individuals and repeat offenders? Furthermore, it was Andrea Coppola who asked, “How can something like personal freedom of some individuals be treated so arbitrarily by the ‘system’?”² Wealth shouldn’t determine freedom from incarceration. The justice system is meant to be fair and impartial.

This paper seeks to demonstrate that cash bail perpetuates inequality and discriminates against lower-income individuals through wealth-based detention, its impact on marginalized communities, and pressured plea bargains. As a way to mitigate these harmful effects, Oklahoma, a state that suffers from one of the highest incarceration rates in the country, should look to New Jersey as a way to effectively implement cash bail reform because

¹Stories From a Broken Bail System. ACLU of Michigan. (2019, May 21). <https://www.aclumich.org/en/stories-broken-bail-system#Jessica>

²Coppola, A. (2020). Re: The Pretrial Risk Assessment: How New Jersey's Bail Overhaul is Shaping Bail reform Across the Country. *Cardozo Journal of Equal Rights and Social Justice*, 27(1), 87-110.

their measure emphasized risk assessment rather than continued to rely on monetary bail amounts. New Jersey’s elimination of cash bail first took effect in 2017, and it has been recognized as a major step towards creating a fairer and more equitable pretrial system. While there have been proposals to implement cash bail reform in Oklahoma, namely SB 252 sponsored in the 2019 Regular Session by Senator Thompson and Representative Kanady that ultimately failed by four votes in the House of Representatives, cash bail continues to disrupt and impact the lives of many Oklahomans today. It is important to analyze the counterarguments of removing cash bail, but seeing as the consequences outweigh the benefits, it should ultimately be eliminated. The paper will be divided as follows: Part I will provide a summary of New Jersey’s cash bail elimination. Part II will answer the following questions: What is cash bail? What are the problems associated with it? Part III observes Oklahoma’s current status of cash bail, focusing on mass incarceration and the costs associated with maintaining cash bail. Part IV will provide the principal argument that cash bail should be eliminated in Oklahoma for it will lower incarceration rates and help better allocate resources in county jails. Part V will outline any counter arguments to cash bail’s elimination.

Part I- Summary of New Jersey’s Cash Bail Elimination

On January 1, 2017, New Jersey was the first state to implement a statewide measure to remove cash bail. Prior to that date, every state conditioned pretrial release on cash bail. Using a risk assessment tool, judges across the country predicted whether certain individuals were less likely to appear in court or posed a danger to their community. The result of this was that indigent individuals waited in jails because they could not afford to pay their bail. Both Andrea Coppola and David J. Reimel III studied New Jersey’s novel reform, and their analysis provides excellent foresight into how New Jersey came to and accomplished cash bail reform.

Prior to 2017, David J. Reimel III stated that, “the New Jersey Constitution guaranteed ‘all persons... before conviction, be bailable by sufficient sureties, except for capital offenses when the proof is evident or the presumption great’”.³ With the passage and enactment of the Criminal Justice Reform Act (CJRA), the “sufficient sureties” language was effectively removed, and there was a transition to a bail system that de-emphasized cash bail. Now, all individuals charged with a crime in New Jersey do not have to wait for their trial date in prison, but of course, there are provisions to account for those certain individuals that pose a risk to themselves or their community.

³Reimel, D. (2019). Algorithms & Instruments: The Effective Elimination of New Jersey's Cash Bail System and its Replacement. *Penn State Law Review*, 124(1), 193-218.

In Andrea Coppola's essay, *The Pretrial Risk Assessment- How New Jersey's Bail Overhaul is Shaping Bail Reform Across the Country*, she analyzed the development of the risk-based algorithms, the background behind New Jersey's legislation reform, and New Jersey's implementation of the Public Safety Assessment ("PSA") to be utilized by courts as a tool for deciding which pretrial monitoring technique to adopt. Coppola argued that all states should adopt some version of a risk-based algorithm that: (1) excludes certain socio-economic and personal factors, (2) enables each state to take into consideration its own unique circumstances and needs in forming these tools, and (3) eliminates the need for cash bail.⁴

There were several stages to New Jersey's elimination of cash bail. In 2008, the Laura and John Arnold Foundation (LJAF) was founded to help fund several philanthropic causes as well as criminal justice reform. Ex-New Jersey Attorney General Anne Milgran (served as Attorney General from 2007 to 2010) was made the Vice President of the LJAF, and soon after, a web-based tool was created to help courts determine who should and should not be incarcerated pending trial.⁵ This tool was instrumental to many of the state's changes in its law enforcement and judicial systems. Before the adoption of the PSA in 2017, Coppola stated,

The New Jersey Attorney General distributed a directive, and several revised versions thereafter, to prepare and assist the state in making these changes... The most recent version of the directive, released on September 27, 2017, acknowledged the fact that money bail has little to do with the dangerousness of the defendant and everything to do with whether or not a given defendant has the financial ability to post bail.⁶

The September 27th directive reorganized prosecutorial and judicial resources with the intent that low-risk defendants who would be unable to make bail will be released in New Jersey pending trial rather than having to spend days, weeks, or months in jail prior to their court date. This was accomplished by utilizing the PSA. Coppola reported that the PSA was created by reviewing 1.5 million cases from approximately 300 jurisdictions across the United States.⁷ Researchers were able to identify nine factors that can best aid courts in the prediction of whether a defendant will return to court and whether they will commit a new crime if released pending trial. These risk factors are: (1) age at current arrest; (2) current violent offense; (3) pending charge at the time of offense; (4) prior misdemeanor conviction;

⁴Coppola. Re: The Pretrial Risk Assessment. 91.

⁵Coppola. Re: The Pretrial Risk Assessment. 92.

⁶Coppola. Re: The Pretrial Risk Assessment. 92.

⁷Coppola. Re: The Pretrial Risk Assessment. 92.

(5) prior felony conviction; (6) prior violent conviction; (7) prior failure to appear in court in the past two years; (8) prior failure to appear in court is older than two years; and (9) prior sentence to incarceration.⁸

New Jersey uses a system called the eDCR for processing every aspect of the arrest procedure, from filing the complaint to electronically scanning a set of fingerprints. The eDCR automatically produces the arrestee's information: name, age address, and any prior arrests.⁹ This will generate the Preliminary Safety Assessment ("PSA"), and it can be used to help police decide whether to issue a summons or a warrant. The summons would allow for an individual to be released prior to their court date, and a warrant would detain an individual until they can see a judge for a preliminary hearing within 48 hours of their arrest. The risk factors compiled with the information from the eDCR will produce two numbers: the FTA and the NCA. The FTA represents a defendant's likelihood of returning or failing to appear in court. The NCA represents a defendant's likelihood of committing new criminal activity. These raw scores are converted into a 6-point system; 1 at the low end of the spectrum and 6 indicating the highest amount of risk.¹⁰ The PSA will also consider new violent criminal activity (NVCA) which will flag a particular defendant who raises some concern to public safety. This is the groundwork for which judges can determine what kind of pretrial restraints each defendant needs. With these scores, it eliminates the need for an arbitrary cash amount that the limited few can afford. For example, the Failure to Appear in Court category weighs, at its maximum of points attainable, 7 points. If a defendant were to have a pending charge at the time of the offense, 1 point would be added to the tally. If the defendant failed to appear pretrial prior to their arrest in the past 2 years, for 1 occurrence, 2 points would be added to the tally; or 2 or more occurrences, 4 points would be added to the tally. The New Criminal Activity category will have a maximum weight of 13 points, and the New Violent Criminal Activity category will have a maximum weight of 7 points.¹¹

Furthermore, New Jersey has provided judges across its several jurisdictions with a step-by-step guide for pretrial release. The Decision Making Framework determines the level of crimes committed and whether or not release should be recommended. There are ten steps that have to be completed before judges can make a recommendation: (1) complete the PSA to generate the scores for the FTA and NCA as well as determine if there is a NVCA flag; (2) determine if any charge brought is subject to life imprisonment, New Jersey's most severe penalty; (3) if the defendant is not

⁸Coppola. Re: The Pretrial Risk Assessment. 93.

⁹Coppola. Re: The Pretrial Risk Assessment, 94.

¹⁰Coppola. Re: The Pretrial Risk Assessment, 94.

¹¹Coppola. Re: The Pretrial Risk Assessment, 95.

eligible for life imprisonment, it needs to be determined if the PSA resulted in a score of 6, the highest score, in either the FTA or NCA categories, which would recommend pretrial detention; (4) if that does not apply to the defendant, determine whether the NVCA flag is applicable and whether the crime is violent (this would result in the recommendation of no release); (5) determine whether the crime being charge falls into a designated list of particularly harmful or violent crimes, and if so, no release will be recommended; (6) determine if the defendant has been arrested previously on two separate occasions and if those charges are still pending; (7) the FTA and NCA scores are applied to the DMF chart; (8) the DMF will be used to reach a Pretrial Monitoring Level of 1, 2, or 3, or in some cases, Release on Recognizance is recommended; (9) if any weapons charges apply, the recommendation from steps seven or eight is increased by 1-point on the DMF chart; (10) a determination is reached based on whether the highest current charge is a indictable offense or a disorderly persons offense related to domestic violence, and, if yes, steps three, four, or six are the final recommendation.¹²

What was the condition of New Jersey that necessitated a complete overhaul of cash bail? Coppola reported that,

38.5% of the total inmate population was imprisoned for the simple reason that they could not afford some form of bail. New Jersey at this time had a Cash or Bond option, as well as the 10% Deposit Option, allowing for 10% payment for release to a private surety. Statistically, this meant that about 800 inmates could have secured release by posting \$500 or less, and another 259 inmates could have secured release by posting between \$501-\$1,000, and another 489 for between \$1,001- \$2,500. In the aggregate, this meant that 1,547 or 12% of the inmate population was being held due to an inability to pay \$2,500 or less.¹³

These findings are harrowing. To incarcerate individuals because they couldn't afford to pay a steep fine is a reflection of the many flaws that are characteristic of the U.S. justice system.

New Jersey paved the way for a sustainable future without a dependency on cash bail. It provides a framework of risk assessment and recommendations that judges can easily follow. It also prevents any inherent biases from determining bail amounts. New Jersey's elimination of cash bail and its success can be accredited to the Laura and John Arnold Foundation because it was able to help fund the PSA. David J. Reimel III found that, "Two years later, in 2019, both New Jersey's pretrial jail population

¹²Coppola. Re: The Pretrial Risk Assessment, 97-98.

¹³Coppola. Re: The Pretrial Risk Assessment, 100.

and crime rate have decreased. Furthermore, judges can rely on analytics that remove the guesswork from bail decisions. Most importantly, no one in the state of New Jersey is incarcerated prior to trial for the sole reason of indigency”.¹⁴ New Jersey, like many states across the country, suffered from astronomical incarceration rates, and by eliminating cash bail, it was able to decrease the pretrial jail population and crime rate within two years of its adoption.

Part II- What is Cash Bail?

The Eighth Amendment to the United States Constitution provides that, “Excessive bail shall not be required, nor excessive fines imposed, nor cruel and unusual punishments inflicted”.¹⁵ Cash bail is a legal practice that varies from state to state. Bail allows for individuals to be released from custody prior to their hearing through a monetary payment. Cash bail was patterned after English Common Law, fully becoming an integral function of the U.S. legal system in 1789. By its precedent, cash bail was supposed to be a mechanism used to ensure pretrial court appearance. In Insha Rahman’s essay, *Undoing the Bail Myth: Pretrial Reforms to End Mass Incarceration*, it was explained that,

Modeled on the use of bail in English law, the early American bail system was based on a simple premise- people must appear for future court dates, and a financial stake in one’s case was, at the time, the best way to guarantee they appear in court. Importantly, bail was historically used as a mechanism for release. Until the 1800s, the typical kind of bail set was what amounted to an unsecured bond vouched for by a surety, either the accused themselves, or a friend or family member.¹⁶

The bail bond was seen as an oath, more realistically a promise, to appear in court on an individual’s set trial date. If they broke that promise, they would be liable for the payment of that unsecured bond.

However, by the late 1800s, cash bail was commercialized. In the early 1900s, Rahman reported, commercial bail agencies had established a stronghold on the American bail system and completely replaced the traditional sureties provided for by English common law.¹⁷ Common law dictated that as long as an individual shows up to their expected court date, the personal surety that was paid by the assisting party, through a friend or fam-

¹⁴Reimel. *Algorithms & Instruments*, 194.

¹⁵U.S. Constitution, Amend VIII.

¹⁶Rahman, I. (2019). *Undoing the Bail Myth: Pretrial Reforms to End Mass Incarceration*. *Fordham Urban Law Journal*, 46(4), 853-854.

¹⁷Rahman. *Undoing the Bail Myth*, 854.

ily member, would be returned in full amount. With the new bail system, on the other hand, commercial bail agencies require an upfront payment, typically 10% of the total bail amount, and keep the deposit regardless of whether the individual maintained their mandated court appearances or if the charges were eventually dismissed.¹⁸

Cash bail has been criticized for several reasons, as it is associated with various negative consequences and inequities in the criminal justice system. Primarily, there are criticisms due to wealth-based discrimination, its impact on marginalized communities, and the growing pressure for defendants to plead guilty. There is also a correlation with increased incarceration rates. When individuals cannot afford to pay their bail amount, they may remain in pretrial detention, leading to a direct link between cash bail and higher incarceration rates. Ultimately, the financial burdens of this system further perpetuates the economic inequality present in the criminal justice system.

In January 2022, the U.S. Commission on Civil Rights published a brief on the civil rights implications of cash bail. Beginning in February 2021, the Commission collected testimony from multiple panels examining the current state of the cash bail system, as well as what reforms have been undertaken to mitigate any harmful effects at the state and federal levels. In its Letter of Transmittal that was intended for President Joe Biden, Vice President Kamala Harris, and Speaker of the House Nancy Pelosi, Norma Cantu, the Chair of the Commission, stated that,

Overall, the report shows that there was a 433 percent increase in the number of individuals that have been detained pretrial between 1970 and 2015, with pretrial detainees representing a larger proportion of the total incarcerated population in that same amount of time. Of those held prior to trial, there were stark disparities with regards to race (i.e., Black and Latinx individuals have higher rates of pretrial detention and have financial conditions of release imposed much more often than other demographic groups) and gender (i.e., males are less likely to be granted non-financial release and consistently have higher bails set than women); additionally, disparities exists between individuals of differing socioeconomic status, and data show that more than 60 percent of inmates are detained prior to trial due to an inability to afford posting bail. Moreover, pretrial detention presents a number of negative consequences for the detainee population, including an increased likelihood of being convicted, lack of access to housing, detrimental effects on employment status, and increased recidivism.¹⁹

¹⁸Rahman. Undoing the Bail Myth, 854.

¹⁹U.S. Commission on Civil Rights (2022, January 20). The Civil Rights Implications of Cash Bail. <https://www.usccr.gov/files/2022-01/USCCR-Bail-Reform-Report-01-20-22.pdf>

Historically, bail was intended to assure an individual's appearance in court, but in practice, it has led to many individuals being detained prior to their hearing due to their inability to afford to pay the monetary amount.

One of the most significant criticisms of cash bail is that it discriminates against individuals based on their financial status. Those who can afford to pay bail can secure their release from pretrial detention, even if they pose a risk to society. In Christine Scott-Hayward and Henry Fradella's essay in *Punishing Poverty: How Bail and Pretrial Detention Fuel Inequalities in the Criminal Justice System*, the authors found that, "According to a research report issued by the Prison Policy Initiative, 60 percent of the people who cannot pay bail come from the poorest third of society".²⁰ The effects of the inability to post bail include a loss of liberty in the criminal justice system. When wealth becomes a determining factor in release, it takes away the presumption of "innocent until proven guilty." Simply put, cash bail punishes poverty. In this cash bail system, individuals may be detained for low-level offenses that might not result in incarceration for those with financial means. A glaring example of this can be found in New York City. Although courts in New York City use bail in far fewer circumstances than other jurisdictions, roughly 45,000 people are jailed each year simply because they could not afford to pay their court-assigned bail. Even if bail was set at a comparatively low amount of \$500, for instance, researchers found that only 15% of defendants are able to come up with the money to avoid jail in non felony cases.²¹

Wealth-based discrimination has a direct correlation with increased incarceration rates. When individuals are not able to pay their court-assigned bail, they may remain in pretrial detention for an extended period of time before their court date. The Commission's report found that, "Approximately 631,000 individuals are held in jails every day and almost half a million or 74 percent of these individuals are unconvicted and awaiting trial".²² There is a necessity to reduce unnecessary pretrial detention. Mass incarceration has wide-ranging and profound impacts on individuals, families, communities, and society as a whole. Individuals who are incarcerated experience a loss of personal freedom and liberty. The challenges faced by formerly incarcerated individuals, such as limited employment opportunities and social stigma, can contribute to a cycle of recidivism.

With high rates of incarceration, community stability is threatened

²⁰Scott-Hayward, C. S., & Fradella, H. F. (2019). The Origins and History of Bail in the Common Law Tradition. In *Punishing Poverty: How Bail and Pretrial Detention Fuel Inequalities in the Criminal Justice System* (1st ed., pp. 5). University of California Press. <https://doi.org/10.2307/j.ctvpb3wzb.4>

²¹Scott-Hayward et al. The Origins and History of Bail, 5.

²²U.S. Commission on Civil Rights. The Civil Rights Implications of Cash Bail.

as large swaths of the population are being targeted and removed. Michelle Alexander, author of *The New Jim Crow: Mass Incarceration in the Age of Colorblindness*, demonstrated that mass incarceration has come to resemble Jim Crow laws by stripping those with a criminal record of their constitutional rights to public housing, employment, welfare, and voting. She was even so bold as to state, “The current system of control permanently locks a huge percentage of the African American community out of the mainstream society and economy. The system operates through our criminal justice institutions, but it functions more like a caste system than a system of crime control”.²³ Radical policy changes, namely through the War on Crime and Drugs, are the sole explanation for the disproportionate incarceration of marginalized communities (primarily African American and Latino). There was a dramatic shift toward punitiveness that resulted in a massive reallocation of public resources such as food stamps and public housing, and this in turn created a cycle of recidivism when marginalized communities no longer have access to those resources. Additionally, Alexander explained how the criminal justice system, in actuality, is nothing like what is seen on television through dramatized portrayals of the courtroom, “Full-blown trials of guilt or innocence rarely occur; many people never even meet with an attorney... penalties for many crimes are so severe that innocent people plead guilty, accepting plea bargains to avoid harsh mandatory sentences”.²⁴ These factors have contributed to the chokehold that mass incarceration wields on the criminal justice system, and it certainly has been heightened by the unrealistic monetary amounts set by the cash bail system.

Cash bail has a disproportionate impact on marginalized communities, furthering existing inequalities within the criminal justice system. Individuals from marginalized communities are more likely to experience pretrial detention due to an inability to pay bail. This can lead to extended periods of incarceration before a trial, even for low-level offenses, with detrimental effects on employment, housing, and family stability. Since 1970, the United States has seen an astronomical increase in incarcerations. It does not matter whether one has committed a serious crime or not, or if one happens to be a person of color, the judicial system has adopted a policy of excessive sentences and pretrial punishments if one could not afford to pay the court-assigned bail amount. One horrific story, for example, follows a single mother, Lavette Mayes, as she was locked up for 14 months after an altercation with her mother-in-law. Because she was not able to pay her bail amount, she was subjected to pretrial punishment as she awaited her court date. How can the standard “innocent until proven guilty” still be upheld if

²³Alexander, M. (2020). *The New Jim Crow: Mass incarceration in the Age of Colorblindness* (2020 edition), 16. The New Press.

²⁴Alexander. *The New Jim Crow*, 75-76.

the cash bail system allows for pretrial punishments to be made because one cannot afford to pay the hefty price, \$250,000 in Lavette’s case to be exact? While she waited for her court date, Lavette lost custody of her children due to her inability to take care of them from her jail cell.²⁵ Additionally, cash bail contributes to the cycle of poverty within marginalized communities. Detention can lead to job loss, hindering economic stability and increasing the likelihood of repeat offenses. Cash bail harms public safety, and it has been associated with a 6% to 9% increase in recidivism. Allie Preston found that pretrial incarceration that lasts for a period extending 23 hours, often the result of an unaffordable cash bail, has been tied to a “consistent and statistically significant increase in the likelihood of rearrest”.²⁶ Marginalized, low-income communities experience the negative effects of the cash bail system the most, and it creates further, long-lasting harm for future generations to experience as well. These marginalized communities are most likely to take a plea bargain in order to escape pretrial detention.

Cash bail can contribute to the prevalence of plea bargains in the criminal justice system. Plea bargains are agreements between the prosecutor and the defendant where the defendant agrees to plead guilty to a lesser charge in exchange for a reduced sentence. Individuals that are unable to pay their bail may feel pressured to take a plea bargain, even if they believe they are innocent, to secure their release. Public Justice, a nonprofit legal advocacy organization, explained that guilty pleas are 30% more frequent when people are jailed pretrial because they are desperate to get back home or to their place of employment.²⁷ These defendants are vulnerable if they cannot secure a bail payment method, and when prosecutors provide an avenue out, albeit a more disastrous avenue, it has been found that defendants are more likely to take it. Thus, this contributes to wrongful convictions and undermines the principle of the presumption of innocence.

Part III- The Current Status of Oklahoma’s Cash Bail System

Oklahoma suffers from one of the highest incarceration rates in the entire United States. In an effort to reduce these rates, Governor Kevin Stitt campaigned on lowering Oklahoma’s incarceration rates and emphasized the need to help those who had committed nonviolent crimes set their lives back on track. In 2019, Stitt released 523 people with low-level offenses,

²⁵Lavette’s Choice. American Civil Liberties Union. (2018, February 8). <https://www.aclu.org/news/smart-justice/lavettes-choice>

²⁶Preston, A. (2023, August 9). The Case for Cash Bail Reform. Center for American Progress. <https://www.americanprogress.org/article/the-case-for-cash-bail-reform/#:~:text=Cash%20bail%20harms%20public%20safety,in%20the%20likelihood%20of%20rearrest>

²⁷Cash Bail Primer. Public Justice. (2023, May 31). [https://www.publicjustice.net/what-we-do/debtors-prison-project/cash-bail/cash-bail-primer/#:~:text=People%20\(including%20innocent%20people\)%20face,desperate%20to%20get%20back%20home.](https://www.publicjustice.net/what-we-do/debtors-prison-project/cash-bail/cash-bail-primer/#:~:text=People%20(including%20innocent%20people)%20face,desperate%20to%20get%20back%20home.)

signed 774 commutations, 290 pardons, and 101 paroles.²⁸ However, these measures were temporary. There were not any more actions taken in an effort to permanently lower incarceration rates by Governor Stitt's office. The effort in 2019 only took 523 people with low-level offenses out of the Oklahoman prisons, but it did nothing to create long-lasting change, nor did it properly assist those released in the reintegration process into society. Adam Kemp stated that, "From those original commutations, more than 200 people had been rearrested... Of those, 21 are back in prison".²⁹ The state's infrastructure to help formerly released Oklahomans is lacking in available resources and its ability to reduce recidivism. Therefore, Oklahoma needs to look to a more lasting measure to reduce its incarceration rates: a complete elimination of cash bail.

There has been an effort to remove cash bail in Oklahoma in the state legislature. During the 2019 General Session of the Oklahoma Legislature, Senator Thompson and Representatives Kannady and Blancett co-authored SB 252 which required courts to not set a bail amount higher than what could be considered necessary to ensure a person's return to court, and it shall not be set in an amount that results in a person's pretrial detention. The bill also added a section that the court should consider a person's ability to pay when setting bail, and the court shall set a cash bail only upon a finding that the person has the present ability to pay the amount required for release. While SB 252 didn't seek a complete elimination of cash bail, it addressed an aspect of Oklahoma's current criminal justice status that Stitt's measure neglected: unnecessary pretrial detention because an individual could not pay the bail amount. SB 252 ultimately failed by four votes in the House on May 22, 2019, and it has not been introduced since.

Ryan Gentzler, the former director of Open Justice Oklahoma, analyzed the impact of cash bail on Oklahomans and published a report that served as an advocacy tool for SB 252. In his report, he stated, "Oklahoma's money bail system drains millions of dollars of wealth from our most vulnerable communities and keeps thousands of our citizens incarcerated each year because they can't afford to bond out. People accused of nonviolent offenses can spend weeks in jail, costing counties millions of dollars with no benefit to public safety".³⁰ Bail amounts for Oklahomans accused of nonviolent offenses vary widely by county. In Ellis County, which is fairly rural, the median bond amount can be as low as \$800 for people accused of

²⁸Kemp, A. (2022, December 27). Oklahoma Has Tried to Lower its Incarceration Rate, but Many Obstacles Face the Newly Released. PBS. <https://www.pbs.org/newshour/nation/oklahoma-has-tried-to-lower-its-incarceration-rate-but-many-obstacles-face-the-newly-released>

²⁹Kemp. Oklahoma Has Tried to Lower its Incarceration Rate

³⁰Gentzler, R. (2019). SB 252 Bail Reform Could Save Counties & Communities Millions, 1. Oklahoma Policy Institute. <https://openjustice.okpolicy.org/wp-content/uploads/sites/4/2019/02/Bail-Fact-Sheet-2019-Full-Report-Final.pdf?x67581>

nonviolent misdemeanors. Comparatively, in Canadian County, the median bond for nonviolent misdemeanors was set at \$2,500. Tulsa County’s median bond ranged from as low as \$4,000 to as high as \$10,000 for nonviolent felonies.³¹ SB 252 sought to remedy the fact that people accused of nonviolent misdemeanor offenses spend two to six weeks in jail before their case is resolved if they cannot afford their bond. For nonviolent felonies, it was double that amount, with Rogers County holding a defendant in custody for as many as 183 days.³²

Seeing as bail bond agents charge a nonrefundable fee of 10% to secure release, annually, Oklahomans accused of crimes are losing millions of dollars. In Canadian County, bail bond agents earn \$246,247.50 in estimated fees for misdemeanors and \$1,300,958.40 in estimated fees for felonies.³³ Gentzler found that, in nearly all counties, a significant portion of people accused of nonviolent offenses fail to post bond; of defendants charged with a misdemeanor in Oklahoma County, 29% failed to post bond.³⁴

Cash bail not only imposes a financial burden on defendants, but it is also a costly practice. The amount of money it costs to incarcerate a defendant due to their inability to pay their bail means that county jails are not able to better fund mental health resources, rehabilitation, or simply ensure that jail conditions are livable, for instance. Looking at the data collected in 2018, Tulsa County spent \$1,919,538, a combination of the fees from misdemeanors and felonies, over a span of 70,000 days approximately; Oklahoma County spent \$775, 224, a combination of the fees from misdemeanors and felonies, over a span of 29,000 days approximately; and Ellis County spent \$9,234, collected from felony fees, over a span of 342 days approximately.³⁵ Pretrial detention contributes to Oklahoma’s incarceration crisis.

Ultimately, Gentzler recommended that counties could substantially reduce jail costs through deliberate pretrial reforms. In his promotion of SB 252, Gentzler asserted, “SB 252 would ensure that people who are accused of nonviolent offenses and are not a flight risk would be granted recognizance bonds. Many counties could realize savings of several hundred thousand dollars per year by releasing these defendants in a timely fashion without monetary conditions”.³⁶ A Personal Recognizance Bond (“PR”) is a type of bond that would allow a defendant to be released from jail without having to pay a financial fee, and it would be a measure to ensure their appearance in court.

SB 252 was a noble effort to reduce the negative effects of cash bail

³¹Gentzler. SB 252 Bail Reform Could Save Counties, 1.

³²Gentzler. SB 252 Bail Reform Could Save Counties, 2.

³³Gentzler. SB 252 Bail Reform Could Save Counties, 3.

³⁴Gentzler. SB 252 Bail Reform Could Save Counties, 4.

³⁵Gentzler. SB 252 Bail Reform Could Save Counties, 5.

³⁶Gentzler. SB 252 Bail Reform Could Save Counties, 5.

in Oklahoma. Rather than relying on a monetary fee to ensure an individual's appearance in court, it suggested a reliance on PR bonds instead and a guaranteed bail hearing within 48 hours of the arrest. It was a bicameral effort to mitigate the negative effects of mass incarceration on the 77 counties.

Part IV- Looking to New Jersey to Affect Cash Bail Reform in Oklahoma

There have been cries for cash bail reform not only in Oklahoma, but also throughout the United States. Cash bail reform can take on a variety of forms: reducing reliance on monetary conditions for release and promoting fairer, more equitable pretrial processes, implementing risk assessment tools, expanding pretrial services, and reevaluating factors that influence plea bargain dynamics. Oklahoma has the nation's fourth-highest incarceration rates. In fact, Oklahoma had incarcerated 22,745 people during the 2022 sentencing period, which demonstrated a 2.3% increase from the previous year.³⁷ While efforts have been taken to reduce Oklahoma's incarceration rates, they have been lacking in the permanent reform the state desperately needs. Therefore, Oklahoma should look to New Jersey and their successful elimination of cash bail in 2017.

Beginning in 2017, New Jersey has paved the way for cash bail reform. After the September 27 directive that acknowledged the fact that money bail has little to do with the dangerousness of the defendant and everything to do with whether or not a given defendant has the financial ability to post bail, the state began to prepare to implement changes through the adoption of the PSA. The directive reorganized prosecutorial and judicial resources to ensure that low-risk defendants who would be unable to make bail will be released in New Jersey pending their trial date.

The PSA utilizes nine factors in determining whether an individual poses a risk to themselves or others or the likelihood that they would commit a new crime that would invoke pretrial detention: (1) age at current arrest; (2) current violent offense; (3) pending charge at the time of offense; (4) prior misdemeanor conviction; (5) prior felony conviction; (6) prior violent conviction; (7) prior failure to appear in court in the past two years; (8) prior failure to appear in court is older than two years; and (9) prior sentence to incarceration.³⁸ The PSA will consider the scores from the FTA, NCA, and NVCA to be converted into a 6-point system which allows judges to determine what kind of pretrial restraints each defendant needs. The Decision

³⁷Ross, K. (2023, December 1). Report Shows Uptick in Oklahoma's Prison Population. Oklahoma Watch. <https://oklahomawatch.org/2023/11/30/report-shows-uptick-in-oklahomas-prison-population/#:~:text=Oklahoma%27s%20prison%20population%20is%20growing,from%202022%2C235%20in%20December%202021.>

³⁸Coppola. Re: The Pretrial Risk Assessment, 93.

crimes to “get their lives back on track.”

New Jersey achieved reform through a 2014 ballot initiative followed by a constitutional amendment and consistent lobbying to Governor Chris Christie’s office to sign the New Jersey Bail Reform Act of 2017. It was a bipartisan effort, and it has been proven to be a success. New Jersey provided the framework of risk assessment and recommendations that judges can easily follow. It also prevents any inherent biases from determining bail amounts. Bail reform is attainable in Oklahoma. The avenue to cash bail reform in Oklahoma would be a call to amend §22-1105.2 and implement the PSA and Decision-Making Framework through comprehensive legislation. This solution would lessen the burden that pretrial detention places on county jails, and it can allow for better funding for resources that are needed based on a county’s needs. Oklahomans deserve a criminal justice system where defendants are not kept in jail due to their indigency and protects the presumption of “innocent until proven guilty.”

Part V- Counterarguments for Cash Bail Reform

It is widely acknowledged that there are two sides to every story. The same applies for cash bail reform. Proponents of cash bail argue that it serves several purposes within the criminal justice system. They argue that cash bail helps ensure that individuals accused of a crime show up for their court appearances. By requiring a financial commitment, proponents believe defendants are less likely to flee and avoid facing charges. Supporters of cash bail also contend that cash bail helps protect public safety by keeping individuals who may pose a threat to society off the streets. In this sense, defendants with the means to pay bail are more likely to comply with court orders and restrictions, reducing the risk of harm to others.

A recent study in California on the public opinion of cash bail reform found that,

The sample evidenced limited awareness of bail reform, was mixed in support of change to the existing system, and believed that an algorithm would augment rather than decrease racial and socioeconomic disparities in the criminal justice system. In terms of actually implementing a risk assessment algorithm for the purpose of pretrial decision making, it is ultimately a human decision maker who must apply a decision threshold and determine whether a given risk level is sufficient to occasion a particular course of action (e.g., deny pretrial release). The sample was also queried about their pretrial decision thresholds. The average respondent’s decision threshold for “low risk” (or pretrial release) was 33%, indicating a 33% or less likelihood of failing to reappear or committing a new crime was tolerable, and 60% for “high risk” (or confinement), indicating a likelihood of 60% or greater of failing to reappear or committing a new crime

Making Framework is a step-by-step guide for pretrial release, and the ten steps, in addition to the PSA factors, provides further guidance. This system eliminates the need for an arbitrary cash amount. When New Jersey's elimination of cash bail was evaluated two years later, Reimel stated that it had lowered the state's pretrial jail population and crime rate.³⁹ The shift to risk-based assessment ensures that individuals incarcerated prior to the trial were not done so for the sole purpose of indigency.

In order to secure release if a defendant is on bail in Oklahoma and cannot afford to pay that amount, defendants would have to pay a nonrefundable fee of 10% of the total amount to a bail bond agent. Bail amounts vary by county, and it can be extremely costly to detain an individual who committed a low-level crime for days, weeks, or even months at a time. With the state suffering from high incarceration rates, it would be imperative to take on an initiative that can lower those rates by adopting the PSA framework. It was Anne Milgram who explained,

The impact of this model of decision making [judicial discretion in cash bail]- on public safety, government expenditures, and fundamental fairness- are far from ideal. All too often, high-risk defendants who pose significant danger to public safety are released quickly, while large numbers of low-risk, nonviolent defendants remain in jail for long periods. Simply put, this means we are spending enormous sums of money detaining the wrong people. And in the process, we are making ourselves less safe, not more so.⁴⁰

By providing judges with a comprehensive guide in determining whether to place an individual into pretrial detention, it would remove any possibility that an individual, who does not necessarily pose a risk to society, would be incarcerated for not being able to afford their bail amount. Milgram explained that the risk assessment principle has been shown to increase public safety by reducing recidivism. On the flip side, there are significant problems that arise when high-risk defendants are under-supervised, or when low-risk defendants are over-supervised. When the risk assessment principle is violated, public safety decreases.⁴¹ The risk assessment principle ensures that the proper defendants, namely those who pose a risk to public safety and/or have committed violent crimes, are being kept in pretrial detention. The PSA through the Decision Making Framework that New Jersey created would allow for Oklahomans who have committed

³⁹Reimel. *Algorithms & Instruments*, 194.

⁴⁰Milgram, A., Holsinger, A. M., Vannostrand, M., & Alsdorf, M. W. (2015). Pretrial Risk Assessment: Improving Public Safety and Fairness in Pretrial Decision Making, 1. *Federal Sentencing Reporter*, 27(4), 216–221. <https://doi.org/10.1525/fsr.2015.27.4.216>

⁴¹Milgram et al. *Pretrial Risk Assessment*, 1.

was acceptable to deny a defendant release.⁴²

It has been argued that risk-based assessment tools have not garnered the same legitimacy as cash bail has, and the study in California seemed to suggest that this method of cash bail reform would only be legitimate if the public views were to be incorporated in the decision-making process. There is also criticism based on several factors: (1) accuracy (algorithms cannot effectively predict the complexity of human behavior; (2) transparency in creation and design, the so-called “black box” problem (the weight given to each factor in the algorithm and how they are combined to render a decision may be proprietary or overly complicated and not subject to verifiable reexamination; (3) implementation (decision makers may be more likely to deviate from the algorithm toward detention for certain types of defendants based on race and gender.⁴³ Finally, risk-based algorithms may indirectly exacerbate racial and socioeconomic inequities because many of the common risk factors (lack of employment stability, failure to appear in court, etc.) are putative “proxies” for race and poverty.

The PSA is still a relatively new mechanism for judges to utilize in determining pretrial detention assignments, but New Jersey is a shining example of why it can work to eliminate any possibility that a defendant is placed into pretrial detention due to their indigency. It has been shown to lower incarceration and crime rates in a relatively short period, and it should be given the highest consideration as a method of reform for the state of Oklahoma.

⁴²Scurich, N., & Krauss, D. A. (2020). Public’s views of risk assessment algorithms and pretrial decision making. *Psychology, Public Policy, and Law*, 26(1), 1-9. <https://doi.org/10.1037/law0000219>

⁴³Scurich & Krauss. Public’s views of risk assessment algorithms.

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- U.S. Constitution, Amend VIII.

Is the Environment Injust? An Econometric Analysis of the Relationship Between Income and Air Quality

Beth Felkner

Abstract

The concept of environmental injustice, i.e. that lower-income and minority areas have worse overall environmental quality, is a hot topic in both environmental economics and social justice conversations right now. This paper sets out to contribute to the discussion by ascertaining an econometric relationship between personal income and air quality at the county level in the United States. I use data from the EPA and BEA and employ a fixed effects regression analysis to hold county-level effects constant across the 3 year period of my analysis. I find that worse air quality is actually correlated with higher income. However, I conclude with a discussion of limitations in my analysis, why I do not find this result entirely convincing, and directions for future research.

Section I: Introduction

The concept of “environmental injustice” is a hot topic in both environmental studies and social justice conversations right now. Proponents of this term theorize that lower-income individuals and people of color experience disproportionate levels of environmental pollution and contamination, leading to overall worse environmental quality in low-income areas. This analysis set out to test whether that claim is true on the county-level in the United States. The research question was “Is there a correlation between lower income and worse air quality in the United States at the county-level?” Due to the discrepancy of findings in previous related research (discussed in more detail below), I wanted to focus less on whether air quality is a causal determinant of income and more on whether the two variables are even correlated at all, because previous work has not yielded a consensus. There is the potential for endogeneity in this model, because people with lower incomes may be forced to live in lower-cost-of-living (LCOL) areas which may be LCOL because they have higher levels of pollution. In this case, endogeneity would cause the results to be positively biased, because cost-of-living would be positively correlated with air quality (i.e. lower air quality would be associated with LCOL) and income (i.e. lower income would be associated with LCOL.) This endogeneity potential would certainly be a concern in ascertaining causality, but is less concerning for this analysis’ goal of proving or disproving the correlation notion of environmental injustice.

Section II: Literature Review

There is some basis to the idea of environmental injustice in previ-

ous economics research. In 1995, University of Central Florida Economists Philip H. Pollock III and M. Elliott Vittas conducted an analysis based on proximity of Florida households to a toxic pollutant release site as designated by the Environmental Protection Agency's (henceforth EPA) Toxic Release Inventory (TRI).¹ Unsurprising, they found that proximity to a TRI site was positively correlated with risk of exposure to toxic pollutants.² Their more interesting finding, however, is in regards to race. Using Florida census data, they found that among low-income households, the mean distance from a TRI site was 2.75 miles for an African-American household and 3.11 miles for a Hispanic household, compared to 3.93 miles for a White household.³ This research suggests that people of color are at higher risk of exposure to pollution, which gives credence to the idea of racial environmental injustice.

James el Saad et al. performed similar analysis within the Los Angeles area, and found statistically significant evidence of unequal distribution for both race and income.⁴ They found that 60.7% of census tracts with a TRI site were predominantly minority, compared to only 48.9% of tracts in the Los Angeles area overall.⁵ They also found that the mean household income in tracts with a TRI site was \$35, 065, compared to a mean household income of \$39, 781 in the Los Angeles area overall.⁶ The t-statistics on these figures were 8.33 and -7.11 respectively, indicating very high levels of statistical significance.⁷ These findings offer evidence for the validity of the idea of environmental injustice, i.e. that low-income and racial minority status is correlated with worse environmental quality.

However, other economics research has found that race and income are not significantly correlated with levels of pollutant emissions. EPA economists Wayne B Gray et al. examine the relationship between socioeconomic demographic variables of an area and the emissions of manufacturing plants in that area in a 2010 research paper.⁸ They use census data to construct a metric of income based on the percentage of population living below the poverty line, a variable they name "poor."⁹ They find no signif-

¹Pollock, P. H., & Vittas, M. E. (1995). Who Bears the Burdens of Environmental Pollution? Race, Ethnicity, and Environmental Equity in Florida. *Social Science Quarterly*, 76(2).

²Pollock & Vittas. Who Bears the Burdens of Environmental Pollution?

³Pollock & Vittas. Who Bears the Burdens of Environmental Pollution?

⁴Sadd, J. L., Pastor, M., Boer, J. T., & Snyder, L. D. (1999). "Every breath you take...": The Demographics of Toxic Air Releases in Southern California. *Economic Development Quarterly*, 13(2), 107-123. <https://doi.org/10.1177/089124249901300201>

⁵Sadd et al. "Every breath you take... "

⁶Sadd et al. "Every breath you take... "

⁷Sadd et al. "Every breath you take... "

⁸Gray, W. B., Shadbegian, R. J., & Wolverton, A. (2010, September). *Environmental Justice: Do Poor and Minority Populations Face More Hazards?* Washington, DC; U.S. Environmental Protection Agency.

⁹Gray et al. *Environmental Justice: Do Poor and Minority Populations Face More Hazards?*

icant positive correlation between “poor” and any of the four pollutants reported in their study (nitrogen oxides, particulate matter, sulfur dioxide, and volatile organic compounds).¹⁰ For volatile organic compounds, there is actually statistically significant negative correlation, and the correlations for the other three pollutants are not statistically significant.¹¹ This research seems to suggest that there is not a correlation between lower income and higher levels of atmospheric pollutants, which disputes the environmental injustice notion.

A 2009 study by Ann Wolverton examines the relationship between the demographic factors of census tracts in Texas and the likelihood to locate a TRI plant in that tract.¹² She finds that race is not a statistically significant predictor for plant location.¹³ She uses two different variables to represent income in a given tract, average income and percent below the poverty level.¹⁴ She finds that income is negatively correlated with plant location likeliness, suggesting that plants are less likely to locate in high-income areas, which does support the environmental inequality notion that lower-income areas are more likely to experience environmental burdens like polluting manufacturing plants.¹⁵ However, her findings on the poverty variable contradict this notion: she finds that there is statistically significant negative correlation between poverty and plant location likeliness, meaning plants are less likely to locate in areas with high levels of poverty.¹⁶ The discrepancy of findings within this study is representative of the contradictory-filled state of environmental injustice economic research in general.

Section III: Data

The data for this analysis comes from two sources: Environmental Protection Agency (EPA) air quality data and Bureau of Economic Analysis (BEA) personal income data. Both data sources reported statistics at the county-level, and thus county is the unit of analysis in my research. The time period for this analysis is the years 2019-2021.

The EPA measures and reports many different metrics of air quality including concentrations of specific pollutants, but for the sake of simplicity I chose to include only one metric. I chose Median Air Quality Index (AQI) as a statistic that comprehensively captures the overall air quality in a county. AQI is a metric developed by the EPA to capture the overall

¹⁰Gray et al. Environmental Justice: Do Poor and Minority Populations Face More Hazards?

¹¹Gray et al. Environmental Justice: Do Poor and Minority Populations Face More Hazards?

¹²Wolverton, A. (2008, August). Effects of Socio-Economic and Input-Related Factors on Polluting Plants' Location Decisions. Washington, DC; U.S. Environmental Protection Agency.

¹³Wolverton. Effects of Socio-Economic and Input-Related Factors

¹⁴Wolverton. Effects of Socio-Economic and Input-Related Factors

¹⁵Wolverton. Effects of Socio-Economic and Input-Related Factors

¹⁶Wolverton. Effects of Socio-Economic and Input-Related Factors

level of pollutants and air quality in a given area. The specifics of AQI calculation are beyond the scope of this paper, but the reader should note that AQI ranges on a scale from 0-500, with values over 150 being considered “unhealthy” and values over 300 being considered hazardous. The critical aspect to understand for this paper is that a higher AQI score corresponds to worse air quality. In interpretation, this means that a positive coefficient on AQI in a regression is actually indicating correlation with worse air quality, not better. The EPA reported each year from 2019-2021 as a separate data file, and there was slight variation in the counties from year-to-year that had to be accounted for while cleaning the data.

The BEA defines personal income as “income that people get from wages and salaries, Social Security and other government benefits, dividends and interest, business ownership, and other sources.” This figure aims to capture the total amount of income from all sources an individual is receiving in a given year, in contrast to other income statistics that may be only reporting a primary income source such as salary. The county level statistic used in this represents per capita personal income. The BEA reported personal income from 2019-2021 as a single data file.

The BEA reports personal income data from all counties in the United States, with occasional N/As where data was not available for some reason. The EPA, on the other hand, only reports AQI data from a subset of counties. The counties to have monitoring sites are chosen by the states, which introduces the possibility for non-random sampling and associated bias, but the effect is likely to even out and be negligible across all 50 states. After cleaning the data to include only counties which had both AQI and BEA data reported in all 3 years, I was left with 938 counties. The mean AQI value was 35.61, with a standard deviation of 9.97. The mean income was \$54,155 with a standard deviation of \$17,677. Full summary statistics are presented in Table 1. Note that summary statistic figures reflect 2814 total observations (938 counties across 3 years).

Section IV: Justification/Background for Econometric Model

The econometric model I used was fixed effects regression on panel data. To test if fixed effects was an appropriate method, I first checked my variables for time variance, which is reflected in Table 2. Note the non-zero mean values for the variance of both AQI and Income, which indicate that both variables are time variant and thus appropriate choices to be variables of interest in a fixed effects model. Time invariant variables likely captured in the county-level fixed effects include average county rainfall, average county temperature, number of manufacturing plants in the county, etc. I organized my data in the “long” panel format, with each county having a unique ID number by which the data could be clustered. A subset of the data

is shown in Chart 1. As a point of curiosity and thoroughness, I also ran a pooled OLS (POLs) regression and a random effects (RE) regression, but these results were not meaningful which is to be expected with the highly time-varying nature of both my variables.

Section V: Econometric Model

My independent variable was AQI, and the dependent variable was income. The regression model is presented below:

$$\text{income}_{ct} = B_1 \text{aqi}_{ct} + a_c + u_{ct}$$

“c” indexes the county (by unique ID number) and “t” indexes the year
a is the intercept (including county-level fixed effects when indexed by county)

u is the stochastic error term

Standard errors were clustered by County ID

To aid in interpretation, I also ran a log-level model as presented below:

$$\log(\text{income}_{ct}) = B_1 \text{aqi}_{ct} + a_c + u_{ct}$$

Section VI: Results

The level-level and log-level model fixed effects regression tables are presented in Table 3. The level-level model returned an aqi coefficient of 120.681, with an R² of 0.968. This result is statistically significant at the 0.1% level and means that my econometric model successfully explains 96.8% of the variation in my output variable given my fixed-effects input variables. The interpretation of this result is that a 1 point increase in AQI is associated with a \$120.68 increase in personal income. The reader will recall that higher AQI scores correspond to worse air quality, so the sign of this coefficient implies that higher income is correlated with worse air quality. The log-level model returned an aqi coefficient of 0.002 with an R² of 0.947. The interpretation of this result is that a 1 point increase in AQI is associated with a 0.2% increase in personal income. The log interpretation also supports the idea of higher income being correlated with worse air quality.

For thoroughness, the list model summary showing the comparison of results from POLs, RE, and level-level FE regression is also included as Table 4. As expected, the R² is negligibly low for POLs and RE, and the result for POLs is not statistically significant.

Section VII: Discussion of Results and Limitations

The results of the fixed-effects regression seem to indicate that on

average, across the United States at the county level, income is actually negatively associated with air quality. There are many nuances to the relationship between demographic factors and environmental quality, most of which are outside the scope of this paper. However, this research does offer convincing evidence against the blanket notion of environmental injustice, that lower socioeconomic and minority areas are overall disproportionately affected by pollutants and environmental degradation. I would not go so far as to say this research disproves the notion of environmental injustice entirely, but the results are certainly enough to raise scrutiny.

This analysis would likely be strengthened by the inclusion of more control variables, particularly race, political affiliation, and poverty levels, which are included in many of the existing research papers on this topic. I did not add these controls for practicality reasons, because they were not included in any of my datasets, and synthesizing the four distinct datasets I had (EPA 2019, EPA 2020, EPA 2021, BEA 2019-2021) was already quite challenging and time consuming without introducing a fifth. I ran a fixed-effects regression in an attempt to control for at least some of the unobservables (those that are intrinsic to the county), and the high R^2 in the FE model seems to indicate a degree of success in that regard.

Section VIII: Directions for Further Research

I chose to use air quality data for this research because it was most interesting to me, but the EPA also maintains a similar report of water quality data. There is an interesting research potential for similar analysis but using water quality instead of air quality. I would be curious to see whether the relationship of higher income being correlated with lower environmental quality still holds in the case of water quality, or if it is unique to air quality.

I think there is also an important consideration in the distinction between urban and rural. It is likely that on a nationwide scale, the air quality for low income areas is being biased positively by the prevalence of low-income rural areas that have high air quality as a result of being farther from polluting activities. An analysis of income and air quality in only urban areas would be interesting, and might be more likely to produce the results that the environmental inequality notion would predict.

Tables and Figures

Table 1:

	Mean	Std. Dev.	Min.	1st Qu.	Med.	3rd Qu.	Max.
AQI	36.51	9.97	1.00	33.00	37.00	40.00	122.00
Income	\$54,155	\$17,677	\$26,630	\$44,691	\$50,686	\$58,342	\$318,297

Table 2:

	Unique (#)	Missing (%)	Mean	SD	Min	Median	Max	
mean.aqi	146	0	35.6	9.7	2.7	37.0	99.7	
var.aqi	63	0	9.3	40.7	0.0	3.0	926.3	
mean.income	936	0	54155.3	17398.0	28869.3	50637.2	295884.3	
var.income	938	0	15007248.1	20164359.3	604903.0	12025190.8	412697736.3	

Table 3:

	state	county	id	year	aqi	income
1	Alabama	Baldwin	1	2019	37	48380
2	Alabama	DeKalb	2	2019	39	33015
3	Alabama	Elmore	3	2019	39	42234
4	Alabama	Etowah	4	2019	43	37407
5	Alabama	Jefferson	5	2019	53	55052
6	Alabama	Lawrence	6	2019	24	35643
7	Alabama	Madison	7	2019	44	53160
8	Alabama	Mobile	8	2019	43	39453
9	Alabama	Montgomery	9	2019	52	43593
10	Alabama	Morgan	10	2019	41	40831
11	Alabama	Russell	11	2019	40	33141
12	Alabama	Shelby	12	2019	42	57963
13	Alabama	Sumter	13	2019	33	32079
14	Alabama	Tuscaloosa	14	2019	35	37898
15	Alaska	Aleutians East	15	2019	10	60712
16	Alaska	Anchorage	16	2019	27	67317
17	Alaska	Denali	17	2019	36	102888

Table 4:

	POLS	RE	LEVEL_FE
(Intercept)	51425.091***	50189.029***	
	(2167.160)	(1091.264)	
aqi	76.677	111.391***	120.681***
	(58.513)	(26.171)	(27.936)
Num.Obs.	2814	2814	2814
R2	0.002	0.006	0.968
R2 Adj.	0.002	0.006	0.952
AIC	63027.5	54464.0	53322.0
BIC	63045.4	54481.8	53333.9
RMSE	17657.51	3855.75	3148.76
Std.Errors	by: id		

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 5:

	LEVEL	LOG
aqi	120.681***	0.002***
	(27.936)	(0.001)
Num.Obs.	2814	2814
R2	0.968	0.947
R2 Adj.	0.952	0.920
AIC	53322.0	69616.6
BIC	53333.9	69628.5
RMSE	3148.76	56956.00

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

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Dangers of Antibiotic Resistance: MacABC and AceI Multidrug Efflux Pumps in *Acinetobacter baumannii*

Sean Roberts

Abstract

The overuse of antibiotic compounds and prescriptions in clinical settings has produced a growing threat to the world in the form of bacterial antibiotic resistance. This overabundance of antibiotics has allowed bacteria to mutate far more frequently than natural genetics allows, causing pathogens to develop broad acquired resistance to multiple antibiotics. It is believed that further information on the mechanisms of antibiotic resistance in bacteria may aid in the development of new compounds to combat bacterial growth. This experiment focuses on understanding the mechanisms and effects of efflux pumps in the cell membrane through study of MacABC and AceI pumps in the bacterial pathogen *Acinetobacter baumannii*. The effects of the overexpression and deletion of these genes in wild type strains and strains with 3 major RND pumps deleted will be analyzed through the minimum inhibitory concentrations of various antibiotics and the growth rates of strains under phenotypic stress conditions. After experimentation, it was found that efflux pump deletions have unique non-overlapping growth phenotypes in WT strains of *Acinetobacter baumannii*. Additionally, it is evident that the deletion of MacABC and AceI may cause overexpression of the AdeAB efflux pumps and that the major RND pumps are primary contributors to resistance to chlorhexidine, dequalinium, proflavine, and acriflavine rather than the MacABC and AceI efflux pumps. Further experimentation involving the production of antibodies and the sequencing of DNA will soon be conducted to solidify this data. These results may be essential to modifying the antibiotic resistance mechanisms of bacteria and increasing the effectiveness of antibiotic treatment.

Introduction

Antibiotic Structures and Functions

Antibiotics are medicinal pills, ointments, or injections that fight bacterial infections by killing the invading bacteria or suppressing the bacteria's ability to replicate.¹ These compounds are categorized by their impact on the invading bacterial infection. Bactericidal antibiotics, such as penicillin, kill the bacteria by interfering with the cell wall or contents of the cell. Bacteriostatic antibiotics stop bacteria from reproducing and multiplying. Common antibiotics include amoxicillin, azithromycin, erythromycin, cephalexin, ciprofloxacin, and many others that will be investigated in the following study.² Each

¹MedlinePlus. "Antibiotics." MedlinePlus, National Library of Medicine, 14 Jan. 2022, medlineplus.gov/antibiotics.html.

²Felman, Adam. "Antibiotics: Uses, Resistance, and Side Effects." Medical News Today, 2019, www.medicalnewstoday.com/articles/10278.

of these antibiotics differ in structure and chemical composition, causing them to inhibit different functions of the cell. For example, sulfonamides block a key enzyme in the bacterial biosynthesis of folic acid, a required component of DNA synthesis, while fluoroquinolones block steps in bacterial DNA replication.³ Oxazolidinones, on the other hand, create a blockade surrounding bacterial protein synthesis to stop the function of the bacterial cell. Each of these aspects are significant in the investigation of the developing antibiotic resistance of bacteria to avert the threat of a post-antibiotic world.

Developing Antibiotic Resistance in Bacteria

Resistance to antibiotics is caused by random mutations in a bacterium cell's genome, a process that is facilitated by the overuse of these compounds. Bacteria can double every 20 minutes in the gastrointestinal tract, and bacterial DNA polymerases make ~1 error in every 10⁶ base pairs of replicated DNA.⁴ Each incorrect base pair that allows the bacteria cell to survive antibiotic treatment is then replicated and passed down to subsequent generations of bacteria. The overabundant use and prescription of antibiotics has allowed these beneficial mutations of bacteria to occur frequently, increasing the bacterial population's resistance to antibiotics. Numerous infections, such as pneumonia, tuberculosis, gonorrhea, and salmonellosis, are becoming harder to treat with antibiotics, and resistant bacteria are increasing medical costs and mortality rates worldwide due to this proliferation.⁵ Additionally, organ transplantations, chemotherapy, and surgeries are increasingly more dangerous, with an estimated minimum of 23,000 deaths annually in the USA from antibiotic-resistant organisms according to The Centers for Disease Control and Prevention.⁶ The World Health Organization has developed a "Global Action Plan" to combat these outcomes, however, with 5 strategic objectives: improving awareness of antimicrobial resistance, strengthening surveillance of bacteria, reducing incidence of infection, optimizing the use of antibiotic medications, and investing in countering antimicrobial resistance. It is believed that further understanding of the mechanisms behind antibiotic resistance in bacteria will allow for the creation of new antibiotics capable of countering resistant strains or increasing bacteria's susceptibility to antibiotic use.

Mechanisms of Antibiotics in Bacterial Infections

Antibiotics function to kill the invading bacterial infection or limit the

³Thompson, James N.; Hellack, Jenna J.; Braver, Gerald; and Durica, David S. *Primer of Genetic Analysis*. Cambridge University Press, 1 Oct. 2007.

⁴Thompson et al. *Primer of Genetic Analysis*

⁵World Health Organization. "Antibiotic Resistance." World Health Organization, 31 July 2020, www.who.int/news-room/fact-sheets/detail/antibiotic-resistance.

⁶Munita, Jose M., and Cesar A. Arias. "Mechanisms of Antibiotic Resistance." *Virulence Mechanisms of Bacterial Pathogens*, Fifth Edition, vol. 4, no. 2, 1 Oct. 2016, pp. 481–511.

reproduction of bacterial cells through multiple different mechanisms, including interference in the cell wall, cell membrane, DNA replication, and RNA synthesis. Beta-lactams of the penicillin and cephalosporin classes and glycopeptides of the vancomycin class interfere with the extracellular cross-linking steps of cell wall integrity, weakening the mechanical strength of the cell's peptidoglycan layer.⁷ Lipopeptide antibiotics, such as daptomycin, also serve to disrupt cell membrane integrity. Lanthionine-containing peptides form transient membrane pores through complexation with a peptidoglycan intermediate in the membrane phase of peptidoglycan assembly, preventing the construction of a stable cell membrane.⁸ Other antibiotics, however, interfere with protein biosynthesis by targeting the small ribosomal subunit and large ribosomal subunit of bacteria cells in order to limit the functioning of the organism. Finally, Synthetic and natural compound antibiotics target the systems of DNA and RNA metabolism to destroy bacterial cells. Synthetic fluoroquinolones target a deconcatenation step at the end of DNA replication with the enzyme DNA gyrase while rifamycin class antibiotics bind to bacterial RNA polymerase at the edge of active sites and block the transcription of DNA into RNA.

Mechanisms and Classifications of Multidrug Efflux Pumps

Fundamentally, antibiotic resistance is a natural byproduct of bacteria evolving through interaction with their environment and creating naturally-produced antimicrobial molecules. As such, many bacterial organisms are intrinsically resistant to one or more antibiotic compounds. Although this inherent resistance is largely unproblematic, the “acquired resistance” of bacteria to previously susceptible compounds in clinical settings is a severe threat.⁹ The severity of antibiotic resistance is especially apparent in bacteria belonging to the ESKAPE group of pathogens. Bacteria under this classification, including *Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Enterobacter spp*, are highly virulent and multidrug resistant, and overexpression of their multidrug efflux transport systems has been identified as a major contributor to antibiotic resistance.¹⁰ Efflux pumps function by expelling antibiotic compounds from the intermembrane space at a high rate, preventing the cell from reaching the minimum inhibitory concentration necessary to destroy the invading bacteria. Additionally, these pumps can be classified into six families: the ATP-binding cassette (ABC), the small multidrug resistance (SMR), the major facilitator superfamily (MFS),

⁷Thompson et al. Primer of Genetic Analysis

⁸Thompson et al. Primer of Genetic Analysis

⁹Munita & Arias. “Mechanisms of Antibiotic Resistance.”

¹⁰Brooks, Lauren E.; Ul-Hasan, Sabah; Chan, Benjamin K.; and Siström, Mark J. “Quantifying the Evolutionary Conservation of Genes Encoding Multidrug Efflux Pumps in the ESKAPE Pathogens to Identify Antimicrobial Drug Targets.” *MSystems*, vol. 3, no. 3, 26 June 2018.

the resistance-nondulation-division (RND), the multidrug and toxic compound extrusion (MATE), and the proteobacterial antimicrobial compound efflux (PACE) families.¹¹ The study of these multidrug efflux pumps is important in determining the mechanisms and functions of antibiotic resistance in ESKAPE pathogens, especially *Acinetobacter baumannii*.

Structure and Function of *Acinetobacter baumannii*

Acinetobacter baumannii cells are non-fermentative, aerobic Gram-negative coccobacilli with acquired multidrug resistance through the use of β -lactamases, permeability defects, aminoglycoside/target site alteration, and multidrug efflux pumps.¹² These Gram-negative bacteria are characterized by a thin peptidoglycan cell wall surrounded by a lipopolysaccharide outer membrane, and they are determined by a red or pink Gram stain using a microbiological staining technique (“Gram-Negative Bacterium”). Additionally, *Acinetobacter baumannii* is an opportunistic pathogen for the skin, bloodstream, urinary tract, and other soft tissues.¹³ Infections from this bacterium have become increasingly more common, and virulence factors involving outer membrane porins, phospholipases, proteases, lipopolysaccharides, capsular polysaccharides, protein secretion systems, and iron-chelating systems have been identified through genomic and phenotypic analyses.¹⁴ The infections of *Acinetobacter baumannii* caused by multiple virulence factors have also developed multidrug antibiotic resistance through efflux pump transport systems, especially the AceI and MacABC membrane pumps.

MacABC and AceI Efflux Pump Genes

The MacABC gene is a transporter belonging to the ATP-binding cassette superfamily (ABC) of proteins that mediates the extrusion of macrolides, peptide toxins, virulence factors, siderophores, lipopolysaccharides, and protoporphyrins in *E. coli*, but its effects are unknown in *Acinetobacter baumannii*. It is a tripartite complex and transmembrane machine involved in both the plasma membrane and outer membrane, and it actively expels these substrates using ATPase MacB.¹⁵ MacA is a periplasmic membrane fusion protein and MacC is an outer membrane channel of the OMF family. The AceI gene, on the other hand, is a multidrug efflux pump of the pro-

¹¹Brooks et al. “Quantifying the Evolutionary Conservation of Genes”.

¹²Lee, Chang-Ro, et al. “Biology of *Acinetobacter baumannii*: Pathogenesis, Antibiotic Resistance Mechanisms, and Prospective Treatment Options.” *Frontiers in Cellular and Infection Microbiology*, vol. 7, no. 55, 13 Mar. 2017.

¹³Peleg, A. Y.; Seifert, Harald; and Paterson, David L. “*Acinetobacter baumannii*: Emergence of a Successful Pathogen.” *Clinical Microbiology Reviews*, vol. 21, no. 3, 1 July 2008, pp. 538–582.

¹⁴Munita & Arias. “Mechanisms of Antibiotic Resistance.”

¹⁵Okada, Ui, et al. “Crystal Structure of Tripartite-Type ABC Transporter MacB from *Acinetobacter baumannii*.” *Nature Communications*, vol. 8, no. 1, 6 Nov. 2017.

teobacterial antimicrobial compound efflux (PACE) family located next to the LysR-type transcriptional regulator (LTTR) family protein that functions as an activator/repressor.¹⁶ This gene encodes a membrane protein of approximately 150 amino acid residues, and it confers resistance to chlorhexidine, benzalkonium, dequalinium, proflavine, and acriflavine with distinct substrate specificity. This project aims to delete the aforementioned efflux pumps from the genome of wild type strains (WT) and *Acinetobacter baumannii* strains with 3 deleted major pumps (Del3) in order to uncover the mechanisms behind conferred multidrug efflux pump resistance.

Materials/Methods

Plasmid construction and Plate Selection

In order to create viable strains to identify the effects of MacABC and AceI deletion/overexpression, plasmids were constructed using a Plasmid Mini kit according to the manufacturer's instructions. Plasmid transformation, the introduction and uptake of foreign DNA into a cell, was conducted in all strains cultured under aerobic conditions at 37°C in Luria-Bertani (LB)/agar. For deletion, pMo130 plasmids with an antibiotic resistant marker for gentamicin (Gm) were selected, and 2 sets of primers with restriction sites ~500 base pairs from the gene were designed for cloning. For overexpression, pTJ1 plasmids with a trimethoprim (Tnp) antibiotic resistant marker were selected, and the AceI gene was inserted into the multiple cloning site of pTJ1. Additionally, helper plasmid pTNS3 was used to initiate insertion of genes into overexpression strains, pAT02 was used to complete recombination in deletion strains, and pAT03 was used to initiate and complete the removal of the cassette from deletion strains during plate selection/electroporation. Strains for use and identification in this experiment include IL185 *A. baumannii* 17978 for wT AceI, IL186 *A. baumannii* 17978 for wT MacABC, IL192 *A. baumannii* 17978 for wT DelAceI, IL193 *A. baumannii* 17978 for wT DelAceI DelMacABC, IL194 *A. baumannii* IL119 for Del3 AceI, IL195 *A. baumannii* IL119 for Del3 MacABC, and various other strains from Table S1.

Creation of Overexpression/Deletion Strains with Mating and Electroporation

Mating and electroporation processes to produce complete overexpression and deletion strains were conducted. For overexpression, Ab wild type (WT) and Ab strains with 3 major deleted pumps (Del3) were spotted on LB plates with *Acinetobacter baumannii* cells and plasmid pTJ1/pTNS3 helper plasmid to facilitate the trade of genetic material during mating. Complete colonies were then collected and transferred to selective plates with genta-

¹⁶Verma, Privita; Tiwari, Monalisa; and Tiwari, Vishvanath. "Efflux Pumps in Multidrug-Resistant *Acinetobacter Baumannii*: Current Status and Challenges in the Discovery of Efflux Pumps Inhibitors." *Microbial Pathogenesis*, vol. 152, Mar. 2021, p. 104766.

micin or trimethoprim. Colonies and strains were grown on plates in aerobic conditions at 37°C and resulting bacteria were inoculated in a liquid media before being confirmed with polymerase chain reaction (PCR). For deletions, selected strains were inoculated on LB plates with carbenicillin and Isopropyl Beta-d-1-thiogalactopyranoside (IPTG) during induction. Electroporation, the use of electrical pulses to create pores in the cell membrane available for DNA transformation, was first conducted to create deletion cells, and cells were incubated with recombinant PCR product at 37°C in aerobic conditions. Frozen competent cells were thawed on ice, and 50 µm of competent cells were combined with 1 µL plasmid or 5 µL ligation product before incubation on ice for 30 min. Cells were then heat shocked at 42°C for 90 sec and chilled on ice for 1-2 min to repair cell membranes. Cell solution was incubated with 1 mL fresh LB for 1 hr and collected by centrifugation at 15000 in room temperature (RT). Supernatant of centrifuged cells was decanted and pellet was resuspended in 100 µL LB before being plated on LB with appropriate antibiotic selection markers. Colonies were collected after growing and plated on selective plates containing Gentamicin or Trimethoprim before being checked with PCR. Identified colonies were then transferred according to the selection process to remove the cassette from bacteria, and the process was repeated until PCR confirmation of the deletion was recorded. To transfer cells from media to selective plates, cells were collected with a pipette and transferred to the plate surface. A hooked metal rod sanitized with ethanol and high heat was then used to spread the liquid cell cultures across the plate until the presence of liquid was no longer apparent. The plate was closed, labeled, and placed in an incubatory oven for a prolonged period of time. All interactions with cells and LB media must be conducted over an open flame to prevent contamination.

Figure 1. Diagram of electroporation used to produce deletion strains with Gentamicin. Displays allelic exchange with PCR product and pAT02 helper plasmid recombinase.

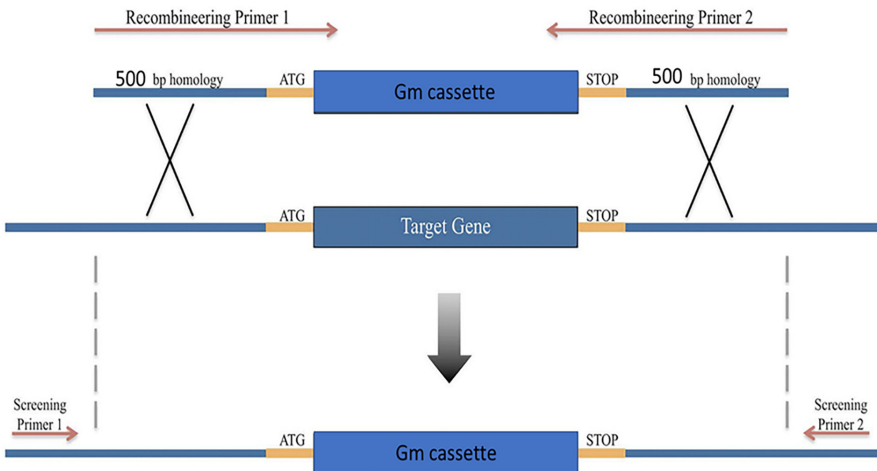
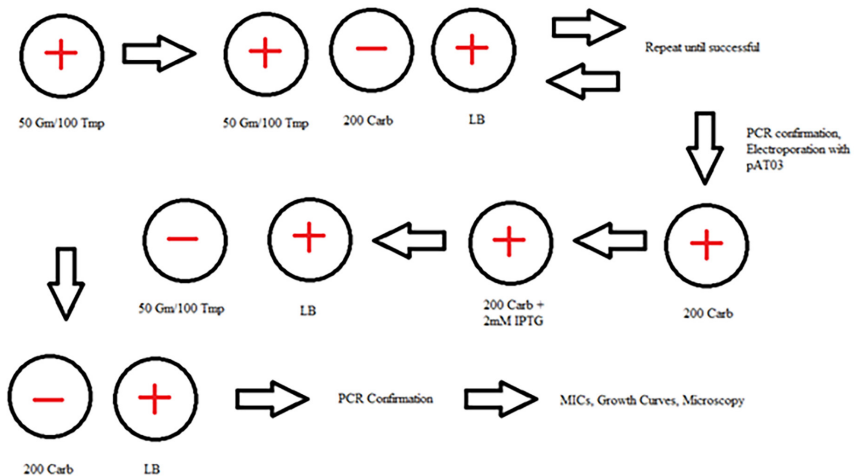


Figure 2. Deletion colonies transferred according to selection process to remove cassette from bacteria. Each process repeated until PCR verification confirms product. IPTG displays Isopropyl Beta-d-1-thiogalactopyranoside plates for induction.



PCR Verification and DNA Purification

Multiple polymerase chain reactions (PCRs) were conducted to verify products throughout the insertion/deletion process. PCR is a technique in which many copies of a DNA region are amplified and reproduced in vitro using a thermostable Taq polymerase and specifically tailored DNA primers. DNA regions are repeatedly cycled through a series of temperature shifts according to an automated system used in DNA cloning, medical diagnostics, and DNA forensic analysis. PCRs in this experiment were conducted using a PCR Mini Kit to verify purified DNA and purified plasmid DNA. DNA purification protocol was demonstrated according to the illustra GFX PCR DNA and Gel Band Purification Kit. 500 uL Capture buffer type 3 was added to <100 uL sample and mixed to produce a yellow mixture. The sample mix was transferred to an assembled GFX MicroSpin column and Collection tube and spun at 16000 g for 30 sec. Flow through was discarded and Microspin column was repositioned to used Collection Tube. 500 uL Wash buffer type 1 was added to sample mix and previous spin steps were repeated. The GFX MicroSpin column was then transferred to a 1.5 mL DNase-free microcentrifuge tube and 50 uL Elution buffer type 4 was added to the mixture. The sample mixture was then eluted at RT for 60 sec and spun at 16000 g for 60 sec. Finally, the flow through of the sample mix was retained and stored at -200C to complete purification. For plasmid DNA purification., cells from cultures were collected and spun at RT for 12 min. Pelleted cells were resuspended with 250 uL Resuspension Solution and transferred to a microcentrifuge tube.

250 uL Lysis Solution was added to the microcentrifuge tube, and the solution was mixed thoroughly by inverting the tube 4-6 times. This process was repeated with 350 uL Neutralization Solution before being spun in a centrifuge at 15000 g for 5 min to pellet cell debris and chromosomal DNA. The supernatant was then extracted through pipette and transferred to a supplied GeneJET spin column without disturbing the produced precipitate. The solution column was then additionally centrifuged at 15000 g for 60 sec to ensure purity, and flow through was discarded. 500 uL of Wash Solution was added and the column was centrifuged at 15000 g for 60 sec. The solution column was then centrifuged at 15000 g for 60 sec to ensure purity, and flow through was discarded. Finally, the GeneJET spin column was transferred to a 1.5 mL microcentrifuge tube and 50 uL Elution buffer was added to the center of the column. The solution was then incubated at RT for 2 min and centrifuged at 15000 g for 2 min before the purified plasmid DNA was stored at -200C for further use.

DNA Gel Electrophoresis

The apparatus for gel electrophoresis contained an electrophoretic chamber with a cathode/anode, an agar gel with wells near the cathode end, and buffer solution. Specifically, the DNA agar gel was created by dissolving 2.5 g optimized grade agarose in 245 mL MQ water in a 500 mL flask. The flask was covered in saran wrap punctured with small holes in order to allow gas to escape during the heating process. The agarose solution was boiled in a laboratory microwave for 3 min and cooled back to room temperature. During this process, 5 mL 50x TAE and 25 uL 10 mg/mL ethidium bromide were added to the agarose flask, and the solution was stirred consistently. Finally, the gel solution was poured into a gel mold with imbedded wells and cooled for 1 hr to solidify before storage in a cold room. Sample solutions of the genome tested are combined with 1X or 4X ethidium bromide dye and loaded into gel wells alongside a control DNA ladder with marked molecular weights via pipetting. The cathode and anode cords are connected to a power supply, creating an electric field that causes negatively charged molecules to migrate towards the anode. Larger molecules, however, move far more slowly through the cell than smaller DNA molecules. After completion, the gel is removed for visualization in a blacklight room and recorded.

Measurement of Minimum Inhibitory Concentrations (MICs)

The minimum inhibitory concentration (MIC) is the lowest concentration of a chemical or antibiotic necessary to prevent the visible growth of bacteria during culturing in liquid media.¹⁷ Increasingly lower concentrations of the

¹⁷“13.5A: Minimal Inhibitory Concentration (MIC).” Biology LibreTexts, 25 June 2018, bio.libretexts.org/Bookshelves/Microbiology/Microbiology_(Boundless)/13%3A_Antimicrobial_Drugs/13.05%3A_Measuring_Drug_Susceptibility/13.5A%3A_Minimal_Inhibitory_Concentration_(MIC).

applied antibiotic are created across a series of wells to identify the limit of bacterial cell growth. The values are necessary to confirm antibiotic resistance in bacterial cells and monitor the effects of genome changes on drug-specific resistance in bacteria. MICs of *Acinetobacter baumannii* were measured in 96-well plates of liquid media with chlorhexidine, dequalinium, proflavine, and acriflavine and 96-well plates of liquid media with azithromycin, erythromycin, gentamicin, and carbenicillin antibiotics. Selected strains of *Acinetobacter baumannii* were grown overnight in liquid LB media at 37°C under shaking at ~200 rpm. Well plates were labeled according to strain and series of antibiotics tested, and 100 µL LB were added to each well. 200 µL of each antibiotic agent (100 µL eventually removed and discarded) were then added to well column 1 and diluted by 100 µL according to the manual microdilution method by the European Committee for Antimicrobial Susceptibility Testing (EUCAST) of the European Society of Clinical Microbiology and Infectious Diseases (ESCMID) from well columns 1-11. Finally, 10 µL bacterial strains were added to well columns 1-10 via manual pipetting before well plates were moved to the incubatory oven overnight. Well plates were then observed for bacterial growth, and MICs were recorded according to the dilution value between the final well with bacterial growth and the following clear well.

Studies of Bacterial Growth Under Stress Conditions

Bacterial pathogens have adapted to 11 various stress conditions within human host environments, such as heat-shock responses to changing temperatures, varying pH levels in the gastrointestinal tract, the presence of bile salts, lacking nutrients, and other environmental factors.¹⁸ Stress conditions impacting *Acinetobacter baumannii* were selected from the PATHOgenex RNA atlas developed from experimentation with Gram-negative and Gram-positive pathogens in infection-relevant stress conditions. The stress conditions found to be most impactful on the growth of *Acinetobacter baumannii* were acidic pH 4.6, osmotic stress, presence of bile salts, temperature 41°C, and low iron, with cells grown in LB media measured as a control variable. Growth curve raw data for each stress condition previously listed was collected using a robotic assay machine. Bacterial strains of interest were plated on a LB agarose plate and incubated at 37°C overnight. Single colonies were collected and inoculated in 5 mL LB medium, then grown at 37°C and 140 rpm overnight. The optical density (OD) of each strain was measured through a spectroscopy machine, and cultures were diluted to a common OD of 0.1. Next, 96-well plates were labeled according to designated bacterial strain, and 200 µL of the cultures were added to well columns 1-11. The plate was then placed into the automatic plate reader in order to monitor ODs

¹⁸Avican, Kemal, et al. "RNA Atlas of Human Bacterial Pathogens Uncovers Stress Dynamics Linked to Infection." *Nature Communications*, vol. 12, no. 1, 2 June 2021.

during incubation at 37°C. Cell cultures were exposed to the various stress conditions and incubated at 37°C and 140 rpm. 200 µL of treated cell cultures were added to the designated 96-well plate, and the plates were placed into an automatic plate reader to collect growth curve data of the concentration of bacterial growth over time in seconds. The resulting data was normalized to 0.00 at time $t = 0$ sec, and the average and average standard deviation of each strain and stress condition combination were found. Finally, growth curves were created in excel according to the measured data, and the area under the curve of each strain's growth was calculated in order to compare growth rates more efficiently.

Results

After verification of the creation of overexpression/deletion strains of *Acinetobacter baumannii*, the minimum inhibitory conditions of antibiotics affected by the MacABC and AceI genes were tested. Unlike previously published data, however, we found changes in MICs only for ciprofloxacin, azithromycin, gentamicin, and zeocin. Additionally, growth rates of WT and Del3 strains were analyzed in various growth conditions. Knockouts of efflux pumps in the Resistance Nodulation Division (RND) superfamily of *Accinetobacter baumannii*, a major group responsible for intrinsic and acquired multi-drug resistance in *Accinetobacter baumannii*, showed varying results of growth rates in phenotypic conditions compared to WT strains. Similar to the RND pumps, the overexpression of AceI was toxic for WT and Del3 strains and decreased growth rates. The overexpression of MacABC followed a similar pattern, but deletion of MacABC improved growth rates of the bacteria.

Verification of Insertion/Deletion with WT and MacABC

Electrophoresis gels used to verify the deletion/insertion of plasmid DNA in strains of *Acinetobacter baumannii* are displayed in the figures below. Figures are labeled according to the strain being tested: blue = AceI Up, green = Del AceI, and red = Del MacABC. The gels in Figure 3 containing AceI Up demonstrate the shift of WT and overexpressors from ~1200 bp to ~400 bp. The gel in Figure 4 containing Del AceI demonstrates base pair differences between control strain, strain without deleted AceI genes, and strain with deletion. Without the deletion of the AceI genes, the strain of *Acinetobacter baumannii* contains a larger amount of DNA base pairs. With the deletion of the AceI genes, however, the band demonstrates a shift to a smaller amount of DNA base pairs. The gels in figure 5 containing Del MacABC demonstrate shift differences between strains with GmR and MacABC pump genes, and all bands in Figure 8 show successful deletion of MacABC gene as bands are shifted down with a smaller number of base pairs.

Figure 3. Confirmation of AceI overexpressors in WT *Acinetobacter baumannii* strains at 500 bp compared to position of WT and ladder.

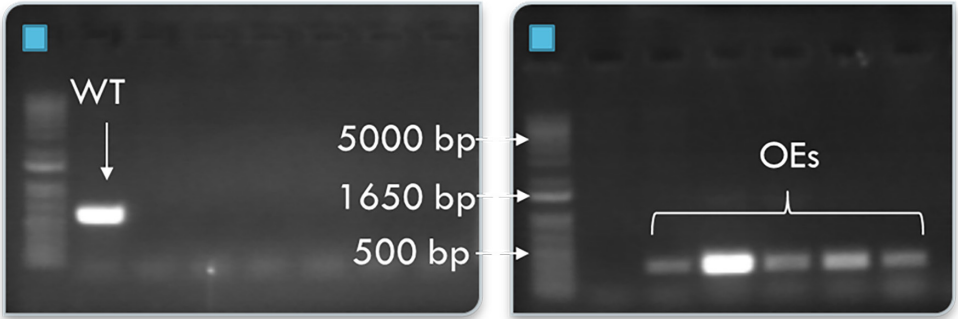
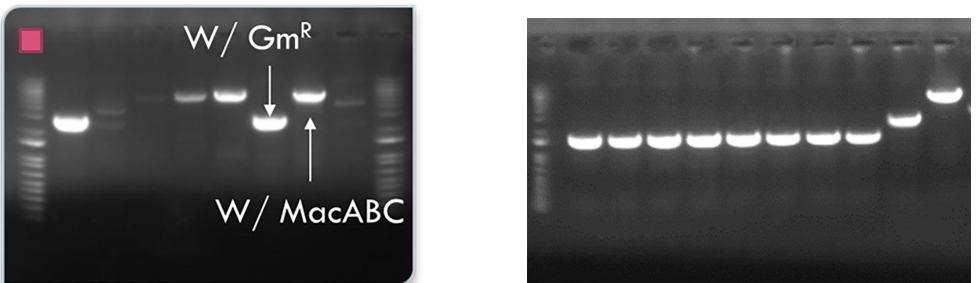


Figure 4. Confirmation of AceI deletion shown by shift of DNA band to position with less base pairs.



Figure 5. Confirmation of MacABC insertion of pMo130 Gm marker plasmid and deletion of MacABC due to band shift.



Minimum Inhibitory Concentration (MIC) Analysis

Deletion strains of *Acinetobacter baumannii* were analyzed for the minimum inhibitory concentrations (MICs) of antibiotics necessary to prevent cell growth in WT and Del3 conditions. The antibiotics tested include erythromycin (Ery), novobiocin (Novo), ciprofloxacin (Cipro), tetracycline (Tet), azithromycin (Azi), chlorhexidine (Chlor/CLX), SDS, gentamicin (Gm), zeocin (Zeo), HT, ethidium bromide (EtBr), trimethoprim (Tmp), dequalinium (DQ), proflavine (PF), and acriflavine (AF). In the WT deletion strains, treatment with ciprofloxacin, azithromycin, gentamicin, and zeocin caused differences between the bacteria strains on a level greater than a two-fold difference. Specifically, the deletion of the DelAceI and DelAceI DelMacABC genes increased MICs for the strains by a large margin in the presence of azithromycin, gentamicin, and zeocin. According to “*Acinetobacter baumannii* Efflux Pumps and Antibiotic Resistance” by Seyyed Naser Abdi, these antibiotics align with the compounds affected by the AdeAB pumps for WT deletions, so it is possible that the deletion of these genes may have caused the overexpression of the AdeAB efflux pumps.¹⁹ In the Del3 deletion strains, however, the MICs of antibiotic treatments were not affected.

Table 1. Minimum inhibitory concentrations (MICs) of various antibiotics on deletion strains of MacABC and AceI in WT conditions and with 3 major RND pumps deleted. MICs measured by noting barrier of cell growth between wells. MIC differences found in Cipro, Azi, Gm, and Zeo.

Strain	Ery	Novo	Cipro	Tet	Azi	Chlor	SDS	Gm	Zeo	HT	EtBr	Tmp	CLX	DQ	PF	AF
Ab WT	10	10.0-20	0.125-0.25	0.25-0.5	0.63-1.25	64	>1024	4.0-8	8	25	128	32	5.25-12.5	>100	25	12.5
ΔAceI	10	10	0.5	0.5	5.0-10	64	>1024	16	128-256	25	128		12.5	>100	50	25
ΔAceI ΔMacABC	10	10	0.5	0.5	10	64	>1024	16	128	25	128					
WT AceI	5.0-10	5	0.125	0.25	0.63	32	>1024	4.0-8	8				12.5	>100	25	12.5
WT MacABC	5	5	0.063	0.16	0.63	16-32	1024	4.0-8	8							
Ab Δ3	1.25	0.08	0.016-0.031	0.031-0.063	0.31-0.63	16-32	16	8	1			16	0.8	6.25	3.1-6.2	1.56
Δ3 ΔAceI	1.25	0.04	0.016	0.016	0.31	8	16	8	0.5-1				0.4	6.25	3.1	1.56
Δ3 ΔMacABC	1.25	0.08	0.016	0.016-0.031	0.31-0.63	16	16	8	1				0.8	6.25	3.1	0.8-1.56
Δ3 AceI	1.25-2.5	0.04	0.016	0.016-0.031	0.31-0.63	8	16-32	8	2				0.8	6.25	3.1	0.8-1.56
Δ3 MacABC	1.25	0.04	0.016	0.016	0.63	8	8.0-16	8.0-16	2							

Table 2. Minimum inhibitory concentrations of Azi, Gm, and Zeo for deletion strains of AceI and MacABC. Shows effects of deletion of MacABC and MacABC AceI in presence of deletion these three antibiotics.

Strain	Azi	Gm	Zeo	Strain	Ab WT	ΔAceI	ΔAceI ΔMacABC	Ab Δ3	Δ3 ΔAceI	Δ3 ΔMacABC
Ab WT	0.63-1.25	4.0-8	8	Azi	0.63-1.25	5.0-10	10	0.31-0.63	0.31	0.31-0.63
ΔAceI	5.0-10	16	128-256	Gm	4.0-8	16	16	8	8	8
ΔAceI ΔMacABC	10	16	128	Zeo	8	128-256	128	1	0.5-1	1
Ab Δ3	0.31-0.63	8	1							
Δ3 ΔAceI	0.31	8	0.5-1							
Δ3 ΔMacABC	0.31-0.63	8	1							

Growth Curves with Stationary Phase and Osmotic Shock

The growth curves of the overexpressed and deleted strains of *Acinetobacter baumannii* were recorded by an automatic plate reader and normalized in excel. In the overproduction of WT AceI, growth rates decreased un-

¹⁹Abdi, Seyyed Naser, et al. “*Acinetobacter Baumannii* Efflux Pumps and Antibiotic Resistance.” Infection and Drug Resistance, vol. 13, 12 Feb. 2020, pp. 423–434.

der acidic conditions, osmotic stress, in the presence of bile salts, and in low iron but were unaffected by temperature changes. The deletion of three major pumps in this gene produced a similar relationship with an overall smaller rate of growth, and it was further affected by bile salts and low iron. The overproduction of WT MacABC, on the other hand, displayed an increasingly lower growth across acidic conditions, osmotic stress, conditions, the presence of bile salts, and low iron. The deletion of three major pumps in this gene decreased growth rates under all stress conditions, but growth rates under acidic pH 4.6 decreased by a drastic margin. Additionally, the WT and Del3 control strains had differing growth rates in acidic conditions, the presence of bile salts, and low iron. Specifically, the overexpression of MacABC and AceI decreased growth rates of bacteria primarily in acidic and bile salt conditions, with AceI having a larger effect. The overexpression of MacABC with 3 major pumps deleted decreased the growth rate to ~0 while overexpression of AceI increased growth rates with deleted pumps. Finally, the overexpression of AceI and MacABC in the presence of bile salts decreased growth rates, and both overexpression of genes and deletion of RND pumps decreased growth rates in low iron.

Area Under Curve for Overexpressors

Table 3. Area under the curve values of growth rate curves in phenotypic

	LB+ARA	Acidic	Osmotic	Bile	Low Iron	Temp
Ab WT	11.89	9.39	3.87	4.78	1.05	9.78
WT MacABC	11.45	7.93	3.61	2.6	0	10.33
WT AceI	12.95	4.96	3.33	2.15	0.05	11.02
Del3	10.62	1.13	3.19	-0.04	0.55	9.1
Del3 MacABC	8.8	0.04	3.1	0.05	0.03	8.95
Del3 AceI	9.32	2.55	2.71	-0.01	0.09	7.58

conditions for overexpressor strains.

Figure 6. Growth rate curve of overexpressor strains in WT and with 3 major pumps deleted in controlled LB conditions. Time in minutes on x-axis and concentration on y-axis.

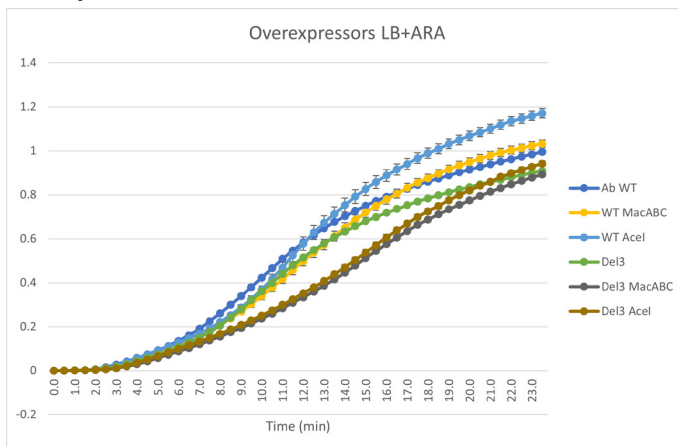
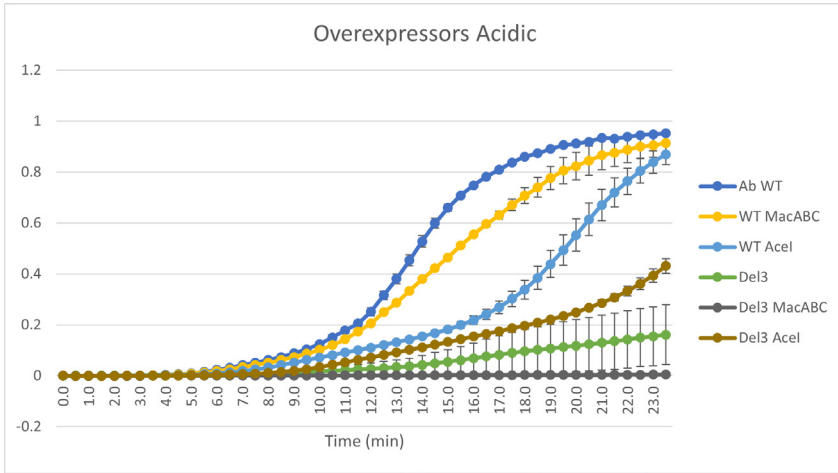


Figure 7. Growth rate curve of overexpressor strains in WT and with 3 major pumps deleted in controlled LB conditions. Time in minutes on x-axis and concentration on y-axis.



In the process of creating deletion strains, it was discovered that MacABC could not be deleted from WT strains of *Acinetobacter baumannii*. It is believed that the presence of this pump may be essential for the growth of the particular strain used in this experiment, but similar research in “MacAB-TolC Contributes to the Development of *Acinetobacter baumannii* Biofilm at the Solid–Liquid Interface” by Brandon Robin was able to delete WT MacABC using a different strain of bacteria.²⁰ In the Deletion strain of WT AceI, stress conditions had little to no effect on the growth rates of bacteria. The deletion of 3 major pumps in the AceI gene, however, decreased the growth rate in high temperatures and low iron and increased growth rates in acidic pH 4.6 conditions. The MacABC gene was only able to be deleted alongside the deletion of AceI, and the WT of this strain had decreased growth rates in acidic conditions, osmotic stress conditions, the presence of bile salts, and low iron. Finally, the deletion of 3 major pumps in Del3 MacABC increased growth rates in acidic conditions greatly but decreased growth rates in the presence of bile salts, low iron, and high temperatures. Additionally, the WT and Del3 strains had differing growth rates in acidic conditions, the presence of bile salts, and low iron similar to the overexpressed strains. The deletion of AceI and MacABC decreased growth rates while the deletion of these genes alongside deletion of the 3 major RND pumps increased growth rates. The presence of bile salts increased growth rates in the deletion of AceI with the major RND pumps deleted and decreased growth rates in the deletion of MacABC. The deletion of these genes in both WT and Del3 conditions also decreased growth rates in low iron. These results seem to suggest that the deletion of ef-

²⁰Robin, Brandon, et al. “MacAB-TolC Contributes to the Development of *Acinetobacter Baumannii* Biofilm at the Solid–Liquid Interface.” *Frontiers in Microbiology*, vol. 12, 13 Jan. 2022.

flux pumps in wT strains creates unique, non-overlapping growth phenotypes.

Area Under Curve for Deletions

Table 4. Area under the curve values of growth rate curves in phenotypic conditions for deletion strains.

	LB	Acidic	Osmotic	Bile	Low Iron	Temp
Ab WT	12.13	11.71	3.48	4.16	3.66	12.1
WT Δ Acel	11.98	10.09	2.93	3.78	1.17	10.13
WT Δ Acel Δ MacABC	11.34	7.63	2.45	2.37	0.15	11.34
Ab Δ 3	10.81	1.67	2.59	0.46	1.69	10.04
Δ 3 Δ MacABC	9.07	3.97	2.77	0	0.03	7.79
Δ 3 Δ Acel	9.18	2.96	2.41	0.61	0.57	6.68

Figure 11. Growth rate curve of deletion strains in WT and with 3 major pumps deleted in controlled LB conditions. Time in minutes on x-axis and concentration on y-axis.

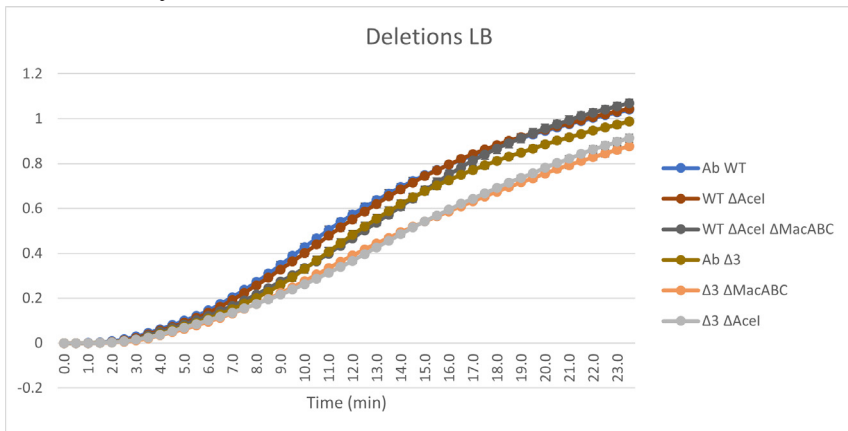
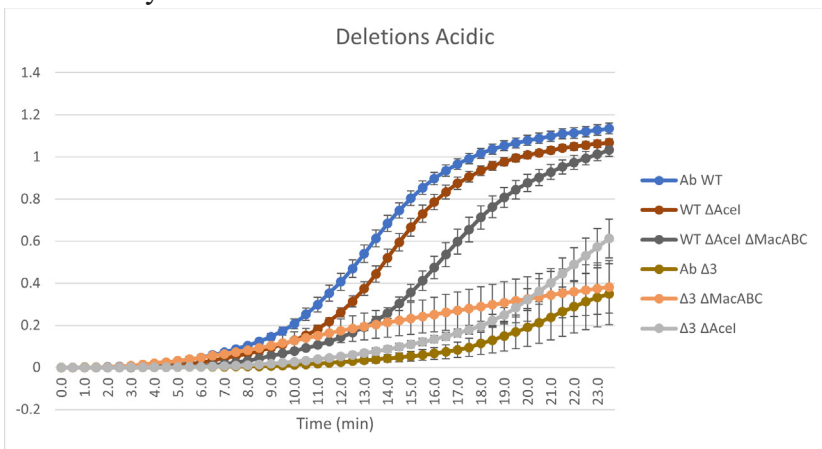


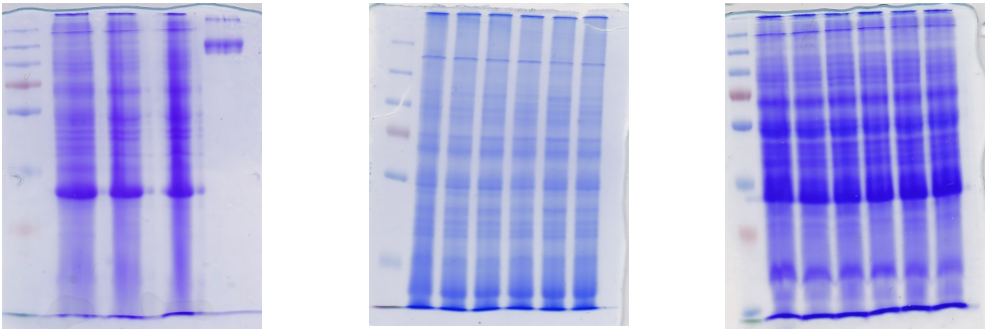
Figure 12. Growth rate curve of deletion strains in WT and with 3 major pumps deleted in acidic pH 4.6 conditions. Time in minutes on x-axis and concentration on y-axis.



Coomassie Protein Gel Staining

Coomassie staining is utilized to make proteins visible through the use of a protein-specific, dye-binding (Coomassie G-250) chemical reaction. In acidic conditions, this dye binds to the basic and hydrophobic aspects of proteins, creating an apparent blue color.²¹ This process is conducted in a tray of liquid reagent over the course of multiple hours. The gel matrix is washed with wash buffer solution between steps. The gel is fixed with a methanol solvent, stained with Coomassie chemical dye, and destained from excess dye. As demonstrated in the figures below containing MacAHisBC and MacABHisC, all strains produced similar protein assays. Therefore, the protein profiles of each of the MacABC and AceI strains are the same.

Figure 13. Proof of protein expression in overexpression and deletion strains of *Acinetobacter baumannii* MacABC and AceI with Coomassie.



Discussion

Previous research has been conducted on *Acinetobacter baumannii* AceI and MacABC genes, and this information is useful in analyzing the results from minimum inhibitory concentrations (MIC) and growth curve experiments. According to “Assembly and regulation of the chlorhexidine-specific efflux pump AceI” by Jani Reddy Bolla and other researchers, transporter proteins of the PACE family, such as AceI, use active efflux mechanisms to resist the antibiotics benzalkonium, acriflavine, proflavine, dequalinium, and chlorhexidine.²² Experiments conducted in whole cells and proteoliposomes of AceI demonstrate that the gene uses an electrochemical proton gradient to translocate antibiotic substrates. It was also found that a mutation in the glutamic acid residue of the first transmembrane helix of the gene prevents the protein from emitting antibiotics and providing resistance. In the MIC experiment with deletion of the MacABC and AceI genes, however, deletion

²¹“Protein Gel Staining Methods - US.” www.thermofisher.com, www.thermofisher.com/us/en/home/life-science/protein-biology/protein-biology-learning-center/protein-biology-resource-library/pierce-protein-methods/protein-gel-stains.html.

²²Bolla, Jani Reddy; Howes, Anna C.; Fiorentino, Francesco; and Robinson, Carol V. “Assembly and Regulation of the Chlorhexidine-Specific Efflux Pump AceI.” *Proceedings of the National Academy of Sciences*, vol. 117, no. 29, 21 July 2020, pp. 17011–17018.

of these genes did not affect the previously mentioned antibiotics unless the 3 major RND pumps of the bacteria were also deleted. Additionally, benzalkonium could not be tested due to major differences in concentration. These differences in MICs may be due to the fact that the efflux of these antibiotics is controlled by the RND pumps.

Conclusion

Multiple conclusions can be drawn from the data observed in analysis of the antibiotics affected by the MacABC and AceI genes and the growth rates of *Acinetobacter baumannii* strains in various phenotypic conditions. In testing for MICs, it is evident that the MacABC and AceI genes are responsible for azithromycin, gentamicin, and zeocin, and deletion of the 3 major RND pumps does not affect the concentrations of these antibiotics. It is also possible that the deletion of these genes may cause the overexpression of the AdeAB efflux pump as ciprofloxacin, erythromycin, azithromycin, gentamicin, and zeocin are associated antibiotics and show, with the exception of erythromycin, changes in the tested deletion strains. The antibiotics chlorhexidine, dequalinium, proflavine, and acriflavine were shown to be affected by the 3 major RND pumps rather than the AceI and MacABC genes as MIC differences only appeared in the Del3 strains. It is also apparent in the growth curve graphs that efflux pump deletions have unique non-overlapping growth phenotypes in WT strains of *Acinetobacter baumannii* cells. In future experiments, it will be important to verify these results and continue experiments for the deletion of MacABC in WT deletion strains that may require the presence of a plasmid.

The process of identifying the functions and mechanisms of efflux pumps will be continued through various other experiments in the future. We will be partnering with ThermoFisher to produce antibodies in rabbits using the strains of *Acinetobacter baumannii* with variable MacABC and AceI genes. The strains will then be tested for expression and chromosomal insertion. Clustering will also be performed on each of the specific WT and Del3 strains of bacteria with MacABC and AceI variations to compare the strains. Finally, DNA sequencing of MacABC was found to be incorrect, so additional experiments to correct the sequence and delete MacABC from the WT overexpressor strains will be conducted.

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Abdi, Seyyed Naser, et al. "*Acinetobacter Baumannii* Efflux Pumps and Antibiotic Resistance." *Infection and Drug Resistance*, vol. 13, 12 Feb. 2020, pp. 423–434.

Bolla, Jani Reddy; Howes, Anna C.; Fiorentino, Francesco; and Robinson, Carol V. "Assembly and Regulation of the Chlorhexidine-Specific Efflux Pump AceI." *Proceedings of the National Academy of Sciences*, vol. 117, no. 29, 21 July 2020, pp. 17011–17018.

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You Are a Product of Your Own Time: Cultural and Historical Perspectives on Suicide

Grace Chesley

Across time and space, people have conceived of suicide in countless ways. In the West specifically, ideas about suicide have gone through dramatic changes informed by cultural and historical shifts. When examining suicide from a historically and culturally comprehensive perspective, it becomes clear that there is no inherent moral obligation to resist suicide. All arguments opposing suicide on moral grounds are informed by the cultural and historical realities of one's time, not by infallible moral truth.

For example, Brandt's philosophical model of the morality of suicide could not have been reproduced in a different time or cultural context. Brandt's model, which investigates the morality and blameworthiness of suicide, represents the modern Western impulse to study suicide scientifically and philosophically. The academic study of suicide is a recent phenomenon that reflects larger cultural ideas about suicide, including, but not limited to, suicide is morally wrong, people commit suicide due to cognitive dysfunction, people commit suicide due to an inability to deal life's obstacles, and suicide is blameworthy. According to Brandt, suicide is either morally wrong, morally dubious, or morally excusable.¹ It should be noted that all of the moral categories of suicide have negative connotations, which demonstrates Western scholarship's uniformly negative way of conceiving of suicide. In investigating the morality, rationality, and culpability of suicide, Brandt posits suicide as generally blameworthy, "there is some moral obligation not to do what one knows will cause one's death; but he surely cannot deny that circumstances exist in which there are obligations to do things which, in fact, will result in one's death".² There are some circumstances in which the victim of suicide is blameless, but most of time suicide is blameworthy.

Under Brandt's model, which is largely in concordance with Western academia, one should not attempt to commit suicide, barring certain circumstances. He contends that there are some circumstances in which committing suicide is the most morally sound option. For example, suicide from a genuine sense of duty, any suicide in an unsound state of mind, and suicide while in an uncharacteristic emotional state are all deemed morally excusable.³ Also, under this model, those who believe suicide is morally wrong fall into two camps: there are those who believe suicide is wrong under all circumstances, and there are those who believe that suicide is so often morally wrong that

¹Benatar, David, and Richard Brandt. "The Morality and Rationality of Suicide." *Life, Death, and Meaning: Key Philosophical Readings on the Big Questions*, Rowman & Littlefield, Lanham, 2016, pp. 306.

²Benatar & Brandt. "The Morality and Rationality of Suicide." pp. 309.

³Benatar & Brandt. "The Morality and Rationality of Suicide." pp. 307.

they may generally declare it wrong. Brandt's entire analysis rests on the idea that suicide is wrong in some way—due to qualms about either blameworthiness or morality. This analysis is reliant upon the ethnocentric, Western idea that suicide is wrong. The Brandt model presents an argument that lacks the nuance intrinsic to the human history of suicide.

When examining suicide outside of the West, a more diverse picture arises. This picture does not align with the Brandt model or Western scholarship. Many cultures accept suicide without assigning blame to or determining the morality of the act. In Japan, social attitudes surrounding suicide are complex but there are instances where it is seen as a viable option. In response to social disgrace, some Japanese may commit suicide, occasionally killing one's children as well to avoid leaving the children in the care of another.⁴ While this kind of suicide is a response to social shame, the suicide itself is socially acceptable. In China, recently widowed, childless women may commit suicide in order to prove their devotion to their husbands and to avoid the negative perceptions of their peers.⁵ Similarly, widowed women in India may burn themselves on their husband's funeral pyre to remain connected to him, as widows can be considered outcasts in Indian society. By burning herself alive, the wife makes a sacrifice—following this tradition means that the husband and wife will experience paradise together and later be favorably rebirthed.⁶ Therefore, by committing suicide, Indian and Chinese widows are demonstrating devotion to their husbands and participating in an important cultural practice. In both cultures, suicide in this context is socially acceptable and positively perceived, breaking Brandt's assumptions about the nature of suicide. People have committed suicide for political reasons throughout history, but suicide by *hara-kiri* (disembowelment) was common among officers in Japan as recently as WWII. *Hara-kiri* was seen as a way to exercise power and autonomy over death and has been a common practice throughout Japanese history.⁷ These examples of socially acceptable suicides from non-Western cultures demonstrate the ethnocentricity and lack of nuance in Brandt's (and most Western academics') scholarship on suicide.

However, European thought has not always viewed suicide as morally dubious. Ancient Romans occasionally viewed suicide as an honorable act, especially when committed for political reasons.⁸ European thought began to

⁴Goldsmith, Sara K. "Society and Culture." *Reducing Suicide: A National Imperative*, The National Academies Press, 2002.

⁵Lee, Hyeon Jung. "Fearless Love, Death for Dignity: Female Suicide and Gendered Subjectivity in Rural North China." *The China Journal*, no. 71, 2014, pp. 26. JSTOR, <https://doi.org/10.1086/674552>. Accessed 2 May 2023.

⁶Goldsmith. *Reducing Suicide: A National Imperative*.

⁷Goldsmith. *Reducing Suicide: A National Imperative*.

⁸Gordon, Daniel. "From Act to Fact: The Transformation of Suicide in Western Thought." *Historical Reflections / Réflexions Historiques*, vol. 42, no. 2, 2016, pp. 32. JSTOR, <http://www.jstor.org/stable/44631071>.

change under the direction of the influential Saint Augustine, who changed the common perception of death by suicide by solidifying the Catholic church's position against suicide. As honorable suicides were associated with paganism and martyrdom, the Church wanted to differentiate themselves. Saint Augustine was a leader in converting public opinion about suicide.⁹ He cited the sixth commandment, thou shall not kill, saying that killing oneself was equal to killing another. Therefore, suicide was a sin in the eyes of God. Saint Augustine's teachings on suicide had massive historical ripple effects that can be traced to Christianity today, where many denominations consider suicide a sin. However, there is no mention of suicide as sinful in the Old or New Testament, and some early Christian scholars revered the instances of self-sacrifice in the Bible.¹⁰

Turning the public away from suicide was not about following the Ten Commandments, but about securing political power for the Church. Suicide not only represented Roman martyrdom and autonomy, but it also showed laypeople that they had a say in the life-and-death decisions that were supposedly reserved for God. Suicide represented the ability to make life-altering choices, "to consecrate suicide would break the monopoly on the legitimate use of force exercised by the church in concert with the state".¹¹ Because of Saint Augustine's influence, moral opposition to suicide became the official position of the church. Following the Catholic church's example, several governments throughout Europe made suicide illegal because the autonomy implied in the act of suicide threatened the power wielded by both church and state.¹² Punishments for suicide in the medieval period were very severe and were designed to publicly shame and chastise survivors and corpses. The hegemony of the Catholic church shaped public perception of suicide for hundreds of years and the impact of Saint Augustine's writings on suicide can still be felt today through limited arguments like Brandt's. In this period, there was no moral debate or variability surrounding suicide; the Catholic church forced homogenous thought on the sinfulness of suicide through scripture as a ploy for increased political power.

Historical context is imperative to understanding contemporary positions on issues like suicide. The modern tendency to scientifically conceive of suicide represents a return to the medieval inclination to stigmatize all kind of suicide, stifle human agency, and to give power to hierarchical authority.¹³ However, suicide in the modern age has been flattened out by scientific authority, not religious authority. Towards the end of the 19th century, ideas

⁹Gordon. "From Act to Fact: The Transformation of Suicide." pp. 37.

¹⁰Gordon. "From Act to Fact: The Transformation of Suicide." pp. 37.

¹¹Gordon. "From Act to Fact: The Transformation of Suicide." pp. 38.

¹²Gordon. "From Act to Fact: The Transformation of Suicide." pp. 38.

¹³Gordon. "From Act to Fact: The Transformation of Suicide." pp. 41.

about the immorality of suicide began to resurface as a reaction to the lax attitudes of Enlightenment thinkers on the subject. Scholars began inquiring into suicide through the social sciences. One such scholar was Emile Durkheim, a 19th century sociologist and philosopher who promoted the idea that suicide was not only self-serving and morally wrong, but solely attributable to social factors.¹⁴ In an effort to establish sociology among the other social sciences, Durkheim used varying statistical rates of suicide to demonstrate that, because suicide rates were variable across countries, that the conditions of these countries must have been to blame. In framing suicide as a phenomenon and not an individual act, Durkheim turned suicide, something deeply personal, into a problem that could only be explained by sociology.¹⁵ Durkheim saw suicide as a moral blight on Western society and wanted to use sociology to end it.¹⁶ Durkheim used his harsh, reductionist, ethnocentric opinions about suicide as justification to strip the subject of its enormous depth and position it as a social concern. While large-scale statistics on suicide can be helpful in suicide prevention efforts, suicide is an intimate and individual act that cannot be solely explained by sociology. By forcing the subject of suicide into the narrow confines of sociology, Durkheim oversimplified suicide both scientifically and morally.

Other scholars contributed to the simplification of suicide through scientific study as well. Psychologist Sigmund Freud and his contemporaries tried to propose large, overarching theories about the kinds of traits that make people suicidal. In doing so, they inappropriately attributed mental strife to be the cause of all suicides.¹⁷ By attempting to explain suicide with no cultural or historical context, 19th century social scientists like Durkheim and Freud oversimplified suicide. By avoiding the humanity and individualism that is inherent in each act of suicide, these social scientists denied people the opportunity to look at suicide holistically. Science's misrepresentation of what suicide is initiated the Western movement back to viewing suicide as a moral taboo, much like how the Catholic church's misrepresentation of what suicide is initiated the medieval European stigmatization of suicide. Both the Church and Western science promoted a uniform, shallow idea of what suicide is and what it means in order to assert their authority in Western schools of thought, consequently stripping people of autonomy and freedom of thought.

Interestingly, the intellectuals of the Renaissance period had a very different outlook on suicide that painted it as a complex phenomenon with moral variability. Until the early modern period, European thought on suicide largely remained aligned with the Church. Many historians attribute this change to

¹⁴Gordon. "From Act to Fact: The Transformation of Suicide." pp. 39.

¹⁵Gordon. "From Act to Fact: The Transformation of Suicide." pp. 39.

¹⁶Gordon. "From Act to Fact: The Transformation of Suicide." pp. 41.

¹⁷Gordon. "From Act to Fact: The Transformation of Suicide." pp. 39.

the politically revolutionary atmosphere, the rise in democracy, the collective decrease in religiosity, and a focus on personal liberty.¹⁸ Renaissance thinkers focused on a comparative and individualistic approach to discussing suicide that offered nuance and diversity. While suicide still was not widely accepted in this era, it was largely understood to be an individual choice.¹⁹ For the first time since Ancient Rome, the West saw an amalgamation of diverse, intellectually stimulating thought on the nuances of suicide. Unfortunately, towards the middle of the 19th century, the conversation around suicide shifted focus to scientific methodology and the humanistic study of suicide was subordinated.²⁰ Western society's shift towards scientific inquiry was a reaction to the Romantic ideas of the late 18th and early 19th century. This reactionary shift and how it impacts Western society today demonstrates how cultural perspectives on suicide are informed by history.

Because of the work of social scientists in the 19th century, modern ideas about suicide still largely revolve around academic study and have lost moral variability. The Brandt model exemplifies contemporary scholarship on the subject of suicide, which largely focuses on morality, mental illness, and societal factors. The Brandt model is built not only on the legacy of 19th century science, but on the history of medieval Europe and the Latin Christendom as well. Contemporary scholarship about suicide lacks debate and nuance because of the historical circumstances that preceded it. However, there are some Western scholars who challenge the moral uniformity of suicide scholarship and recognize the moral meaninglessness of suicide. Albert Camus, a mid-20th century French philosopher, assesses that life is meaningless, and thereby suicide is meaningless.²¹ Camus is unique in Western scholarship, not only because he conceived of suicide as morally meaningless, but also because he examined suicide on an individualistic scale. Brandt, Durkheim, and other theorists on suicide put categorical labels on types of suicide and assessed the morality of each, while Camus stipulates that every suicide lacks moral meaning. Camus's perspective on suicide is valuable because it presents an alternative to Brandt, for whom suicide is teeming with meaning, and because it indicates that Western scholarship on suicide is not entirely homogenous.

Diverse cultural perspectives, traditions, and histories surrounding suicide should be included in academia today not only to better understand the human condition, but to paint a better picture of death and dying cross-culturally. Also, centering the traditions of non-Western cultures in scholarship

¹⁸Gordon. "From Act to Fact: The Transformation of Suicide." pp. 44.

¹⁹Gordon. "From Act to Fact: The Transformation of Suicide." pp. 44.

²⁰Gordon. "From Act to Fact: The Transformation of Suicide." pp. 46.

²¹Camus, Albert. "Life Is Absurd." *Myth of Sisyphus: And Other Essays*, Random House US, New York, 2012, pp. 148.

would challenge Western academia's ethnocentric ideals and demonstrate the lack of moral obligation to resist suicide. Incorporating different cultural and historical perspectives on suicide paints a more complex, comprehensive picture of the phenomenon and opens the door for more nuanced academic study.

Every argument opposing suicide on moral grounds is informed by the cultural, political, and historical realities of one's time, not by moral truth. Suicide does not carry any intrinsic moral value—it is morally meaningless. Suicide has no inherent moral meaning, therefore there is no moral obligation to avoid it. Competing cultural perspectives and changing historical circumstances have shown that meaning of each individual suicide is deeply dependent on cultural and historical context in which it occurs. Cultural and historical perspectives are what imbue suicide with meaning, not morality.

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