Proceedings of GREAT Day

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The Proceedings of GREAT Day 2021

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About GREAT Day and *The Proceedings of GREAT Day*

Geneseo Recognizing Excellence, Achievement, & Talent is a college-wide symposium celebrating the creative and scholarly endeavors of our students. In addition to recognizing the achievements of our students, the purpose of GREAT Day is to help foster academic excellence, encourage professional development, and build connections within the community.

Established in 2009, *The Proceedings of GREAT Day* journal compiles and publishes promising student work presented at SUNY Geneseo's GREAT Day symposium. The projects, presentations, and research included here represent the academic rigor, multidisciplinary study, and creativity of the students taking part in the SUNY Geneseo GREAT Day symposium.

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An Interview with Adam Frank

Ethan Owens

Adam Frank, PhD, was the keynote speaker for GREAT Day in 2020 and the Helen F. and Fred G. Gowen Professor at the University of Rochester's Department of Physics and Astronomy. His speech was titled "Light of the Stars: Seeing Climate Change and the Human Future in Our Universe Awash in Worlds."

Could you tell me about astrobiology?

Astrobiology is the new version of an old idea and it's the idea that to really understand life you need to consider it in its true astronomical context, which means a planetary context. But you can go even to broader scales like with the Galaxy and certainly the solar system. You may want to know how the host star for a planet changes things or you may want to know about the whole solar system environment like asteroid impacts. Even in the galaxy, there are places in the galaxy that may be better for life so astrobiology tries to look at life and its conditions for formation and evolution in this sort of broader context. But, there wasn't much to do in the field until the late or the mid-1990s. That was when they discovered two major things happening. One was the discovery of other planets orbiting other stars, what we call exoplanets. The other was that there was a meteorite that was found in the Antarctic which was actually a chunk of Mars that had been blown off of Mars. That meteorite, in the analysis, had hints of possible life of microfossils and chemicals that were interesting. It turns out that that meteorite probably didn't have evidence for life, but it made NASA really interested. NASA then created a part of funding astrobiology as opposed to exobiology.

Could you tell me about your research specifically? And what you will talk about in your keynote speech for GREAT Day?

I'm interested in a wide variety of questions and astrobiology, but the things I'm really talking about is the part of astrobiology that has to do with intelligent life, the possibilities of EXO civilizations. What I'm interested in is what I call the astrobiology of the Anthropocene, the Anthropocene is this era that we have entered where human activity is dominating the functioning of the Earth. We consider earth to be a bunch of coupled systems: there's the atmosphere, the hydrosphere, the cryosphere, the lithosphere, and then the biosphere, which is the sum total of all life. Each of those systems are tightly coupled with all the other systems, and the Anthropocene is this era where we were finding that human activity is basically pushing on all of them. It's now human beings that move more mass around the planet than anything else. The Anthropocene has been proposed as a new geologic epoch, and what I'm interested in is the astrobiological aspect of of a planetary transition. If we're not the only time that an intelligent species and a

technological species has arisen, then it may be generic. This may be the kind of thing that any civilization that arises on a world, and becomes successful enough is going to hit this point. In the talk, I'm really going to be focusing on that question: can we look at climate change and the Anthropocene through that lens and it doesn't have anything useful to teach us about what we're going through right now?

Can you tell me how important you think this research is at the undergraduate level to further these fields?

There's a huge amount to be done and especially for undergraduates. I asked the question, does any technological civilization drive some version of climate change or Anthropocene? How do you want to answer that question? From a research perspective, what we could do is we could take a model of a planet like the Earth and we could move it around and say "imagine that you have another version of the earth that is 20% farther from the Sun than our Earth is." If a civilization evolved on that world would it trigger a climate change? How about a third version of a planet like the Earth that's a little bit closer to the sun? An example of this kind of research is finished a paper which was led by an undergraduate Ethan Savage that just got accepted. And Ethan did the work; Myself and my collaborators put together the model, but then Ethan ran the model and design. He was amazing. He designed to the research program, sort of, "how to set up the variables," "which which conditions to use," and we wrote that paper and set it up so there's really a lot of work to be done answering this question from a theoretical perspective, where we have models and simulations that can be done that's really quite good for an undergraduate.

Do you think that GREAT Day is a good opportunity to share this undergraduate research?

If it's about undergraduate research, absolutely. This is a great place for undergraduates to show that they can be involved in cutting edge research. The sooner you can get involved in research, the better off you are. Because scientific training is interesting, you start off just reading books and taking tests. That's not what science is about at all; soon after you get to graduate school, you find that you've run out of answers in the back of the book. And what's almost more important than finding answers is asking questions. What's the right question to ask? You can spend a long time and get nowhere because you haven't figured out how to match your question to the tools you have to answer the question.

So can you see any other benefits to GREAT Day in regards to research that isn't just putting in the initiative to start research?

I think what's important is to also communicate research, you have to go out and communicate your research results to other people and that means standing in front of your poster. You're writing it up, creating the poster in a way that people can understand thinking about how to best communicate this standing in front of it, giving talks. The

more practice you have an understanding that science is a human process and requires communicating with other human beings, the better. That's an essential skill for researchers and some people are very comfortable doing that and some people aren't comfortable doing that, but it's so important that if you're not comfortable about it, you have got to practice and challenge yourself to do it as often as you can.

Could you give some examples of how, in your own research, you communicated your research to heighten the project?

One thing I do is a lot of science communication: I do writing, I give talks, I do TV shows. But, even as a scientist, I go to conferences. If I have a new result that my group has done that I'm really excited about I will look to go to conferences, get in front of people, and explain to people why this research is important. You have to let people know there's a lot of scientific research out there, you have to let interested parties know that you've done something that you think can contribute to the conversation.

For communicating to the public, how would you go about doing that in an effective manner?

You should, first of all, start your own blog and get used to writing. Write, write, write, write, write, Hemingway said the most important thing about writing is getting your butt in the chair. You can start there, just doing your own thing. You can also make a video, if you're more interested in Visual Communications, or create a podcast for auditory communictions. However, if you would like a more established platform, you can reach out to a science magazine. There are a lot of online science magazines that you can use. You should find someone to contact, find out who is the editors of these publications. Contact the writer and say "hey, I'd like to write for this magazine, how do I do it." They may not be helpful and they may not get back to you; however, you do that enough times and somebody is going to get back to you and then you pitch an idea. Hopefully, as time goes on, you'll build a portfolio of material that you've done. The next time you go to another publisher, they'll be more inclined to take your research and maybe even pay you for it.

An Interview with Anne Baldwin

Quinten Seskin

Anne Baldwin, PhD, is the current Director of Sponsored Research here at SUNY Geneseo

How would you describe the importance of undergraduate research? Do you have any comments about the opportunities available to current students?

I think that undergraduate research is tremendously important. I benefited from it when I was an undergraduate student, and countless people do as well. Research, or involvement in scholarly activities, comes with the typical benefits like learning skills but it does more intangible things for students—it can build self-confidence, it can build a sense of community, a sense of self-worth, and it can help clarify career goals. In fact, I did not originally intend to go to graduate school, however, doing research put me in touch with numerous people who became my closest friends. That experience clarified for me the career path that I wanted to take, and influenced me to apply to graduate school. It takes a while to get to that point, but I truly believe that involvement in undergraduate research is very important.

What grants does SUNY Geneseo provide to students for conducting research in their respective fields?

SUNY Geneseo started funding undergraduate research and travel grants, which are now known as track grants, in 1988—back then it was just a few awards for a total of $3,000, but over the years that has grown tremendously. These last few years have been a-typical because we can't travel, but in a typical year the research council awards more than 200 track grants. For instance, in 1920 we awarded 244 track grants for a total of $121,946. The research council is the body that reviews and votes on all of the internal research funding programs at the college for students and faculty. Thus, the track grants are reviewed by the student grants sub-committee of the research council; and that has faculty members and students on it. And the track grants are funded by the student association and the Geneseo foundation—which comes from donations to the college from alumni and other donors, so the students see the value in it as does the college. It's our largest program, we have other programs for students, and we have many programs for our faculty too, but it is our largest in a normal year. This year, in 2021, we only voted 109 compared to the 244, and the dollar amount was only $31,925 because we couldn't travel.

Are there any sponsored works that have been funded by SUNY Geneseo that you remember?

They're all so good, I'd be hard-put to identify a single one, but there are projects going on in all departments, and as a result, it varies. The majority of the track grants for research come from the stem departments, and that's often because there are costs involved for chemicals, test kits, and other scientific equipment. However, we also have students going into archives, so I wouldn't want to pick out one because they're all incredibly well done and they all have the potential to make an impact.

An Interview with Lytton Smith

Quinten Seskin

Lytton Smith, PhD, is the current director of GREAT Day, and is a Professor of English and Creative Writing here at SUNY Geneseo

Can you describe the experience leading GREAT Day last year?

It has been a fantastic experience. When you are just a faculty member, you get some sense of what students are doing, but as one of the organizers you really get to see all the different kinds of research that students are doing in their respective disciplines. There is a level of excitement you get from coming in and seeing people submit their titles and their abstracts, and I learn so much about the world from the hard work that students are doing.

Are there any challenges that you faced when conducting GREAT Day last year? If so, how do you plan to address them this year?

We were doing a lot of new things last year, for example, GREAT Day took place over multiple days when it normally takes place in just one day. Additionally, it was the first time we adopted a virtual format with time to plan it out, rather than just converting it to virtual the last minute like we have done in the past. There were definitely things we had to learn and work around, and everybody has a certain familiarity with zoom, so there were hitches here and there about people not being able to get into a zoom. But fortunately, there were not many, and I think while we are really excited to go in-person and have the single day with no classes this year, there was something quite fun about having the five days…like a full academic conference that might last over multiple days, it gives you time to look forward for things.

As we know, last year's GREAT Day was held online due to the circumstances. Are there any aspects of virtual GREAT Day that you plan to incorporate this year?

Absolutely, we are trying to make sure that we don't leave behind the opportunities of the virtual world, which is why we are moving to a new conference platform. One of the factors that we took into account when choosing to work with this new platform was the inclusion of a user friendly virtual gallery. What this means is that students can display their poster presentations in the campus ballroom, and additionally have an on-line equivalent that can be referred to if someone misses a session, or wants to look back at a poster. Additionally, if students want to record their sessions, we can host those as well. We are not quite making it a fully hybrid event because we are trying to focus on

the in-person experience, but we are now catering to people who want to add in those moments online. Essentially, by adding an online equivalent of this gallery we can reach different people like family members, or friends at other schools that wouldn't be able to be here in-person.

What aspects of GREAT Day do you find to be most impactful to the campus?

The visibility of the amazing work that students are doing is what I find most impactful. I love the fact that it's a day that—while it wouldn't happen without the tremendous efforts and management by faculty—really focuses on students, and that's what we are recognizing. I think one of the really wonderful things about that aspect is that it provides inspiration and pathways from one student to another where, as a student, you sort of see… "a student did this presentation and I learned something from it, and now I have this other thing to share." It's another reason why I'm excited that we are back in-person and we have a single day for GREAT Day, because if you are on campus that day and you're not sure what GREAT Day is yet, you can't help but discover what's going on—it just wonderfully takes over the campus.

Are there any memorable works that have been published in the GREAT Day Journal that you remember?

Definitely, but I wouldn't single out any specific one because I would be leaving out all the others that were fantastic, and I don't mean to offend anyone. What I will say is that the journal we publish for GREAT Day keeps it alive so that it doesn't just last that one day. I belive that aspect is the other advantage of what we are taking away from virtual GREAT Day—how do we have something last longer that just the one day? Also, the fact that it is interdisciplinary effectively makes it a place for discovery, which is what I like most about it.

Is there anything specific that you hope students gain from participating in GREAT Day?

The fact that someone is presenting at GREAT Day hopefully means that they are excited about sharing their work and that they have confidence in sharing their work, but it is also a big step to take. For many people, it is their first time presenting a poster or paper. Thus, I think one thing I'm hoping is that they realize that their ideas and their research really matters, people care about them, and they have a role to play sharing those ideas. And hopefully that continues, and they sort of catch the bug and go, "where next? Can I go to a conference, or do this in another way?" We think of college as a time where you come to learn things, and of course that is true, but it is also a time where you communicate the things that you have learned. And that is maybe more important, or more profound. We are a public liberal arts college, and the public is really important to that; if you can share with the public, on and off campus, that's wonderful.

An Interview with Jaime DeVita

Ethan Owens

Jaime DeVita acted as a student editor for the *Proceedings of GREAT Day* for 2019 and 2020

Why did you become an editor for the *Proceedings of GREAT Day*?

It was the end of sophomore year and I was in organic chemistry. There was a part of the lab where we had to use a database, and Jonathan Grunert came as a librarian and showed us how to navigate the databases. He mentioned the *Proceedings of GREAT Day* during the lab and said he could really use someone in the STEM field, due to the various STEM disciplines we get with submissions. It intrigued me because, at the time, I was just a normal writer for *The Lamron*. So, being a biology major, and having a minor in math, I rarely ever wrote any papers, but felt that I had a knack for writing and enjoyed it. *The Lamron* sort of fulfilled that for me but after Dr. Grunert explained what the internship was about and was looking for submissions, it piqued my interest and I reached out to him, applied and I got it. I've been doing it for two years now and I've thoroughly enjoyed it.

Could you tell me about some of the things that you learned through the *Proceedings of GREAT Day* that you might use after you graduate?

I'd say I learned a lot about time management, and how to juggle something that's outside of my course material which I found was sort of a learning curve within my first year of being a part of the proceedings internship. I now know how to properly communicate with people via email, I have a template in my head on how to sound professional and how to get your point across in a concise manner. I also just learned a lot about the various fields of study here at Geneseo. I learned about that last year, citing the different kinds of studies. It taught me more about what Geneseo students can do and what they are doing here on campus.

What are your plans for after graduation?

I have nothing really in the works but I'm studying actuarial science. I figured that out a little late in the game here at Geneseo being a biology major, I realized my junior year, that's what I wanted to do. So I've taken the actuarial science class with Dr. Tom here at Geneseo and have been studying for my first exam, which is just a little behind track of if you knew from the get go by like a year. So my plan after graduation is to really lock in studying and passing those exams to be able to join the field and become an actuary.

Do you think that this internship has prepared you to be an actuary?

One hundred percent. As for applying to internships and looking at job postings, a lot of them want the ability to communicate proper language and to have communication skills, which I find the proceedings has really kind of strengthened. Throughout the years, I have become confident in my abilities to communicate, like I said previously to communicate via email. Tweaking and ripping apart a bunch of papers to make sure they are up to the standard of the proceedings, I find, gives me more critical thinking and can help me find what's wrong with something, for lack of a better word, or what we want to hold to our standard. Other than that, I gained a lot of professional development, how to meet deadlines and how to follow up a month long deadline that we have to follow to a tee. That takes a lot on our end to make sure that things are running smoothly and hitting those checkpoints throughout the semester is also a useful skill I believe for any career.

The Mental and Emotional Impact of Being a College-Aged Black Woman Amid the Current Sociopolitical Climate

Drew Brody O'Neil

sponsored by Melanie Medeiros, PhD

Abstract

Although many Americans assume that systemic racism has been washed away through history, research shows that this is far from reality. Across a range of interdisciplinary scholarly research exists a consensus that systemic racism induces Black women's suffering. The main question guiding my research asks how systemic racism facilitates college-aged Black women's mental and emotional health outcomes. The goals of this study included documenting where systemic racism is prevalent, analyzing the mental and emotional impact of systemic racism on college-aged Black women, examining the coping mechanisms that college-aged Black women employ to minimize race-based distress, understanding how media attention to systemic racism impacts college-aged Black women's mental and emotional health, and learning how college-aged Black women value public support for Black lives. Following a semester of quantitative and qualitative research, I assert that by virtue of the policies and practices sustaining the politico-economic exploitation and social marginalization of Black women, college-aged Black women are structurally vulnerable to adverse mental and emotional health. The consequences of the structural inequities burdening Black women's lives deserve comprehensive understanding and solutions. My research advances an emerging scholarly call to action to uproot the systemic racism and structural inequities devastating the welfare of Black lives.

Although many Americans today assume that systemic racism has been washed away through history, research shows that this is far from reality. Across a broad range of interdisciplinary scholarly research exists a consensus that systemic racism induces Black women's suffering. Systemic racism, the structurally rooted policies and practices that manufacture and maintain race-based inequities in access to resources and opportunities, has survived both the abolition of slavery and the civil rights movement and continues to sabotage every aspect of Black American life.

Research suggests that structural inequalities are embodied in race-based health disparities (Bell et al., 2018). Structural and social inequalities are biologically reflected among Black Americans (Gravlee, 2009). Moreover, critically examining health through an intersectional lens highlights the simultaneous and interdependent influences of class, race, and gender on Black women's health (Pouget, 2017). An intersectional approach to Black women's health emphasizes that these three interconnecting systems of power require a collective investigation to accurately understand the disproportionate adverse health outcomes among Black women (Mullings, 2005). As a product of their subordinate status in the politically and economically constructed hierarchical social order, Black women are structurally vulnerable to embody their suffering (Quesada et al., 2011). Through a critical medical anthropological approach, structural vulnerability highlights how systemic racism engenders Black women's suffering.

Existing research predominantly focuses on how social and structural determinants of health produce Black women's physical maladies. Bell et al. (2018) assert that residential segregation is embodied in disproportionate rates of HIV among Black women. McLemore et al. (2018) identify that unstable housing, environmental stressors, and food insecurity harm Black maternal and infant health. Furthermore, Gadson, Akpovi, and Mehta (2017) describe how Black women's lack of access to healthcare and transportation encourage poor pregnancy outcomes. Significant research maintains that the chronic stress of systemic racism cumulatively induces Black women's weathering, or premature biological aging (Michaels et al., 2019). Research on Black women's health concentrates on the social and structural forces burdening physical health.

However, while there is ample scholarly work on how the chronic stress of racism facilitates physical health adversities, there are fewer studies examining the implications of systemic racism and discrimination on Black women's mental and emotional health. While Grollman (2012) and Thomas, Witherspoon, and Speight (2008) identify a relationship between Black women's experiences with discrimination and poor mental health, further analysis is needed that examines the structural forces producing these outcomes. This article is inspired by the work of Black female scholars, including Lewis and Neville (2015), Lewis, Mendenhall, Harwood, and Browne Huntt (2012), and Woods-Giscombé (2011). Lewis and Neville (2015) identify a relationship between gendered racism and psychological distress. Lewis, Mendenhall, Harwood, and Browne Huntt (2012) analyzed the coping mechanisms Black women employ to minimize the distress of discrimination. Woods-Giscombé (2011) determined that the cultural trope of a strong Black woman leads Black women to internalize and embody their stress. To acquire a thorough understanding of Black women's biopsychosocial health, more research explicitly spotlighting the mental and emotional consequences of systemic racism is essential.

The results of this study target an extensive audience including medical anthropologists, Black feminist scholars, public health professionals, policymakers, social science scholars, and laypersons. I believe that this topic deserves universal acquaintance. The purpose of

this study is to bring awareness to systemic racism, its destructive power over Black lives, and its assault on college-aged Black women's mental and emotional health.

The main question guiding my research asks how systemic racism facilitates college-aged Black women's health outcomes in the United States. Following this broad question, I composed three sub-questions: (a) Where do college-aged Black women experience discrimination most frequently? (b) How do college-aged Black women overcome daily experiences of discrimination? (c) How do the current social and political climates and the growing Black Lives Matter movement affect college-aged Black women's mental and emotional health? Accompanying these questions, I crafted a list of objectives. The goals of this study included documenting where systemic racism is most prevalent, analyzing the mental and emotional impact of systemic racism and discrimination on college-aged Black women, examining the coping mechanisms that college-aged Black women employ to minimize race-based distress, understanding how increased media attention to systemic racism impacts college-aged Black women's mental and emotional health, and learning how college-aged Black women value public support for Black lives.

I argue that college-aged Black women most frequently encounter emotionally traumatizing experiences of discrimination where White people determine their access to opportunities or resources. Additionally, I assert that although the strong Black woman stereotype motivates Black women to cope with discrimination through perseverance, it is ultimately detrimental to college-aged Black women's mental and emotional well-being. Lastly, I claim that the growing Black Lives Matter movement and media attention to systemic racism are emotionally triggering and mentally exhausting for college-aged Black women, but public support for Black lives positively impacts their mental and emotional health by providing them an avenue for optimism about a future of racial equality and equity.

Methods

I employed qualitative and quantitative research methods. I conducted nine interviews over Zoom, eight of which were life-history interviews with undergraduate Black cisgender women attending predominantly White institutions in New York, and one of which was a key-informant interview with an associate professor of psychology with numerous additional professional engagements pertaining to Black mental health. I specifically recruited college-aged Black women for my life-history interviews to answer my research questions with lived experiences. Upon concluding, transcribing, and coding all nine interviews, I proceeded to analyze two data sets from the Pew Research Center and the Center for Disease Control and Prevention (CDC) to accompany and strengthen my qualitative findings. This study received human subjects research approval from SUNY Geneseo's Institutional Review Board.

Alienation in White Spaces

Emotionally triggering experiences of discrimination are most prevalent in settings in which college-aged Black women's access to resources, services, or opportunities is dic-

tated by White people. When I asked Ana, a 21-year-old Black woman from the Bronx, where she recalled experiencing discrimination, she told me about a time when she was denied entry to a fraternity party during the first week of her freshman year at her upstate New York college because she was Black. Following the incident, Ana admitted, "I just went home and cried." She explained, "even though we're all college students, and we're all here for the same experience, they're denying my chance to experience [college Greek life] just because of the color of my skin." Ana's story highlights how white supremacy's perpetual role in restricting Black people's access to resources and opportunities is mentally and emotionally stressful for college-aged Black women.

Greek organizations within the American higher education system were originally established to conserve elite White males' social status (Hughey, 2018). As universities began admitting more diverse classes, Greek organizations were formed to preserve inequality by establishing social hierarchies within educational institutions (Hughey, 2018). While Black women's access to university and Greek organizations grow, the classist, racist, and sexist foundations of Greek organizations prevail through discriminatory practices such as denying Black women like Ana access to fraternity parties. Whether implicit or explicit, discrimination like this makes college-aged Black women like Ana feel alienated, reminds them of their subordinate ranking within the social hierarchy, and engenders adverse mental and emotional salubrity.

In a nationally representative survey of 6,637 American adults, Horowitz, Brown, and Cox (2019) found that 70% of Black Americans say they are treated less fairly than their White counterparts in restaurants, or while shopping. During my interview with Michelle, a 21-year-old Black woman from Rochester, NY, she described her experience receiving racial microaggressions from White servers at a restaurant. Michelle conveyed vexation when White people at the restaurant gave her family suspicious looks because she knew it implied negative connotations about their skin color. Similarly, Malika, a 23-year-old Black woman from Long Island, NY, voiced that she most frequently encounters discrimination at predominately White, upscale restaurants. "It's just the way people look at you," said Malika, adding, "I'm a customer, don't treat me any differently." Like Michelle, Malika's emotional response to discrimination from White people at restaurants was anger. Although Black women have greater access to services like lavish restaurants than in the past, discrimination from White people in these settings is ever-present and contributes to college-aged Black women's perturbation. Furthermore, Jada, a 21-year-old Black woman from Buffalo, NY, told me that she experiences discrimination when clothes shopping. Jada said that White retail workers oftentimes question her presence, watching her fervently to ensure she does not steal. Jada expressed exasperation when White employees apply unwarranted racial stereotypes to her.

When I interviewed 21-year-old Sasha, a Black woman from the Bronx, she revealed how the unrelenting discrimination at her workplace drove her to such mental exhaustion that she quit. Sasha worked at a high-end grocery store with a wealthy, White customer base. Every time a White person would make a racially-discriminatory comment, Sasha said, "It was just another reminder of where I stand." She recalled one White man asking

her to roar like a lion from Africa. Eventually, Sasha quit her job because of the persistent, emotionally draining discrimination. According to Horowitz, Brown, and Cox (2019), 84% of Blacks agree that with regard to racial discrimination, the bigger problem is people's indifference or ignorance towards racial discrimination. The data highlights how White-dominated institutions still exhibit and perpetuate racism and discrimination insofar that it fosters Black women's poor mental and emotional well-being.

Pressure to Be Strong

The strong Black women stereotype entails the perception that Black women are naturally strong and resilient (Woods-Giscombé, 2011). While the strong Black women stereotype comes with a sense of inner strength, Katherine, a Black female psychology professor from an accredited university in Boston, Massachusetts, stressed that the stereotype also inspires a great deal of toxicity and pain. As a Black woman herself, Katherine said that the strong Black woman stereotype means that "we don't get to be pampered. We don't get to be supported. We don't get to cry on other people's shoulders. They're crying on ours. They're looking to us for guidance, us for our energy, us for nurturance." According to Katherine, the expectation for Black women to be a reliable source of emotional support has psychological consequences including anxiety and depression.

Katherine described that because Black women go through life with the assumption that being Black means that life is going to be challenging, anxiety and depression seem like a guaranteed part of the Black experience. She further elucidated that Black women show up to therapy with more severe depression because they show up decades after the first episode. According to Katherine, research shows that Black women with anxiety show up to therapy on average 30 years after their first symptoms, whereas the national average for seeking therapy treatment for mental health is seven years. During my interview with Michelle, she explained that she would not seek mental health support even if she recognized her need to do so. Katherine expounded that Black women's reluctance to seek therapy treatment exacerbates their mental and emotional health. A study by the CDC found that Black women had the highest percentage of depression among Americans aged 20 and older with depression (Brody et al., 2018). In this regard, upholding the strong Black woman role contributes to Black women's high rates of depression.

Furthermore, when Ana and I discussed the burdens of living in America as a Black woman, she explained her feeling that people expect her to always be strong and emotionally conservative. However, "in reality, I do have those times when I just wanna cry and be fragile and have somebody take control of something for me. I just wish I didn't have all these expectations," shared Ana. For my participants, the expectation that as a Black woman you constantly have to have it all together is emotionally exhausting. Katherine explained that this is a typical challenge for Black women, adding, "the cost of that plowing through is that we don't have the opportunity to actually sit down and just cry and emote about what we're struggling with." Katherine asserted that coping with systemic racism and discrimination by internalizing and persevering does not allow Black women to properly deal with the race-based trauma they have endured since childhood.

My data demonstrates the emotionally detrimental influence of the strong Black woman stereotype. This stereotype leads Black women to assume a resilient and reserved persona that can only be maintained by ignoring psychological distress. For many college-aged Black women, the strong Black woman stereotype comes with emotionally burdensome expectations that manifest in adverse mental and emotional health outcomes.

Consequences of Mattering

A third and final theme emerging from my data regards the impact of the current American social and political climates and growing Black Lives Matter movement on Black women's mental and emotional health. For many of my participants, the rising momentum and support for the Black Lives Matter movement and its accompanying presence on social media has been a source of mental and emotional exhaustion. Within the past year, the largely publicized murders of Black people like George Floyd and Breonna Taylor have exposed college-aged Black women to a constant assembly line of graphic videos, hate speech, and reminders that white supremacy constantly works to marginalize them. In spite of this, my participants found solace from public displays of support for Black lives.

During the summer of 2020, protests for and against the Black Lives Matter movement were at an all-time high. While marching in protests empowered some of my participants, it was too emotional for others. Sasha shared that she had been participating in Black Lives Matter protests at her predominately White institution in upstate New York. When I asked her about her experience, she expressed despondence. Sasha explained, "I'm over here on a Saturday night walking and screaming that my life matters and I'm paying to be here. When we were walking through the campus, you'd see all these White kids looking through the windows of their dorms. They get to chill and I'm over here wasting my college time." Fighting for your life and community while watching your White counterparts have the luxury to sit back and go about their everyday lives is alienating and emotionally taxing. The pressure many college-aged Black women feel to be at the front of social change is mentally exhausting, especially when the movement concerns their existence.

On the other hand, Malika expressed that she avoided going to Black Lives Matter protests. "I don't protest because I know it would be too emotional for me," she said. Malika identified that marching in protests would have a negative effect on her mental and emotional health, so by actively avoiding these situations, she was able to manage her well-being.

Many participants shared that they avoided social media over the summer because seeing constant posts regarding police brutality, racial profiling, and the unnecessary and unwarranted murders of innocent Black people was mentally draining. Malika mentioned that over the summer she intentionally avoided Twitter to cope with her anxiety and stress. Jane, a 21-year-old Black woman from Manhattan, shared that she also avoided Twitter because it was too mentally draining, noting, "it is traumatizing to not only watch a person die, but to also identify with them." For many of my participants, seeing

images and videos on social media of police violence against Black people is not just mentally disturbing, it is also personal. Opening social media to once again be reminded of your social marginalization is mentally exhausting for many college-aged Black women. Avoiding social media is a coping mechanism used to protect mental and emotional health.

Although Evelyn, a 21-year-old Black woman from Rochester, NY, identified herself as a social media addict, she told me that it was too mentally overwhelming to check social media as frequently as she regularly would. "Even one little tweet will ruin my entire day," she expressed. Evelyn added how much of an impact the Black Lives Matter movement was having on her mental and emotional stability, sharing, "there was a period of time for like a week where I was just crying and crying and crying because I was just so emotionally overwhelmed with everything happening."

Although the Black Lives Matter movement has been emotionally triggering and mentally draining for many college-aged Black women, it has also offered a glimpse of hope for the future. Many participants expressed the positive value of public support for the Black Lives Matter movement. Jada shared that seeing her non-Black friends show support for the Black Lives Matter movement made her feel "on cloud nine." Similarly, Evelyn said, "I think that it shows that they care and understand and that regardless of what race they are that they're going to be there for me and others."

The Black Lives Matter movement, founded and organized by three Black women in 2013, seeks to bring justice and affirmation to Black lives (Black Lives Matter, n.d.). By highlighting the fatal ways that white supremacy continues to afflict the Black community, many of my interviewees expressed the emotionally paralyzing effect that this movement has had on their mental and emotional health. However, they all actively align themselves with the movement whether or not they possess the emotional capacity to participate in protests. Furthermore, social support eases college-aged Black women's mental suffering concerning the unjust treatment of Black lives in America.

This data illustrates how college-aged Black women's mental and emotional health is agonized by the systemic racism ingrained throughout the American judicial structure. While the Black Lives Matter movement is necessary, many of my participants feel mentally drained from daily reminders of their subordinate social status in America. Our current social and political climates facilitate the racial tension dividing our country and challenge mental and emotional well-being for college-aged Black women.

Systemic Racism and Black Women's Mental and Emotional Health

Forces of systemic racism expose college-aged Black women to chronic mental and emotional suffering. Applying an intersectional lens to Black women's distress illuminates the interdependence of classism, sexism, and racism inducing adverse biopsychosocial health. My research findings exemplify that systemic racism engenders college-aged

Black women's distress. Systemic racism cultivates college-aged Black women's structural disadvantage to the point of poor mental and emotional well-being.

College-aged Black women most frequently experience emotionally-traumatizing discrimination in settings in which their presence at White-dominated locales is questioned. This data ethnographically elaborates on research suggesting that chronic stress induced by lifelong exposure to structural racism and discrimination contributes to Black women's poor health. Extant research confirms that the chronic stress of living a life that continually oppresses you via systemic racism fosters Black women's weathering and predisposes chronic physical maladies like hypertension (Michaels et al., 2019). My research concentrates on the mental and emotional consequences of the chronic stress associated with systemic racism and highlights that college-aged Black women's mental and emotional suffering is constructed by systemic racism.

The claim that the strong Black woman stereotype exacerbates college-aged Black women's poor mental and emotional health confirms the works of Woods-Giscombé (2011), Lewis and Neville (2015), and Perry et al. (2013). In her study, Woods-Giscombé (2011) concluded that the way in which the "superwoman role" obligates Black women to manifest strength, suppress emotions, and resist showing vulnerability leads Black women to embody their stress via anxiety and depressive symptoms. My finding that the strong Black woman stereotype intensifies college-aged Black women's mental and emotional health suffering is consistent with this conclusion. Furthermore, I affirm the argument of Lewis and Neville (2015) and Perry et al. (2013) that Black women's internalization of stress magnifies their poor mental and emotional health with my finding that when college-aged Black women repress their experiences of systemic racism and discrimination, their mental and emotional health further deteriorates. My results reinforce existing scholarly research declaring the mentally fatiguing effect of the strong Black woman stereotype. The power dynamics enforcing systemic racism preserve the strong Black women stereotype and leave college-aged Black women vulnerable to poor mental and emotional health.

College-aged Black women are emotionally exhausted by our current social and political climates. This argument develops a qualitatively deficient research area. Statistical research from the Pew Research Center indicates that most Americans agree that since President Trump was elected, race relations have worsened and it is now more common for people to express racially insensitive views (Horowitz et al., 2019). The results of my study accompany this statistic from the Pew Research Center to prove that growing racial tension in Trump's America facilitates college-aged Black women's psychological distress. Due to persistent marginalizing structural forces, college-aged Black women become vulnerable to mental and emotional suffering. Moreover, my data indicates that public support for the Black Lives Matter movement positively influences college-aged Black women's emotional well-being. When these qualitative and quantitative findings merge, the conclusion that greater acknowledgment that Black people suffer from structural inequities promotes college-aged Black women's mental and emotional well-being

emerges. My finding of the mental and emotional consequences of the prevalence of racial injustice within the media is an understudied area requiring further research.

Conclusion

Racial discrimination from White people exacerbates college-aged Black women's mental and emotional health. Moreover, the strong Black woman stereotype forces college-aged Black women to internalize their psychological distress insofar that it is embodied in their poor mental and emotional health. Lastly, the growing racial tension in our current social and political climates has adverse and long-term effects on college-aged Black women's mental and emotional well-being. Evidently, systemic racism is a public mental and emotional health crisis.

The results of this study serve to inspire public policy promising to structurally progress racial equity. First, systemic racism must be uprooted from institutions and practices. Second, college-aged Black women need accessible and affordable mental and emotional health services. Third, all states must require accurate and comprehensive education on mental and emotional health and systemic racism. This research functions to prompt the inclusion of mental and emotional health in the assertion that racism is a public health problem. Further research is needed on the long-term mental and emotional impacts of systemic racism. A future study might look to interview two age demographics, for example, college-aged Black women and elderly Black women, to examine how the mental and emotional consequences of systemic racism develop over time.

It has been 400 years since European colonizers kidnapped and enslaved Africans, 155 years since slavery was legally abolished, and 56 years since institutional discrimination was outlawed. While these systems may no longer exist in their established intent, the racist ideologies supporting them persist. Today, instead of being born into slavery, Black women are born into systemic racism. By virtue of the policies and practices that sustain the politico-economic exploitation and social marginalization of Black women, college-aged Black women are structurally vulnerable to adverse mental and emotional health. The consequences of the structural inequities burdening college-aged Black women's lives deserve comprehensive understanding and solutions. My research advances an emerging scholarly call to action to uproot the systemic racism and structural inequities devastating the welfare of Black lives. Regardless of your race, gender, sexuality, ethnicity, age, ability, socioeconomic status, or political affiliation, join the fight for justice and equity for our Black sisters with pride.

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Care in a College Pandemic: Masks as an Extension of the Self

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sponsored by Jennifer Guzman, PhD

Abstract

This visual ethnography project presents a collection of photographs depicting care and daily life in Geneseo during the COVID-19 pandemic. Student researchers discuss images they have captured in six collections: meaning and change in mask culture, creativity in celebrations and holidays, labor and precautions in essential work settings, and care for our physical, mental, and emotional health.

Introduction

Not too long ago I was standing in line at the grocery store, six feet apart from the person standing in front of me as I waited for my groceries to be scanned. It was the holiday season, and to get into the spirit of things I was wearing a polar bear mask, as at this time the COVID-19 pandemic raged on and masks were a required asset to enter public spaces. When it was my turn to step up to pay, the cashier looked at me for a moment before complimenting my mask. She scanned my items and proceeded to laugh, "It's crazy how we've come to complimenting each other's masks, huh?" I politely agreed and laughed along with the innocent comment. We exchanged a few more pleasantries and once our transaction was completed, I went on my way, content with having received a compliment on my mask choice. By the time I returned to campus, approximately a month following the transaction at the grocery store, I adopted that same style of compliment. I found myself complimenting others' design choices for their masks, and in turn I received them. I always felt a surge of pride at the compliments, as if they were complimenting something inherent about me. I found this to be especially true on the college campus, where a variety of different designed masks were utilized by students to complement their outfits or display a fun design. Girls I had never met before would stop me with an "oh my gosh I love your mask!" as I walked around campus, and I would do the same.

While these incidents were simply casual experiences of daily life I overlooked at the time, upon closer reflection, I now realize the unique importance of such innocent remarks. It was the acknowledgement of what I term, *mask culture*, that the cashier and the various girls across campus unknowingly participated in. This mask culture is a form of

care in which people engage in masking practices and masking behaviors that perpetuate the safety of themselves and others amidst the pandemic. I argue here that mask culture has evolved from initial medicinal practices into an incorporation and extension of the self. Likened to clothes or a smile, masks have become synonymous by many as a way to extend their inner personality to an outward expression. In this study I analyze how masks are understood and utilized as an extension of the self, and how said extension is a form of self-expression. Based on my findings, I will focus on two expressions of the body: masks as a substitute for the smile, and the relation between masks and clothing choice.

Theoretical Background

The usage of masks as an extension of the self takes place within the context of care amidst a global pandemic. In order to understand this application of mask culture, we must first ask ourselves—what, in this sense, is "care?" According to Rapport (2018), care is a "particular kind of social framework or environment that endeavors to give an appropriate proportionality to autonomy and inclusion" (p. 250). In the context of his article, this enactment of care exists in a formal capacity (i.e., formal institutions of care systems) and is broken down into four different interconnected subsections proposed by Tronto (as cited in Rapport, 2018): caring about, caring for, giving care, and evaluating care (p. 253). While similar in essence in that each level seeks to ensure the well-being of others, the differences arise in the directionality and focus on the care, with the first two subsections more so oriented towards partnership while the latter two are more related to institutional care. Regardless, at the basis of all levels of care is the individual self, and all care is enacted based on one's individual autonomy interacting with the public sphere and expectations (Rapport, 2018). In such a sense, Rapport's idea of "care" is of an environment that promotes well-being for others while maintaining individual autonomy. I understand this to indicate individual choices of each person within the environment should contribute to the overall well-being of others. Referencing Rapport's work, I refer to "care" as such: the culmination of individual action that furthers or promotes the overall well-being of the community. In the context of care on a college campus, the "overall well-being" pertains to the physical, social, mental, or emotional health and well-being of the members of the college community, be they faculty, staff, students, or community members.

Mask culture, therefore, is a particular manifestation of care in the context of the COVID-19 pandemic. This involves the utilization of masks for both medicinal and social purposes, pertaining to the various forms of "overall well-being." In this study, masks will be perceived in two different ways as the extension of the self. By "extension of the self" I refer to modes of expression as outward signs on the body, as utilized by the smile to portray nonverbal communication and articles of clothing or fashion to portray attitudes or ideas of social belonging. First, masks will be perceived as a substitution for the smile, a unique manifestation of inherent personality. In a study conducted on Russia-China border crossing, in which smiling was not permitted, the lack of a smile seemed to indicate a performance by Russian border security to indicate the seriousness

of crossing from one realm into another (Humphrey, 2018). In this sense, a smile is attributed to performative action to indicate the feeling within a particular social context. The idea of a smile plays into modern ideas of polite etiquette through semiotics. Based off approaches such as Brown and Levison's (1987) "politeness theory," smiling can be interpreted as "a part of repertoires of behavior, an accompaniment to other linguistic and non-verbal pragmatics, such as turn-taking, interruption, avoidance of humiliation, maintenance of personal distance, and so forth" (Humphrey, 2018). The nonverbal associations of a smile within a conversation possess significant semiotic control. Therefore, the loss of said smile relinquishes an aspect of control over the conversation one would normally hold non-verbally, and thus forces it into verbal queues. I propose that masks are another way to regain a sense of control over interactions. While not necessarily in the sense of non-verbal queues in the formation of a smile, but rather, in the expression of self that is prevalent within a smile.

Secondly, masks will be perceived as an extension of self as they relate to clothing choice. According to a study on associations of dress between Norwegian teenage girls and adult women, clothing choices were directly associated with body expression and associations of age and maturity (Klepp & Storm-Mathisen, 2005). As such, the choice of clothes not only became a symbol important to the "ideal body" image, but also to the avoidance of social embarrassment and anxiety (Klepp & Storm-Mathisen, 2005, p. 337). In such a sense, outfit choice is an indication of more than simple desire but also implicit social constructions. With the addition of masks as an essential item, I argue that they have become an article of clothing to be taken into consideration. As such, consideration of display of outfit choice plays into the concept of mask culture we see today.

Ethnographic Context

The focus of this study is the analysis of mask culture expression as seen on a college campus. SUNY Geneseo, the focus college, is a public liberal arts college located in Western New York, the United States of America. Founded in 1871, it follows along the core values of learning, creativity, inclusivity, civic responsibility, and sustainability, per the SUNY Geneseo mission statement that combines rigorous academic and social responsibility (SUNY Geneseo, n.d.-b). As a socially responsible community that seeks to "inspire students to be socially responsible and globally aware citizens who are prepared for an enriched life and success in the world," the student body largely involve themselves in nationwide social movements and adherence to COVID-19 guidelines (SUNY Geneseo, n.d.-b). The college services undergraduates and select graduate programs for an average student age between 18 and 22. With a gender disparity difference of male to female of 60–40, the majority of the student body is female, yet, this is on par with the National Gender ratio for public universities (College Factual, n.d.). Over 90% of said student body comes from within New York State (College Factual, n.d.). While this could be owing to the public nature of the college, it nonetheless falls below the national average on geographic diversity. In terms of racial diversity, the college again falls within the average for the nation, leaning more towards the "less diverse" side of the scale with a demographic makeup of approximately 75% White students. The remainder of the

population consists of 7.5% Latino or Hispanic students, with similar levels for Asian students (College Factual, n.d.).

In terms of restrictions imposed by the college in relation to COVID-19, the college adheres to mandates as imposed by the state and SUNY school system (State Universities of New York). Based on these mandates, SUNY has imposed a three-pronged approach to maintain safe and open campuses that includes SUNY-wide testing, data transparency (release results of tests and keep students and SUNY informed of rates), and uniform enforcement and regulation (SUNY, 2020). The SUNY chancellor imposed specific guidelines in relation to how transgressions regarding policies should be handled, including transgressions such as a failure to get tested, failure to quarantine, or failure to adhere to mask mandates, with certain issues resulting in expulsion from the college (SUNY, 2020). SUNY Geneseo has adopted these same mandates as imposed by SUNY. Students must engage in a series of weekly pooled-testing procedures, with mandatory quarantine or isolation should the pooled-test session come back positive (SUNY Geneseo, 2020). Visitation policies are strictly prohibited and monitored on campus, and students are not to engage in large gatherings unless fully vaccinated and pre-approved by the college (SUNY Geneseo, n.d.-a). Based on college policies, masks must be worn by all participating members of the community in both indoor and outdoor settings, with the exception of their private residence, eating or drinking, or if they are by themselves (SUNY Geneseo, 2020).

Research Methods

This ethnographic study primarily utilizes participant observation and interviewing. An ethnographic study is, in general terms, the observation and gathering of data for critical analysis. According to Blommaert and Jie (2010), ethnography is often misunderstood as a simple methodology and description of collecting and describing data. They push back against this assumption by asserting that ethnography is much more than simple data collection and description and involves a wealth of analysis in the realms of language, communication, and an understanding of how knowledge is formed (Blommaert & Jie, 2010). Based on their holistic definition of an ethnography, this study will utilize ethnographic methods to understand mask culture in the ways individuals utilize masks as extensions of themselves. By engaging in participant observation (the observation of individuals to determine particular behaviors or habits) and utilizing fieldnotes (the documentation of experiences based on participant observation), I observed students within the SUNY Geneseo campus and the ways in which they engaged in methods of care. My particular focus was on masking behavior and the different types of mask designs students wore. Photography was another key part of this study, as I collected photographs of students and their masks to document the type of masking behaviors they practiced. These photographs compliment findings revealed through various student interviews. The data provided showcases information from 5 separate interview sessions with different individuals and was synthesized throughout the data analysis process. Through the data analysis process, a series of 13 interviews were analyzed and key information and trends were selected. The five interviews I refer to in this study represent the general

trends I witnessed throughout a majority of the interviews and observations, which seek to provide a holistic view of the ways students view masks as an extension of the self.

Findings

By wearing face coverings, students are participating in a mask culture of care that utilizes masks to promote the well-being of themselves and their community. This usage of masks extends beyond medicinal purposes and into the realm of expression. Through a series of interviews, students associated the usage of uniquely designed masks as an extension of their body. In particular, the usage of masks as a substitution for the smile is a primary way in which the students viewed masks as an extension of themselves. When prompted about why people may opt to wear masks with designs as opposed to generic surgical masks, L, an undergraduate student at SUNY Geneseo, comments:

> I think [wearing those types of masks] just like not describe themselves but like you can't like see your smile and for me at least like my smile is a big part of like who I am so like some people I know like Anna on TikTok I love her she has like the white mask with the uhm yellow smiley faces and like that just makes me feel like she's a happy person.

Figure 1: TikToker, Anna Sitar (Sitar, 2021)

This comment presents a unique relationship between the ideas of identity and self-expression. In this case, the student is presenting a disconnect between the two commonly associated ideas of self-expression and identity. By insinuating that masks do not "describe themselves" (i.e., personality expression), but going on to indicate a smile as being "big part of like who I am," she presents a smile as an inherent aspect of her personality with self-expression being more so a representative choice. However, she goes on further to emphasize her favorite TikToker (i.e., a social media personality associated with the video-sharing phone app TikTok) as wearing a mask that describes her inherent personality as a "happy person" (mask pictured in *Figure 1*). In this case, her comments are contradictory in nature. Is the smile not a way in which she expresses her inherent personality? To add to this, the masks as a substitution for the smile would equate with expression of inherent personality. Another student, V, emphasizes this relation between the smile and expression of personality. V regards this relationship as much more directional, with a smile being an important way to portray one's inherently unique personality, and mask design choices as being a substitute for the smile.

> I mean I know for me it [a mask with designs on it] represents my personality a little bit more [than generic surgical masks] and it—you know a smile's something we can't show any more and so I feel like your smile is a big indicator of your personality you know how much you smile how- you know if you smile at strangers if you don't whatever and so I feel like you know as much as you know…your smile is what makes you—like it's something personal to you it's identifying to you um I can probably be identified off my smile alone and I think a lot of people could.

In this way V both agrees with and negates a smile serving as an expression of personality. On one hand, V describes the smile as a "big indicator of your personality" and how wearing different masks "represents my personality." While on the other hand, she understands a smile as something deeper and more meaningful than a simple personality expression by indicating that "your smile is what makes you—like it's something personal to you." In this way V is highlighting the unique role designed masks play as an extension of ourselves. By substituting masks for the smile, she essentially raises the usage of masks to the purpose of displaying inherent personality, a role otherwise taken on by the presence of a smile.

Like ideas of the mask as representative of the smile, students understand masks in relation to clothing choice. According to R, another student attending the college, clothing choice can be equated to a form of communication, similar to the ways in which a smile is understood. "I think [mask designs] might just be part of a fashion statement. Umm, that's just one way to show what you would say without showing your mouth. It's kinda like reading lips, I guess in a way." By referring to masks as a "fashion statement" then further associating them with reading lips, R creates a linked identity between clothing and forms of communication. These forms of nonverbal communication are similar to the smile, in that they express something about the individual without overt explanation.

This association of masks with communication through clothes is emphasized by the level of consideration placed into selecting masks based on outfit choices.

> I usually like darker colors and then like the patterns are like camo or like black and grey, just the neutral patterns—just so it matches my outfit. My mask has to match my outfit.

This concern over masks matching outfit choice speaks to the way in which individuals such as L desire to be perceived. Students revealed that one of the most popular choices for mask designs were neutral or black colors, to ensure they matched with their outfits. *Figure 2* depicts a student wearing a black mask. Further in the interview, L continues:

> …I do kind of like at least to me if someone's mask matches their outfit, it like tells me that they care about their appearance or like uhm just about the way they are around people just because you can't really get to know people at these current times so like seeing a bright colored mask like in my head might make someone feel happy, but I don't know, that's probably just me.

Here, she places emphasis on masks that match a person's outfit, in that it portrays certain aspects about the person such as their care for appearance or even how they interact

Figure 2: Student wearing a black mask. Photograph: Elizabeth Mac Kay

with others. Under this assumption, L insinuates that individuals who wear brightly colored or fun designed masks may be an indication of their care for others. Other interviewees such as student S indicate that this emphasis on clothing is more for aesthetic appeal of each individual person, and what they see as "cute."

> Umm, I think it's [masks with designs or logos] cute, y'know I think they've kind of become an extension of our accessories, kind of like a scrunchie, so I think it's just fun to customize them, or have little different designs.

Figure 3: Mask Designs. Photograph: Iversen

Still, another student disconnects this expression of clothing with the expression of personality. When asked about how she utilizes masks as a form of self-expression, she states in a quippy exchange how matching it with the outfit is simply too much effort.

> Z: I mean, I pick out the mask patterns that I like. I just don't really match them with my clothing…That's more effort than I put into anything.

In this brief exchange the interviewee, Z, insinuates that while she selects mask designs based on what she herself likes, she does not make the next step to match with her outfits. Rather, her mask choice involves her likes and dislikes, and in such a way, this is a type of personality expression. *Figure 3* displays masks with designs, not those commonly associated with "matching everything." If this is so, what then does this lack of usage of designed masks indicate about a person? Does this indicate that individuals who opt not to wear masks with designs on them are less expressive?

This is hardly the case. There could be a wealth of reasons why individuals opt to not wear a mask with designs on them. The lack of a design mask does not indicate a lack of

personality, just as much as the presence of a design mask does not indicate an overabundance of personality. As with any way of expression, they are simple choices. L comments on this usage of masks on the SUNY Geneseo campus, and points out a common reason behind certain mask usage patterns.

> But I think like walking around campus in Geneseo I see more like the athletes wear the medical ones and then more like everyone else wearing like patterns or just something to like help describe themselves in a way. Uhm but I will say like last semester I was in person for a class like wearing a normal mask was so difficult like I had to wear the medical ones because they're much more breathable so I think once classes like start and if people have issues like breathing when walking up the hill and sitting in class and then walking back down I think medical masks will probably be more popular.

Mask design choice, in this case, has to do with both personality and physical comfort. This connection between the two creates a field of uncertainty for mask choice—should you choose self-expression or comfort? According to many students, it is comfort that they look for the most in a mask. When asked what mask is their favorite and why, they generally answered in one of two ways, or both. First, they emphasized the color of the mask, be it neutral, black, or a dull camo, with statements that the mask matched their outfits or, as V puts it, "vibes with [her] personality." Secondly, they emphasized the comfort of the mask, including material and size of the mask.

Discussion

Mask culture has become a salient aspect of the campus community. Through considerations of care for the community in mask usage, students have found ways to incorporate ideas of the self within mask utilization. In essence, they have extended mask culture from simple medicinal purposes to an extension of the self. Utilizing masks as an extension of the self is accomplished through two primary associations: the association of masks to the smile and the association of masks to clothing choice.

The smile is an expression of inherent personality, and through association, the mask is depicted similarly. The usage of smiling provides various forms of nonverbal communication. A half smile can indicate a silent hello. A wide smile can indicate happiness. No smile can indicate a state of neutrality. As such, these various identities can be communicated through the usage of a smile, and in such a way, the smile can be utilized as an extension of the self. Based on what you wish to portray, your smile outwardly expresses your feelings. However, with these new considerations for care in the community, mask usage has become a necessity and has inherently cut off that form of bodily communication. As a result, students have had to implement new forms of bodily expression in exchange for the smile. This has been negotiated with the implementation of mask design. Through different mask designs (i.e., dark color, light color, floral print, plaid, tie-dye, etc.) students can communicate an aspect of themselves to others in place of the smile. Take, for example, a student who smiles often. This can be attributed as a personality trait of theirs, or a form of expression often seen. If you ask other students to describe

them, they may use descriptions such as "happy," "kind," or "always has a smile on their face." The smile has become an inherent part of their personality. Now, take this same student in the context of the COVID-19 pandemic. The smile can no longer be seen. In place, said student may wear a brightly colored mask, or a mask with smiley faces on it to portray that aspect of themselves that has been kept hidden. In this way, people's identities are contested and created through the usage of masks.

Of course, this is neither meant to insinuate that the same smiley student is forced to wear certain masks to portray their personality, nor are they restricted in the types of masks they can use. This is where the second utilization of masks as an extension of the self-manifests. In this way, masks are associated with clothing choices, with an emphasis on the mask matching clothes or being comfortable. This is in relation to clothing choice in general, in which individuals tend to select clothes based on levels of social acceptance (i.e., fashion) (Klepp & Storm-Mathisen, 2005). Clothing style is associated with social acceptance and maturity, and thus, has evolved into an important consideration in everyday life. This emphasis on clothing choices has permeated into a unique blend of societal expectations and self-expression, with modes of self-expression through clothing tending to fall within societal expectations. Masks have become an associated article of clothing for the modern student in the context of the COVID-19 pandemic. Consequently, students place a heavy emphasis on mask designs that can be incorporated into their clothing style to maintain social significance or relevance. This falls within the realm of social expectations of style and personal expression of style.

Conclusion

Mask culture has been incorporated into forms of care in college during the COVID-19 pandemic in the form of mask expression. Two primary ways in which this is understood by students is through masks as a substitution for smiling and masks as an extension of clothing style. Smiling and clothes are both expressions of the self in the sense that it portrays our inner personality and our desire to adhere to social standards for fashion. In this sense, are masks essentially a performative action that we engage in to portray our personality? Or are they simply based on comfort? Results from this study indicate that it could be a mix of both. Students reveal the unique dichotomy between them, in which they understand masks to have meanings of self-expression, while also making their selection of masks based on levels of comfort or fashion. Further analysis may look into the underlying logic behind this mode of self-expression, and the role comfort plays in the selection of masks.

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Mask Culture

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sponsered by Jennifer Guzman, PhD

Abstract

This paper defines care in a college context as well as discusses the topic of mask usage in the same setting. It addresses how people have adapted to the implementation of masks and how society has changed their daily routines in order to guarantee that their masks were now a part of it. It consists of various feedback from college students surrounding the topic of masks, as well as how they, as individuals, deal with the guidelines executed across the SUNY Geneseo campus. An ethnographic research process was used to understand the usage of masks in today's society and if/how they have been implemented. Through field notes, interviews, and a coding and memoing process, it was found that the usage of masks had shifted people's perceptions of others throughout the year of the COVID-19 pandemic. The interviewees expressed that they felt anger and frustration towards those who did not wear a mask in public. It was also found that people did not find the implementation of masks as much of an inconvenience as I expected they would before going into this research process. As well as people realizing that masks were no longer a temporary objective and more of a permanent one. After examination of all the findings, it was concluded that masks have played a vital role in society today, as well as becoming a permanent objective, more importantly throughout people's daily lives.

A year ago, people would hear the word masks and think of superheroes and their colorful disguises or doctors in hospitals wearing their simplistic plain blue masks. It was a time when we never second-guessed the role they played or didn't play throughout society. People wouldn't give them a second thought if they saw a doctor wearing one in their natural setting, but nowadays, we do not give masks a second thought when we see them in public spaces or even classroom settings. Who would have thought that just over a year later, masks would have a completely different, integral, role in society? We as a country have adapted to the use and implementation of masks as a whole. They have become a part of our everyday lives, just like a piece of clothing or even an accessory to make an outfit "complete."

By examining the use of masks in a college setting, we can begin to understand how something as simple as masks plays a vital role in the daily lives of students, both on and off-campus. This specific study can also shed light on how the pandemic has affected the lives of students not only physically, but mentally and emotionally as well. My research is centered around the evolution of masks and how they began in a medicinal setting

and have now become a crucial staple in our society. I also looked into how people view masks. Do they still see them as an inconvenience or have they adjusted to wearing a mask for over a year now. My questions are evaluating how people have adapted to masks as a way of life but also how they view others' adaptations to masks. Does someone get angry when they see somebody else not wearing a mask? Are they so accustomed to seeing masks, they don't realize when there is not a mask being worn? This is fascinating when it is looked into since a majority of us tend to not think about it in this sense, but just overlook it and move on with our day. However, do people still have a hard time adjusting to masks even though it has been over a year? Is it a habit to grab a mask when going in public or do you still have to remind yourself to reach for that small piece of fabric in its own newly-made space?

During my research, I looked at the term 'care' as an act that someone does for someone else, as well as themselves. Wearing a mask not only benefits you in the long run, but also the people around you whether they are family, friends, or even strangers. I saw care as a means of adapting the newly-introduced lifestyle of incorporating masks into our every move. In terms of mask evolution, I viewed the word 'evolution' as both an adaptation to masks as well as how they have changed from a medicinal use to ways of self-expression. Evolution can be defined as, "…the change in the characteristics of a species over several generations…all species are related and gradually change over time" (Yourgenome, 2017). Regarding this terminology, I do not mean that future generations will be born with masking on their faces or a better filtration system within them, but more so that the younger and future generations will grow up wearing masks during cold/flu seasons or may have to wear them all year round, depending on how they are raised. Evolution in this sense relates to how people have adapted to the mask mandates and having to wear these pieces of fabrics over our noses and mouths in order to reduce the spread of COVID-19. We as a society have the mutual understanding that you are to leave the house with a mask and not be without one until told otherwise. Although it seemed hard to adjust to in the beginning, we now understand the benefits of the mandates.

Throughout my research, I realized that we have adjusted to the use of masks in ways other than just wearing them. We have given masks a place in our homes that makes them easily accessible when leaving for the public. The term I find best suits this evolutionary change is "cultural invention." According to anthropologist H. G. Barnett (1942), "a significant relation exists between one aspect of the acceptance of newly introduced traits and the phenomenon of invention" (p. 14), ultimately defining the relationship between mask implementation and society's reaction and acceptance of them. Throughout the study, I realized that many of us have some sort of hook device near our main doors that is primarily for our masks (see *Figure 1*). This is so we do not forget them when leaving our houses and can keep them near important exit points that are easily accessible. Obviously, this device was not discussed amongst the people who include them in their homes. However, as a society, we saw that we had to implement masks and decided that this was the best and most functional way of doing so without completely changing our way of life. Some people may have already had these hooks near the door for either a sweatshirt/jacket, or their car keys; this demonstrates "the possibility of utilizing two

different principles, already acting through two different but familiar forms, to achieve the same function" (Barnett, 1942, p. 16). By simply adding a mask to the hook, it completely changes the way that we see masks as a part of our society; this minute action demonstrates that they are now a part of our everyday lives and have become part of our essential daily items such as car keys or a jacket. Someone may have a jacket hanging on that hook to take out with them in case they need it and put it right back when they return home. It is not that it is there to remind us to take it, but instead because we may need it whilst we are out in public, and not while we are in the comfort of our own homes. It is quite similar with masks. We may need the mask while we are out and about in public, but once we return home, we can leave it at that threshold and not have to think about it in the privacy of our homes.

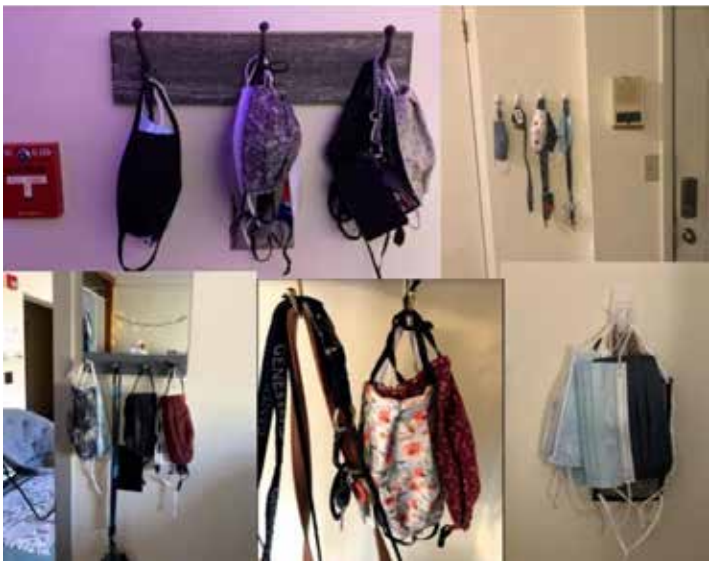

Figure 1: Masks on hook device for accessibility

The ethnographic research was conducted within students of the State University of New York at Geneseo (SUNY Geneseo) on and off-campus. SUNY Geneseo is a public liberal arts university with a large on-campus population, as well as students residing off-campus. The surrounding town is a very small, rural area made-up of mostly locals and families. It is not your typical "college town" where there are students everywhere, but during the school year, you are most likely to see students around the main strip and in the locally-owned businesses. Students acquire off-campus jobs in order to have an income while attending school, so it is a great way to interact with the local residents, as well as peers in an off-campus setting. A majority of businesses close to the campus are family-owned, so they were affected greatly when the COVID-19 pandemic began, resulting in some closing down.

The student body has done a great job in upholding the precautions and mandates implemented by the school's officials. A campus-wide mask mandate was announced by President Battles soon after New York's Governor, Andrew Cuomo, announced the mandate for the entire state. This information is easily accessible to students from the SUNY

Geneseo website under the "COVID-19 Information for Students" page. The face mask requirement by the school states, "Masking is still required by all members of the campus community on campus at all other times, including all indoor spaces, even when six-foot spacing exists—unless when alone in their private residential, office, or personal space; eating meals on-campus while seated and physically distant; or by themselves" (SUNY Geneseo, n.d.). This mandate limits the amount of COVID cases across campus, in turn keeping the student body safe and healthy during this pandemic. On top of the face mask precautions, the school also implemented a weekly testing procedure for all students and faculty, whether they are on or off-campus. Once identified, they can keep sick individuals away from healthy individuals and keep the cases to a minimum across campus. Weekly testing also allows for the school officials to minimize the oubreak and identify all those that may have been in contact with the sick individual. I do believe that SUNY Geneseo has done a great job in limiting the spread of the COVID-19 virus, as well as making sure their students and faculty are kept safe and healthy while still being able to enjoy the "college experience" that we all came here to have.

The research methods used throughout this ethnography were very thorough and helpful when understanding the main points of the research itself. We based a lot of our research structure off of anthropologists Jan Blommaert and Dong Jie (2020). Their book laid every detail out step-by-step to encapsulate the importance of each moment of ethnographic fieldwork and research. We were able to understand how each step was to be carried out, but also what can happen when things don't go according to plan. This idea was prominent in chapter four of Blommaert and Jie's (2020) book when they suggest that "chaos is the normal state of things" (p. 25). I took this statement as anticipating that my interviewees and other participants would not be able to give me a multitude of opinions regarding masking due to the pandemic. I was hoping that since it was a new topic in our lifetimes, they would be able to give me a strong opinion when talking about masks. I tried to get various responses to my research questions by asking a multitude of different people. Blommaert and Jie (2020) were also able to give me a better understanding of what an ethnographic study truly is. They stated:

> Ethnography is perceived as a method for collecting particular types of data and thus as something that can be added…even in anthropology, ethnography is often seen as a synonym for description. In the field of language, ethnography is popularly perceived as a technique and a series of propositions by means of which something can be said about "context." (Blommaert & Jie, 2020, p. 6)

I viewed this statement as a way in which we as researchers can observe and interact with the people around us, as well as those participating in the study within their real environment. There are no bells and whistles to the research process, all the information you need is right in front of you, you just have to go looking for it. I also believe that an ethnographic study was the best way to go about collecting this data because it allowed us to get a true understanding of the people around us, whether they be on or off-campus. I enjoyed this study as an ethnography because I was able to talk to people I know while

also being able to learn from people that I don't know. I also think it was a great way to get into the topic of fieldwork and fieldnotes because it gave me a chance to observe the way that people around me live and interact during a time like this. An ethnographic study made it possible for the researchers involved to become more involved than ever before and get a true first-hand experience of the world around us. I don't think I would have gotten the same results that I did if we conducted this study under different terms.

As previously mentioned, we conducted fieldwork in different areas of our lives and were able to turn those experiences into field notes. Those notes better assisted in understanding the environment around us and how people that we may or may not know function on a day-to-day basis. They also provided us with invaluable information about what an ethnographer saw and how they did so. Fieldnotes, in a sense, coincide with participant observation since you can focus on things that register as striking and occur throughout your daily life. I, personally, was able to get a lot more information into my field notes when I started looking at the less obvious, more shocking things that were going on around me. After conducting field notes, we as a team came together and were able to narrow down different topics to find what fits best in our study so we could later go out and find examples fitting to capture in a photo and share with the others. Photos provide support when making an archive and can become a part of the data to look at and think, 'wow this really is going on around me, I just have to go out and find it.' The photos were a big help when conducting this study because it gave a lot of information about various experiences that each one of us had. Although photos may change throughout the study, it was a great starting point to begin to understand the important role certain things have on society today. The last part of the research collection was conducting interviews. Each of the ethnographers interviewed at least one person either on or off campus and gather a multitude of information that helped each one of us when analyzing all the data collected. I thoroughly enjoyed the interview process since I was able to get a deeper understanding of my own research and decide if what I was worried about in the beginning would hold true or not.

After everyone finished the interview process and was able to provide a transcript, I dove straight into the coding and memoing process. This was probably the most interesting part of the entire study because I was able to look back on things that I had done earlier in the research process and had forgotten about or didn't fully understand how it coincided with my research overall. I was able to pick through all the compiled data collections and find the information I needed to complete my own study. I found a couple patterns within the interviews, one being that depending on how the interviewer asked the question, the interviewee would interpret it in different ways, ultimately leading to mixed responses. For example, my research involves the question of "when was the last time you remember not having to wear a mask in public settings?" Some interviewees took this as a recent recollection of not wearing a mask such as being in the park or on a simple walk during the pandemic, where others took it as the last day before news of the pandemic hit that you did not have to wear mask in *any* public setting. I think this is mainly due to the wording of how different researchers asked the question, but also if the interviewee even had a last memory of not wearing a mask in public. After completion of the coding

and memoing process, I had a much better understanding towards my research overall and how each small part that went into it, coincides with the other. It was fascinating to see it all come together before even completing the entirety of the study.

Once I finished the coding and memoing process, I was able to take a look at all of my compiled data and see how my initial research questions were answered throughout the entirety of the study. My first question was regarding the reaction people had when seeing others around them not wearing masks, whether it be improperly or not at all. I wanted to know more about this specific topic because I could not tell if it had shifted or stayed the same throughout the past year of the pandemic. I asked the question during my interview, "what do you think when you see someone in a public space without a mask on?" (LaMartina, personal communication, 2021). Although this question was pretty straight-forward in terms of coordinating to my research question, the interviewees took it in different directions. When it came to the person I interviewed, she responded with,

> I think there's like two different kinds of like two different ways to answer this question I guess. So like if I see someone like out in public that has a mask on but it's like here [gesturing to below nose, above mouth] like not covering their nose I'm like can you just pull up your mask like I don't get why you can wear it over your mouth and not over your nose like I almost think that's more stupid than not wearing a mask like I just don't—I can't understand that like you're halfway there, just pull it up. Um, and people I see like—I don't see a lot of people that don't wear masks unless it's outside which I'm like fine with but like sometimes people at Wegmans don't have a mask on and honestly I kind of don't notice it like in the beginning which is weird cause I said I notice on TV when they're not wearing it but I feel like we're used to people at Wegmans like not wearing a mask like before, but then I'm like I don't understand it like it's like proven that it protects you in some sort of way even if it's a little bit and like everyone else is around you and it's kind of like masks are more to protect others from you or something like that so…we're just trying to protect ourselves so I think it's more like I'm wearing a mask to protect you so you better your mask to protect me. (LaMartina, personal communication, 2021)

This answer, as in-depth as it was, gave me a wonderful understanding as to how people not wearing masks in a public setting truly affects those around them. Although it may not seem like a big deal, in the world we live in now, a piece of fabric can really change someone's entire thought process of somebody else whether they know them or they are just a stranger. The prime response from the interviewees was that they would feel anger, frustration, or even disappointment, but not do anything about it. This general feeling was primarily discussed in another interview. The interviewer asked the same question as myself ('what do you think when you see someone in a public space without a mask on?') and got the response of, "Just kinda like disappointment and exhaustion. I just think like 'wow here we go', but then I'm not the one to pick a fight with an anti-masker so… helplessness is a very good way to put it" (M, E., personal communication, 2021).

I found this response interesting because at the beginning of the pandemic, if someone saw somebody else not wearing a mask, they would try to get an answer as to why there was not one in sight. However, there is a continued pattern of answers consisting of people not intervening with the other person's choices and just letting them be since they don't think it is worth it. This raises the question of, did people think confronting others at the beginning of the pandemic regarding non-mask usage would help/change the situation, or was it just to show that they care for the people around them whereas the "anti-masker" may not? This idea of not wearing masks in public places also relates to taking them off when around people you know, even if there are people there you may not be particularly close with. I feel that the same idea comes into play of being disappointed or just tired of people not adhering to the mask mandate, even if they do find loopholes within it. In one field note excerpt, it was mentioned that a friend of a friend had come over to the table outside to stop by and say hi, "A few of C's friends approached our table so I stopped eating and quickly put my mask on to be considerate, however, they pulled their masks down to speak with C" (Iversen, personal communication, 2021). Being that this ethnographer included this interaction in their field note, it alludes to the idea that it the action of the "visitor" of the table pulling their mask down, peeved them. Although they were outside and had a mutual friend, the person that came up to the table to say hi, was not in the same "COVID bubble" as the ethnographer, making it an uncomfortable situation to be put in and ultimately disregarding the mask mandate of the school. Once again, we can see that the observer did not say anything to the person who had pulled their mask down, demonstrating that improper mask usage is not something that people pick a fight over nowadays, contrary to the beginning of the pandemic as earlier stated.

Another question I had that was answered throughout this research process was that of how people see masks as an inconvenience throughout their daily lives. On top of that, when they saw masks as a more permanent objective rather than temporary. One question I asked relating to this finding was, "describe for me how you were able to adjust to the mask mandate implemented last year." By asking this question, I was able to get an idea as to how easy or hard it was for different people to get used to the usage of masks, ultimately demonstrating how much of an inconvenience they were and maybe still are. My interviewee was able to give me a different perspective on adjusting to them since she mainly stayed home when the mandate came out but also works at her family-owned business where you have to wear a mask. She stated:

> …we were inside so I didn't really see people going from no mask to mask like when I went out I was kind of just like used to everyone wearing a mask…but I remember like working since I was home and I was like this is so difficult to work in a mask like I have to talk to people like all this stuff and like now I'm like ehh it's just a mask…I do think that adjusting did take some time but I also think it's because we didn't know a lot so we're like what is this mask doing and whatever. Uhm and now with the double mask like people know it's more important to wear a mask so I think that with more information comes more like adaptability and like willingness to wear the mask. (LaMartina, personal communication, 2021)

This answer gave me great insight into how people are able to adjust to the masks over time and may not see them as much of an inconvenience now as they once did. I do understand that this may not be the case for everyone, but as long as a majority of people don't see them as an inconvenience, there might be a chance that once the mandate is lifted, people will continue to wear masks at least for their own protection. Another question I asked to better understand the implementation of masks into people's daily lives was, "when did you realize that the use of masks were not going to be a temporary objective?" An answer to this question that I found to be most informative was from a fellow ethnographer's interview. Their interviewee responded with:

> …we started getting the vaccines, um, distribute, and I got both doses and we still had to wear masks…So i feel like that was the time where I was like oh okay, this is not gonna, like, end soon. This is gonna be for the long run… probably at the beginning of the semester. Yeah more like—yeah. I say more recently. As everything is getting better still. (Alisa, personal communication, 2021)

I found this response most interesting because it mentions that the interviewee did not see masks as a permanent objective until most recently. This differs from a majority of other answers I saw during my coding and memoing stage because people had seen masks as a permanent thing towards the beginning/middle of the pandemic. It was also mentioned that once the mandate was in effect early on, a lot of people realized that masks were not going away any time soon.

I believe that masks were seen as an inconvenience to people right at the beginning of the pandemic. As soon as the state-wide mandate was announced, it set in for people that they would have to learn to adjust to them and see them as a way of life instead of an inconvenience. During my memoing process, I also found that other researchers were asking questions that helped both my research and their own. Such as, "Describe to me in as much detail as possible what it is like to have to wear a mask when being physically active" helps me understand how much of inconvenience masks are for certain people. Although this question is not directly related to my overall research questions, it still helps since it alludes to the daily use of masks. Another ethnographer asked her interviewee this question and I found that their answer helped me understand the inconvenience of masks for different types of people. Once asked the question she responded with:

> Um, I would say it's one of the hardest things I've ever had to do. Because, you know, when you're out of breath, all you want to do is catch your breath. And you can't when you have, you know…literally the only two places that you can breathe. A lot of the times we find ourselves like pulling on masks down. No, like they get so wet. It's just, it gets really gross. It's really tough. (Benedict, personal communication, 2021)

Seeing that masks are this much of an inconvenience for not only athletes but people who are physically active in general, makes me wonder how fast the mask mandate will be lifted for those in sports or other highly physical activities. I enjoyed seeing the overlap

between another ethnographer's research question and my own since it gave me a completely different view of masks being a possible inconvenience throughout our daily lives.

After a complete examination of my findings and various responses to my questions, I found that masks have, obviously, played a vital role throughout society's daily life, as well as being somewhat of an inconvenience during it. I believe that this is an important observation throughout my research because it shows that although we as a society may find masks inconvenient, we will not put our health at risk. We have adapted to the implementation of them over the course of the past year and made them something we could fit into our daily lives by hanging them up with our car keys or even making them an accessory to our outfits. I think that masks have changed who we are as people because we see things in a much different light now. Before, many people saw our health as something we could control but when the pandemic hit, we felt a sense of hopelessness. I see masks as a way of getting that control back into our lives and being able to dictate how we feel not only physically, but emotionally as well. Masks are a new way of caring for yourself in times like this. If you don't wear a mask in public, people see you as careless for not only yourself but the people around you as well. This type of care through masking is one that nobody has ever had to experience before, so adapting to this as a country makes it that much easier since you're not necessarily "alone in the fight." Care through masking is, I believe, going to be something that sticks around for a while with or without a mask mandate in place. It allows us to be in control of our health now more than ever before since we are not exposing ourselves to all the germs on every surface we touch daily. Masks truly have changed the way that each of us cares about ourselves and for the people around us.

In terms of mask usage, I think that people will continue to use masks when close to other people since they have seen the positive effects they can have during certain periods of mass infection and have helped keep the non-COVID-19 sicknesses to a minimum. An action item that may follow this specific research study would be the continuation of mask usage, but not thinking less of people who do otherwise. The issue that society still has a year later is shaming people for not wearing masks in public settings, whether the person has health complications or they just don't see the upside to wearing them. Regardless of the reason behind not wearing a mask, we should not be the ones to judge them and see/make them lesser than ourselves. Care practices that I found to be valuable were when we recognized that masks were/are an inconvenience, but that didn't deter society as a whole from wearing them either in crowded public settings or even around close friends. We continue to wear them despite their annoyances during physical activity or other strenuous actions. I believe that this goes to show how determined we as a country are to get over the entirety of the pandemic and return to a more "normal" life once again. By continuing to wear masks and following mandates, I believe this will end shortly, especially since we have yet to let these precautions affect us negatively.

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The Relationship Between Social Inequality and COVID-19 Morbidity and Mortality

Allison Panaro

sponsored by Melanie Medeiros, PhD

Abstract

Coronavirus, also known as COVID-19, has greatly impacted the world as we know it. Each country has suffered in their own ways and faced many hardships regarding the pandemic. There have been 134,957,021 confirmed cases of COVID-19 globally and 2,918,752 recorded COVID-19 deaths (World Health Organization, n.d.-b). This study will analyze World Bank and World Health Organization data to examine the relationship between inequality and COVID-19 morbidity and mortality globally. The analyzed data includes, the total number of COVID-19 cases, COVID-19 deaths, percentage of total cases per population size, and the Gini coefficient (the measure of income inequality) for each country. This study will present graphs comparing the percentage of COVID-19 cases and COVID-19 deaths per a country's population in relation to their Gini coefficient, to explore the relationship between inequality and the severity of the COVID-19 pandemic in nation-states.

The Gini coefficient is a numerical ranking of a country's income inequality. *Figure 1* shows that there is a direct correlation between the Gini coefficient and morbidity rates. *Figure 2* shows that there is a slight correlation between the Gini coefficient and mortality rates.

Countries with a lower Gini coefficient within their population had lower COVID-19 morbidity, while those with a higher Gini coefficient per population had higher COVID-19 morbidity. This means that those countries with a lower measure of income inequality also had a lower percentage of COVID-19 cases, while those with a higher measure of income inequality had a higher percentage of COVID-19 cases. The top twenty countries with the highest number of COVID-19 cases in 2020 include: The United States of America, India, Brazil, the Russian Federation, The United Kingdom, France, Spain, Italy, Turkey, Germany, Colombia, Argentina, Mexico, Poland, Iran, South Africa, Ukraine, Indonesia, Peru, and Czechia (World Health Organization, n.d.-a). Globally, about 1.47% of the population contracted COVID-19 in 2020. About 3.21% of the

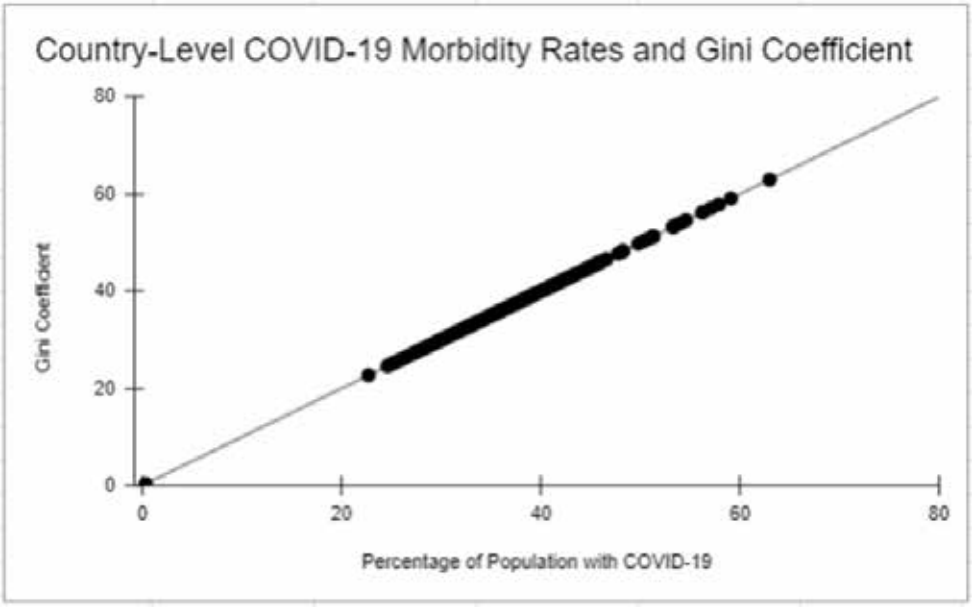

Figure 1: This figure shows the Gini coefficient as compared to the percentage of COVID-19 cases per population within each country in 2020 (Central Intelligence Agency, n.d.).

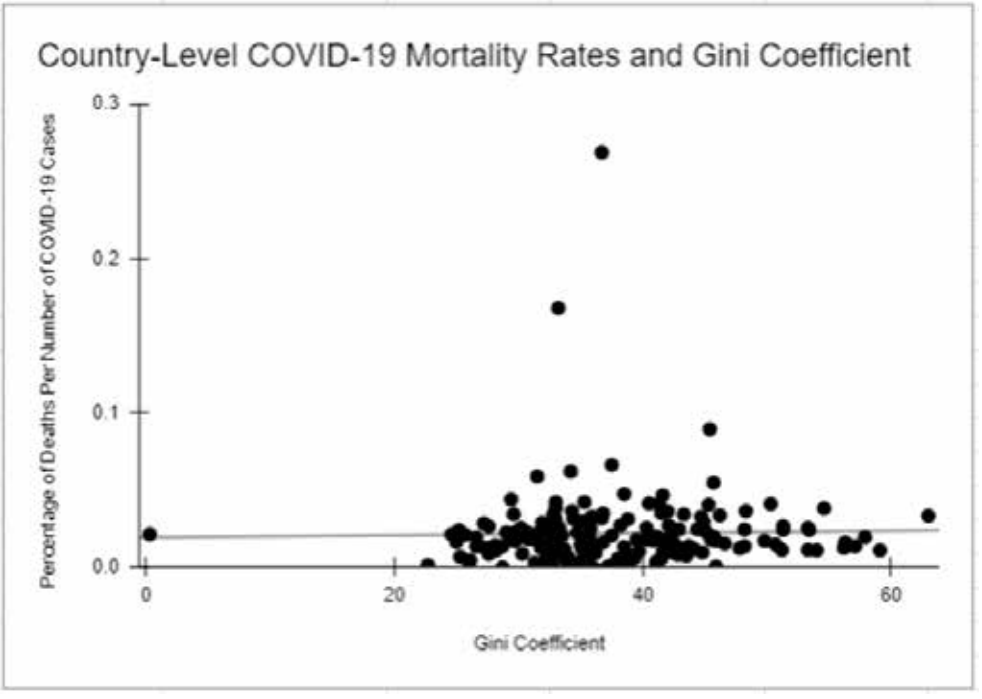

Figure 2: This figure shows the Gini coefficient as compared to the percentage of COVID-19 deaths per number of COVID-19 cases within each country in 2020 (Central Intelligence Agency, n.d.).

population of the Holy See was infected with COVID-19, which was one of the highest. Namibia had about 1.58% of their population infected with COVID-19, ranking second in the entire world (World Health Organization, n.d.-a). Brazil was included in the top 10 countries with the highest Gini Coefficients (53.4) from 1967 to 2019, meaning there is a high-income inequality within their country (World Bank Group, n.d.). Globally, Brazil was ranked 43rd in the percentage of COVID-19 cases per their population.

This is high compared to the 236 other countries, dependent areas, and disputed territories. They also had the third highest number of COVID-19 cases in the entire world (World Health Organization, n.d.-a).

Countries with a high level of income inequality will most likely have higher COVID-19 mortality rates, while countries with lower levels of income inequality are likely to have lower COVID-19 mortality rates. However, there have been some exceptions to this trend. Yemen for example, had the highest mortality rate with only a 36.7 Gini coefficient. This country did not have the highest level of income inequality even though they had the highest mortality rates. This means that the trend is neither linear nor direct. The top twenty countries with the highest number of COVID-19 deaths include: The United States, Brazil, Mexico, India, The United Kingdom, Italy, The Russian Federation, France, Germany, Spain, Iran, Colombia, Argentina, South Africa, Peru, Poland, Indonesia, Turkey, Ukraine, and Belgium (World Health Organization, n.d.-a). The United States ranked highest in COVID-19 morbidity as well as COVID-19 mortality worldwide. Of the top twenty listed for the highest number of COVID-19 cases, nineteen of these countries also hold the highest number of COVID-19 deaths.

The top twenty countries with the highest population in 2020 include: China, India, The United States, Indonesia, Pakistan, Brazil, Nigeria, Bangladesh, the Russian Federation, Mexico, Japan, Ethiopia, the Philippines, Egypt, Vietnam, the Democratic Republic of the Congo, Turkey, Iran, Germany, and Thailand (World Health Organization, n.d.-a).

Of these twenty countries, only eight ranked in the top twenty for the highest number of COVID-19 cases and COVID-19 deaths. This means that even though a country has a large population, it does not guarantee that they will have higher COVID-19 morbidity or mortality rates.

When looking at each country's ranking into low income, lower middle income, middle income, upper middle income, and high-income countries, there is a trend between countries with higher COVID-19 mortality, higher COVID-19 morbidity, and higher incomes. For example, the United States is placed into a high-income country and ranked first in total COVID-19 mortality and COVID-19 morbidity in the entire world (World Health Organization, n.d.-a). In fact, most high COVID-19 mortality and morbidity rates were seen within the middle income to high income countries. Brazil and Mexico are placed into the upper middle-income countries. They were ranked among the top 5 countries with the highest rates of COVID-19 mortality and COVID-19 morbidity globally (Central Intelligence Agency, n.d.). Argentina is placed as a middle-income country and was ranked 12th for the highest rates of COVID-19 morbidity, and 13th for

the highest rates of COVID-19 mortality worldwide. India is considered a lower middle-income country. Globally, however, they ranked 2nd for the highest rates of COVID-19 morbidity, and 4th for the highest rates of COVID-19 mortality. Ethiopia is a country who falls under the low-income category. They ranked 72nd in the highest rates of COVID-19 morbidity, and 71st in the highest rates of COVID-19 mortality (Central Intelligence Agency, n.d.). This data shows that low-income countries have lower rates of COVID-19 morbidity and mortality, while those with higher incomes suffer from greater rates of COVID-19 mortality and morbidity.

This data provides insight into the links between inequality and COVID-19 morbidity and mortality. It is likely that the direct link between inequality and morbidity is due to socioeconomic and occupational factors, poverty rates, and the quality of or access to healthcare. It is also very likely that variables such as the quality of the healthcare and sanitation infrastructure, poverty rates, and/or the existence of conflict influences the mortality-to-inequality ratio. However, more research is needed to further understand why there is a direct link between inequality and COVID-19 morbidity, but not mortality. By looking at inequality and COVID-19 rates, this study has shown that inequality must be addressed as a public health issue in order to prevent future pandemics.

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LGBTQ+ Experiences with the COVID-19 Pandemic

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sponsored by Melanie Medeiros, PhD

Abstract

The LGBTQ+ community regularly faces discrimination at both the interpersonal and structural level, causing stress that manifests itself in adverse physical and mental health outcomes. LGBTQ+ youth and young adults are in a precarious position where they are still dependent on others and have less freedom to limit their interactions with unaccepting individuals. The COVID-19 pandemic and subsequent lockdown forced most college students and young adults' home to family, facing financial insecurity and the loss of services. The lockdown further limited the mobility of LGBTQ+ and constrained their ability to access protective factors against discrimination, such as social support and therapy. Guided by Meyer's minority stress model, this research highlights how certain unique stressors already faced by the LGBGTQ+ community have compounded in the context of the pandemic. Using interviews and surveys conducted during the pandemic with LGBTQ+ within and outside the SUNY Geneseo community, issues such as familial acceptance and uncertainty for the future juxtaposed with discussions on self reflection and forms of resilience were highlighted. This research seeks to add to the discourse surrounding the specific needs of minority groups during the current pandemic and future crises that may replicate similar conditions.

Background

The LGBTQ+ community has historically been faced with discrimination in healthcare, the workplace, family, and local communities. Primary forms of discrimination, such as violence and ostracizing, have direct physical effects, but the stress from subtler forms of discrimination, such as microaggressions and perceived stigma, become embodied and manifest as chronic diseases. The minority stress model posits that the constant stress of being a discriminated minority has an accumulating effect that increases the risk of heart disease, diabetes, and obesity due to the overactive stress response (Azagba, Shan, & Latham, 2019). Stigma also has adverse effects on mental health, presenting increased mood disorders, and suicidal tendencies (Quinn et al., 2015). As a way of coping with this, many LGBTQ+ turn to risky behaviors such as

smoking, substance abuse, under and overeating, and unsafe sex, thus increasing morbidity, mortality, and stigma (Fredriksen-Goldsen et al., 2016).

The stigma arising from these behaviors is present as structural stigmas in community-level norms and discriminatory policies (Parker et al., 2018). The interplay of this type of stigma and enacted stigma contributes to the fear of the healthcare setting. Structurally LGBTQ+ already have limited partner benefits with insurance and may not align with the binary male-female system (Quinn et al., 2015). As a result, 1 in 6 LGBTQ+ avoid healthcare, especially preventative care measures, and only utilize care when needed (Casey et al., 2019; Burgess et al., 2007). The high-intensity care sites they rely on are also the locations with the highest discrimination levels (Callahan et al., 2014).

However, LGBTQ+ individuals are readily capable of engaging in forms of resilience with the right context. While familial support is often low for LGBTQ+ individuals, they can strategically utilize "chosen families" for social capital (McConnell, Birkett, & Mustanski, 2016). Strategically revealing their identity, self-affirmation, self-care, and pro-active coping can all mediate the effects of discrimination (Fredrikson-Goldsen et al., 2016; Colpitts & Gahagan, 2016). At the community level, social activism, safe spaces, and positive representation can produce protective effects and improve individual factors that mitigate discrimination (Colpitts & Gahagan, 2016; Meyer, 2015).

My research follows a period where society is being put through a mental and physically taxing period. Health disparities and risk behaviors already present in the community put LGBTQ+ at risk for severe complications from COVID-19. Fear of discrimination in the healthcare setting limits their willingness to seek help until critical, increasing the risk of death and spreading the virus. President Trump's rollback on protections for transgender individuals against discrimination in healthcare, at the height of the pandemic, sends a message to the community that their fears are valid. The stress most feel from quarantine, and job insecurity can compound the high levels of mental illness already present in LGBTQ+. The quarantine process, especially for teenagers and young adults, put LGBTQ+ at risk of being stuck in a household without support; and away from their "chosen families" that provide them social capital and buffer the effects of discrimination (Fish et al., 2020). There is a small amount of research to build upon on COVID-19 and LGBTQ+, but this makes this study even more appropriate.

This study's objectives were to identify how the LGBTQ+ community has experienced the pandemic differently, and the sources of stress impact health and healing. The first goal was to determine what issues specific to the LGBTQ+ community are being faced because of the pandemic. Specifically, I looked at how limited healthcare options have transformed, the effect of quarantine on mental health outcomes, and the changes in risk behaviors. Secondly, I hoped to uncover what practices individuals engaged in that promoted health and moderated their experiences' adverse effects. Here, I looked at what forms of social support and healthcare resources the community relied on, tried to identify what resources are detrimental or inaccessible to the community, and what forms of health maintenance were relied on before the pandemic. Lastly, this study sought to uncover how the community views their health and what long-term concerns have arisen

because of the pandemic. Identifying primary sources of stress and any resulting physical or mental manifestations, and how the pandemic has elevated fears already present within the community regarding their safety, image, and future community.

In this paper, I will argue that the LGBTQ+ community, youth especially, are likely to experience discrimination at home, pushing them to utilize friends and partners as their primary form of social support. Using data on friends versus familial acceptance rates, I demonstrate how young LGBTQ+ utilize "chosen families" and strategically conceal their identity to mitigate familial discrimination. Next, I argue that LGBTQ+ in this study reported high levels of stress and subsequent mental distress but prefer not to utilize mental health services. Other sources of discrimination will be discussed, and the effect of Trump's overturn of protection laws on views of the future. This paper addresses reasons for the avoidance of therapy and what young LGBTQ+ utilize instead to alleviate mental distress. Lastly, I argue that these LGBTQ+ individuals used preventative measures to avoid stressful interactions and increase protective factors like social interconnectedness and positive self-image. Some of these methods include positive self-reflection, and social media use to keep in contact with close friends and forms of social support.

Methods

Over four weeks, I collected data in the form of structured surveys and semi-structured interviews. The surveys consisted of 45 voluntary questions on gender and sexual identity, risk behaviors, forms of health maintenance, preferences on social support, and experiences with discrimination. In the end, a free-response question allowed participants to fill in anything they deemed relevant that was not included in the survey questions. I released the survey on Geneseo Pride Alliance email listserv, Geneseo Women's rugby team Facebook page, and SUNY Geneseo's Class of 2021, Class of 2022, and Class of 2023 Facebook pages. Outside of the college community, I posted the survey on Reddit in the r/SampleSize, r/lgbtstudies, and r/AskLGBT forums. A total of 77 responses were collected, with 24 respondents coming from within the college community and 53 from outside the college community, all of which were ages 18 and above. The survey was anonymous, but participants were given the option to leave their email to be contacted for a follow-up interview.

I experienced setbacks with the Reddit forums I chose to post my survey to, as all required an authentication process, which involved submitting proof of IRB approval to mods, and then secondary approval once I made the post before it became visible on the forum. This process took anywhere from three days to a week and a half. I was left with limited time to collect and record interviews, on top of an already shortened schedule as I had to wait for IRB approval. Also, I was only able to collect minimal data from non-White LGBTQ+ members, and all interested interviews identified as White, limited by possibilities for future discussion on multiple minority stressors.

Ultimately, six interviews were conducted ranging from 34 to 55 minutes, and all but one were recruited through snowball sampling from the survey. A total of 12 people left their email, and nine were contacted about interviews. Two lived outside of the United

States, and their country only experienced a lockdown for a short period, and one individual was significantly older, and my questions did not apply to either situation. Seven out of nine individuals responded to my follow-up email, and one of those seven individuals canceled our interview and never rescheduled. All were college students between the ages of 20 and 22, with two identifying as bisexual females, one lesbian female, one pansexual female, one queer, non-binary individual, and one asexual male. My attention was directed toward college students for my interview sample as they are more likely to be dependent on others financially and are at a transition period in life, moving from at-home living to independence. At this point in age, I anticipated more information on establishing personal agency and learning to navigate various social spheres.

The interviews consisted of 30–35 questions that primarily elaborated on the survey questions while also asking about family interactions, views on the political climate, experiences with discrimination and how they prevent them, and how they define good health. Experiences with COVID directly, whether becoming sick or hypotheticals had they gotten sick, were also discussed. Essentially, the questions were designed to uncover pathways of stress that are already exacerbated by the pandemic and uncover what unique factors can compound these stressors for LGBTQ+ youth and how they manage them.

Literature Review

Everyday life stressors are present universally, but for the LGBTQ+ community, their stress is compounded by their identity and resultant negative experiences. This stress results from distal stressors such as victimization and microaggressions, and proximal stressors present as internalized homophobia and concealment of identity (Livingston et al., 2015). Minority stress has an accumulating effect that cannot be viewed as singular events, rather a "characteristic experience" of the individual in the community (Eldahan et al., 2016, p. 833). Identifying types of stressors and their prevalence are essential for connecting LGBTQ+ health disparities and marginalization. In turn, stress and stressors display themselves as behaviors, physical, and mental ailments in the community.

The effects of this stress manifest itself in risk behaviors as a form of maladaptive coping (Fredriksen-Goldsen et al., 2016). Smoking, substance abuse, unhealthy eating and obesity, and unsafe sex are present at higher levels in the LGBTQ+ community. Smoking, obesity, and other risk factors are tied to the higher-rated of cardiovascular disorders in older LGBTQ+ individuals (Williams & Mann, 2017). Stress eating as a form of comfort, and under eating as a form of control was reported in lesbian women and gay men (Azagba, Shan, & Latham, 2019). Unsafe sex and substance abuse, sometimes coinciding during "chemsex," contribute to the higher rates of STDs, Hepatitis A and Hepatitis B, and HIV (Pienaar et al., 2020; Callahan et al., 2014). Through this lens, we can see that simplifying these behaviors as individualized faults obscures the practices and attitudes toward the LGBTQ+ community that causes them in the first place. A more obvious measurable effect of this stress can be viewed through physical and mental ailments.

Mental health disorders are also disproportionately higher in the community. While many determinants for poor mental health are unknown**,** psychosocial stress from stig-

matization has been identified as a major contributor (Burgess et al., 2007). Psychosocial stress is a form of stress that arises from a threat of your social identity, perceived or otherwise (Burgess et al., 2007). Depression, anxiety, eating disorders, self-harm, and suicide are overly present in the community (Quinn et al., 2015). This begins even in youth when individuals are first discovering their identity (Watson, Grossman, & Russell, 2019). Symptoms of these illness such as social isolation, rumination, hopelessness, and pessimism all mediate the effects distal stressors have on the risk behaviors mentioned above (Livingston et al., 2015). As such, risk behaviors may increase mental illness, and mental illness may increase the chance of risk behaviors. Physical health issues are also affected, as cardiovascular disorders and other chronic conditions such as asthma and diabetes are furthered by high-stress levels, making their management incredibly difficult for the LGBTQ+ community (Conron, Mimiaga, & Landers, 2010). These physical ailments are forms of embodiment**,** whereas the constant stress strains individuals' natural stress response increasing their insulin, heart rate, and blood pressure; precursors to various chronic illnesses that act as a reflection of the stress these individuals are under. These disparities become more evident when including discussions of minorities within the LGBTQ+ community.

It is essential to utilize an intersectional lens, as POC sexual minorities also accumulate stress from their racial or ethnic minority status. An intersectional lens suggests that multiple minority statuses create individual health outcomes for the individual. For example, Black LGBTQ+ youth are also disproportionately represented in homeless youth, and must also deal with systemic racism, police harassment, and microaggressions (Shelton et al., 2018). Microaggressions are thinly veiled forms of homophobia, which may include things like assumptions about HIV status or drug use. LGBTQ+ spaces can lessen the effects of LGBTQ+ victimization and promote community resistance, but racial-ethnic stigma can also come from within, reducing the protective effects (McConnell et al., 2018). Those who do experience LGBTQ+ stigma along with racial-ethnic stigma are also more likely to minimize the experience of LGBTQ+ discrimination, even though said stigma has more of an effect on their self-worth than White sexual minorities (McConnell et al., 2018). Women, especially bisexual women, are continuously reported as having more stress, depression, and victimization than LGBTQ+ men (Lindley, Walsemann, & Carter, 2012; Robinson & Espelage, 2012; Jabson, Farmer, and Bowen, 2014). Utilizing an intersectional lens is essential for identifying which members of LGBTQ+ are most at risk for the aforementioned health disparities, and which groups are better to target for health policy in communities with limited funds. Some factors such as social capital can mitigate the effects of these stressors.

Social capital is the tangible and intangible resources one gains from being part of a social circle and receiving support. Various forms of social support exist, and the studies utilized compared between familial, peer, and significant other (McConnell, Birkett, & Mustanski, 2016). LGBTQ+ are in a unique situation where they tend to utilize "chosen families" and forms of peer support, due to common experiences of low familial support (Watson, Grossman, & Russell, 2019, p. 31). Nonetheless, familial support is more likely to promote mental health, prevent risk behavior, and be understudied regarding

LGBTQ+ health outcomes (McConnell, Birkett, & Mustanski, 2016). Rosario et al. (2014) specifically found maternal rejection directly connected to substance abuse problems. LGBT youth also report increased familial support over time if high non-familial support was present, which could mean family's original lack of support reflected societal stigma and can be remedied by being exposed to a more accepting community (McConnell, Birkett, & Mustanski, 2016). This discussion is especially important at the time of this writing, as the COVID-19 pandemic has forced more LGBTQ+ individuals to be isolated with unsupportive parents resulting in a decline in both their mental health and access to other support or therapy (Fish et al., 2020; Gonzales et al. 2020). Considering the significant disparities in mental health and stress management present in LGBTQ+ adults, promoting forms of social support for both young and adult sexual and gender minorities creates the opportunity for them to gain social capital to protect against mental illness and better stress management. The need for more studies on familial support is underscored by the rates of homelessness in the LGBTQ+ population.

LGBTQ+ youth make up 20-40 percent of all homeless youth, experience homelessness at younger ages, and by relation, for more extended periods (Shelton et al., 2018). Youth LGBTQ+ individuals make up to 40% of the homeless population, and family conflict regarding their sexual orientation or gender identity was cited most as a reason for their loss of housing (Shelton et al., 2018). They often must engage in some of the risky behavior they are discriminated against by trading sex for housing and food (Callahan et al., 2014). They also often have less access to healthcare, which increases chances for substance abuse to cope and STIs (Callahan et al., 2014). Whitbeck et al. (2004) also suggest trauma theory, whereas homelessness is traumatic in that it is incredibly stressful, increases chances of mental illness, and exacerbates current symptoms of mental illness, all of which LGBTQ+ are especially vulnerable to. These studies highlight the need to intercept the loss of familial support that leads to homelessness and establish forms of social support for those who do end up homeless to moderate their mental health effects. Studies regarding peer support have been more thorough but often focused on the wrong issue.

When discussing LGBTQ+ and peer support, bullying is a common topic that arises. However, again deficit-based research ideals focus on ending LGBTQ+ bullying but ignore the larger gender policing and heteronormativity that cause it; and obscuring how LGBTQ+ meaningfully uses peer support in the absence of other support (Payne & Smith, 2013). Gender policing is the actions that reinforce normative gender expectations (Payne & Smith, 2013). Robinson and Espelage (2012) found that even after accounting for victimization from bullying, LGBTQ+ youth still have higher suicide and suicidal ideation rates. This supports Parker et al.'s (2018) findings that account health disparities to various forms of structural stigma, like community-level norms and discriminatory policies. LGBTQ+ individuals also experience enacted stigma in direct violence or shunning, felt stigma that causes concealment of identity and modified behaviors, and internalized stigma, which expresses itself as outward hatred of LGBTQ+ people (Herek, Gillis, & Cogan, 2009). Forms of blatant discrimination are themselves enacted stigma but may also affect subtler forms of structural stigma. The interplay be-

tween these forms of stigma means LGBTQ+ are continually exposed to various forms of discrimination, and a singular approach tackling one type of stigma may not be successful.

Despite the factors mentioned above, the LGBTQ+ community is regularly capable of engaging in protective measures that can collectively be called resilience. Resilience is a framework that identifies the capability of an individual and community to withstand stressors and victimization (Colpitts & Gahagan, 2016). Fredriksen-Goldsen et al. (2016) found that health maintenance and the ability to moderate stress response were dependent on the level of resilience an individual had. Unfortunately, most research on the LGBTQ+ population health disparities is deficit-based, identifying risk behaviors and working to limit them (Gahagan & Colpitts, 2017). However, a strength-based approach that identifies forms of resilience could identify traits for social programs that would have lasting impacts on a social level rather than an individual level (Colpitts & Gahagan, 2016). Traditionally research that focuses on a deficit-based individual approach tends to vilify minorities for engaging in the risk behaviors they do, further stigmatizing them. Despite this, research can still occur on the individual level as resilience is present both among people and the community.

On the individual level, forms of resilience exist with self-image and personality traits. Individuals who strategically make their identity known to some, but not all, had better outcomes than those who were out to everyone or no one at all (Fredriksen-Goldsen et al., 2016). This ability to balance self-worth and social support allows one to gain the protection of each factor instead of neither. Self-affirmation itself was associated with a better ability to regulate stress (Fredriksen-Goldsen et al., 2016). Livingston et al. (2015) defined those personality traits of lower neuroticism, higher extroversion, agreeableness, openness, and conscientiousness were "adaptive" and thus more resilient to stigmatization and victimization (p. 324). Other traits identified were "positive self-esteem, self-efficacy, cognitive ability to mediate stress, self-acceptance, pro-active coping, self-care, shamelessness, and spirituality (Colpitts & Gahagan, 2016, p. 4)." These traits showcase that LGBTQ+ individuals can improve their response to stigma, but most of these characteristics need the proper social context to promote them, hence why community-level tactics may be a better focus for health policy.

Resilience on a community level includes "perceived social support, social connectedness, positive LGBTQ+ role models, positive representation of LGBTQ+ populations in the media, family acceptance, positive school, and work environments, having access to safe spaces, connection to LGBTQ+ communities, and social activism" (Colpitts & Gahagan, 2016, p. 4). Simply being interwoven into the LGBTQ+ community socially, can produce protective effects in an individual, even if no apparent support has been gained (Meyer, 2015). Focusing on community resilience also eliminates the Western notion of individual responsibility that obscures broader social issues (Meyer, 2015). However, an individual must identify itself with the LGBTQ+ community to gain resilience (McConnell et al., 2018). Also, communities with a disproportionate amount of risk behavior and lack of resources are likely incapable of promoting resilience (McConnell, Birkett,

& Mustanski, 2016). It would then be unwise to assume that merely allowing LGBTQ+ spaces to exist would alleviate disparities; rather, these studies showcase the possibilities if greater acceptance of LGBTQ+ occur along with tangible support such as programs and funding.

Scholars have shown that the unifying variable in these ideas is stress, what causes it, how it's exacerbated, and what the LGBTQ+ community does to manage and prevent it. My study is being conducted in a period characterized by uncertainty, new stressors, and loneliness for most regardless of gender identity or sexual orientation, leading to a general decrease in physical and mental health over time. Social isolation, hopelessness, and pessimism can increase the chance of engaging in risk behaviors and psychosocial stress (Livingston et al., 2015). Health disparities and risk behaviors already present in the community put LGBTQ+ at risk for severe complications from COVID-19, both mentally and physically. The cause of these disparities is best explained by the minority stress model, which asserts that stigmatized minority groups are disproportionately affected by forms of discrimination that heighten the group's stress levels (Azagba, Shan, & Latham, 2019). So, while everyone is experiencing stress because of the pandemic, the LGBTQ+ community is having their minority stress compounded and being placed in conditions that can increase their exposure to discrimination they would otherwise be able to avoid. Messages spread during the pandemic, such as President Trump's rollback on healthcare protections for transgender individuals, intensify fears about their future and how safe they are in accessing care during the pandemic. In these settings, not discussing their identity puts them at risk for unmet specific health needs, but conversely, acknowledging their identity puts them at risk for discrimination. Short-term avoidance of healthcare puts one at risk of spreading the virus unknowingly or waiting too late until their condition is severe. The quarantine process, especially for teenagers and young adults, puts LGBTQ+ at risk of being stuck in a household without support; and away from their "chosen families" that provide them social capital and buffer the effects of discrimination (Fish et al., 2020). The minority stress models provide a framework that distinguishes LGBTQ+ stress from others' stress during the pandemic and directs this studies attention to specific stressors that warrant attention. Under this framework's guise, I found patterns of "at-home" stigma, high levels of mental stress coupled with evasion of healthcare, and protective measures regarding presentation and self-reflection.

Results

I argue that the LGBTQ+ community, youth especially, are likely to experience discrimination at home, pushing them to utilize friends and partners as their primary form of social support. Out of 77 respondents, 42 stated they quarantined with their family initially, and five emphasized it was "not by choice." Only eight answered that they would have preferred to quarantine with family. This lack of mobility was also stated in the free-response section where one stated, "I have had to stay at home with my family, this has made my mental health deteriorate quicker, but it wasn't an option to stay with anyone else."

Out of 59 respondents, 31 or 52.5%, reported that they had experienced some form of discrimination at home. In the free-response section of the survey, six left statements such as "Covid has been hard for people with non-accepting families," and the pandemic made it "difficult to interact with people I'm comfortable expressing myself around." Blair, who identifies as queer and nonbinary, mentioned that their parents are accepting of their queer identity but

> "there [sic] not great about me being trans though, I mean they say they're supportive, but they constantly misgender me and then if I correct them misgender me it turns into 'Oh well this is so difficult for us and we're trying so hard, and you have to cut us some slack."

Again, three responses in the survey also reflected this idea, with one stating, "I thought my mom was more accepting than she actually is. After spending every second of the day with her, microaggressions have become more common." Discrimination exists on a sliding scale, but a common theme was it correlated with how openly one discussed LGBTQ+ topics in their home. An almost even split occurred in the survey, with 50.6% saying they don't openly discuss LGBTQ+ issues with their family and 49.4% saying they do. For some of these individuals, withholding conversation on LGBTQ+ topics may result from discrimination, as seen in Blair's case. They mentioned how "I can't talk about that "trans stuff" at home because it'll be a big thing and make everything uncomfortable.

However, not all respondents have come out to their parents, as 31% report, they have concealed some or all of their identity. In my interview with Petunia, a bisexual female, she stated her reasoning behind not telling her family about her sexual orientation was that they were "Not very accepting of those identities," because of her religious background and that "There is some extended family that would be more comfortable, but I probably still would not tell them because it could get to my parents." Lou, another bisexual female I interviewed conversely, has come out to her immediate family, but not her extended family because "they're all from Nebraska and super religious." She believes, however, that her mother has outed her to her aunt and uncle, which she states does not bother her, but highlights how some family members exchange information about young LGBTQ+ family members' identity without their consent. She was outed initially by her sister, and she felt her mom was "weird" about it until her brother brought home his girlfriend, who was also bisexual.

Ethan, who identifies as an asexual male, has chosen not to come out because of his family's heteronormative values. He views his family as "a very macho family" who believe that "men should be men," and that they "stay with whatever is normal and safe and straight is normal." He has a cousin who is trans that he believes, had they been born to any other set of aunt and uncle in his family, "they would've been out on the street." Scarlet, a pansexual female, cites that her mother and family are very accepting, but she has a brother who is a "conservative man," that didn't quarantine with her but isn't accepting. These interviews suggest that many have accepted family members in their

extended family but are uncomfortable telling those family members out of fear it would travel back to their immediate family.

Unsurprisingly, these data points coincide with relying on non-familial social support such as friends and partners. Only 69% reported that their family was aware of some or all of their LGBTQ+ identity, compared with 86.8% of their friend group. For example, Lou mentioned they find it "much easier to talk about my sexual identity with friends or strangers than like family."

When asked to rate on a scale of 1 to 5, with one being not accepting and five very accepting, 71% said their friends were very accepting, followed by 17% a step below at mostly accepting, and 11% somewhat accepting. However, family acceptance was rated more uniformly across the scale, with 27% reporting very accepting families, followed by 23% mostly, 23 % somewhat, 17% mostly not, and 9% not accepting. This is likely demonstrative of LGBTQ+ youth actively surrounding themselves with accepting individuals when they leave for college or home. Vinta, a bisexual female, stated that she tries to "surround myself with the most liberal accepting people, who don't care about anything." The other interviewees mostly echoed this sentiment as, all but one mentioned their friends as "very accepting," with the outlier explaining they don't associate with enough friends for that to be a discussion. The LGBTQ+ youth also can find others in the community once they leave their home community; Lou emphasized that "most of [her] friends are gay too."

Overall, the data demonstrate that familial unacceptance contributed to a significant amount of stress and tension at home. Being sent home from college and the loss of jobs and summer programs meant LGBTQ+ youth were put into more contact with their family then they may have chosen to. For example, Blair stated this was "probably the longest I had stayed home since I started college," which was three years ago for them. The discrimination they face exists on a sliding scale but regardless makes conversations and openness difficult in the family setting.

These findings lead to the study's second result that LGBTQ+ reported high levels of stress and subsequent mental distress but prefer not to utilize mental health services. While straight individuals' experiences were not considered to compare stress levels during the pandemic, LGBTQ+ stress has already been established in many interviews and survey responses as being compounded from interpersonal interactions and unique outside influences. In the six interviews conducted, four mentioned one of their top three concern throughout lockdown was having to live with family. Another top concern was one's job and job security. Some were grateful for their front-line position but lamented the work environment they were stuck in. Vinta, who works in a stereotypical masculine profession, stated, "it's tough because you don't get the respect at all anyway being a woman, but if they knew I was gay that would be a problem, and I would never get any support or respect or anything," but also mentioned two of her co-workers did find out, and they have never gotten along with her because of it. Scarlet also said that she's careful how she talks at work because "I have had co-workers respond negatively like things I have said [about being gay], so I try not to be as open any more." While many experi-

ence at-home discrimination, tense workplace cultures also make it difficult for younger LGBTQ when they travel home for summer work. This paper is not arguing that these individuals specifically would have left their jobs could they have, only that the job insecurity created by the pandemic could easily be a source of stress for LGBTQ+ who are forced to choose between staying in a hostile workplace or not having a job. Other concerns centered around their health and future.

During the pandemic, President Trump reversed non-discrimination protections for transgender people in healthcare settings, and interviewees were asked about their thoughts on the future of healthcare and what that means to them. All six respondents reflected disgust toward the move and varying responses to their future. Petunia felt "the immediate concern is not there for me but for like my friends who will be affected by," which is echoed by Scarlet, who indicated, "I don't understand the immediate fear, but as a member of the LGBTQ+ community and just a human being it was very scary to watch things like that happens, it was just very stressful." Blair, who identifies as part of the trans community, became very alarmed. While they don't think protections were great before, "to take away what little there was, it honestly made [them] really scared for [their] future." Lou mentioned she "wasn't surprised" about the move but "would have been more worried if Trump was re-elected. Conversely, Vinta became concerned "whether we're [her and her girlfriend] going to be able to have private healthcare in the future or have access to adoption agencies…it's definitely a stressor." Even if someone who is part of the LGBTQ+ community does not identify as part of the trans community, removing those protections felt like foreshadowing for the removal of more in the future. To make a move such as that, in the middle of a public health crisis, created an environment of uncertainty and stress. As Scarlet aptly summed up, "It's always up in the air whether we're going to have the same, less, or no rights. That is just always something I think about."

According to interviews, these stressors, discrimination, and uncertainty likely contributed to the mental distress many have been experiencing. Lou felt stressed when classes went online, and then when she went home and was jobless for a period, but recently back at school has noticed a "depression funk" in her house that she and her three housemates are struggling with. She had previously experienced a "funk" when she first moved to college but had been fine since, especially with coming out. However, she now finds herself concerned "with how easy it is to slip back into the depressive-like episodes." Vinta, who had past experiences with depression and anxiety that had gone away in high school, now finds herself becoming "very heavy chested" and experiencing body aches while also feeling more depressed as well. In general, she thinks our age group is especially suffering and has recently lost two friends back home to suicide. Blair was already experiencing anxiety and depression before the pandemic, which has gotten worse, and they believe it is causing physical manifestations in the sudden worsening of their chronic conditions. While not certain, Scarlet somewhat attributes her sudden rise in stress to her diagnosis of bipolar disorder in August. She believes that the "different emotional factors all hitting at once was too much," and she knows stress can trigger episodes.

Scarlet was seeing a therapist and psychiatrist at the time, but few others sought mental health services despite higher reports of stress.

About 60% of respondents said that they did not utilize mental health services or therapy. This does leave 40% who say that they do, however, the survey did not ask about frequency or how recently. Also, 39% say that they never turn to therapists in times of mental or emotional struggles, leaving 21% unaccounted for; assuming the 60% of respondents don't utilize therapy is true, and the 40% that do, did not answer never. Regardless, 55% of respondents stated it has become more challenging for them to access mental health services because of the pandemic. Blair had attempted to find a therapist before the pandemic, "which is harder than it sounds, and then the pandemic started, and I really couldn't," and they had previously poor interactions with their school's counseling service and couldn't go there. Three of the interviewees stated they wished they could go to therapy but haven't because of specific barriers or generally didn't know why. For example, Petunia is under her parent's insurance, and "it requires a conversation no matter what I want to schedule, and sometimes those conversations are not my favorite thing to do." Lou mentioned her previous aversion to therapy but now stated more than once that she both "need[s] to go to a therapist" but finds it "so much effort to find one and get it all set up, and I don't feel like bad enough that I need it." Her statement was interesting, if only for the juxtaposition of "needing" therapy while also questioning whether it was bad enough for her to go. This dilemma is reiterated by Vinta, who said, "I've been saying this whole semester, like, I really need to get a therapist and I just haven't…I don't know why it could be that I'm just putting it off." Even the respondents who did utilize therapy regularly, such as scarlet, stated that traveling from home and back to school often interrupted their regular therapy sessions. Ethan was seeing a therapist, who occasionally had to move to virtual sessions, which he felt "worked" but he "would probably 100,000% prefer in-person." What is exhibited here is that the importance of therapy is understood, and the desire for it is clear, but barriers seriously affect access to it. For LGBTQ+ youth, with parents who may be discriminatory, having to rely on their insurance could be a cause for concern and likely more difficult if they don't know how to access these resources on their own. Also, the mobility of young LGBTQ+ who have not settled in their own house makes it difficult for them to keep up with therapy sessions.

It's important to note that all interviewees defined 'good health' with an emphasis on having good mental health. Lou explains good health as a "feeling," not based on diet or exercise but ensuring the "quality," of life is at it's best. For Scarlet, "feeling secure mentally…or just feeling comfortable with where you are mentally." was her first and top priority in her definition of good health. Whereas Ethan included more of a discussion on the physical aspect, he nonetheless emphasized that "it all starts with the mental part… if you're not mentally healthy that should be where you start."

In the meantime, when experiencing forms of distress, they turn to friends instead or simply keep it to themselves. 50.7% of survey respondents stated they turn to friends primarily in times of mental or emotional struggles, and 62% said they turn to quality time

with friends to de-stress. Vinta, specifically when I originally asked if she uses a therapist asked, "Do friend therapist count?" However, Lou said, "Does talking to a wall count?" for the same question. Blair's preferred form was not seeking anyone out or putting it on Twitter, and Ethan, who stated his small friend group and little interaction with family usually meant he kept his feeling to himself. Again, we see a reliance on friends as outlets for issues, but those who feel they cannot place that emotional toll on friends often keep to themselves. Loneliness and social isolation during this pandemic may be shutting off serious lifelines for the LGBTQ+ community.

However, this studies' final point is that LGBTQ+ utilized preventative measures to both avoid stressful interactions and increase protective factors like social interconnectedness and positive self-image. As mentioned before, some interviewees mentioned they are not as open to their co-workers or family to prevent discrimination. While these conditions can certainly lead to stress, they nonetheless highlight the community's ability to receive social capital even from those who may not traditionally associate them. Only 46% of respondents stated they are open to everyone they meet about their identity, with 49% changing their demeanor or style around strangers. In families, this number jumps to 61% of respondents changing some aspect of their persona or style to "pass." This skill is essential for young LGBTQ+ who may be threatened with a loss of housing or financial instability if they were out or obviously gay to their parents. This concealment could coincide with embarrassment over one's identity, however, 81% of respondents reported they were proud of their identity.

This latter statistic may have also been influenced by the time spent in isolation. Some survey respondents reported that the time in isolation helped improve their relationship and confidence in their identity. One mentioned, "The pandemic is what led me to realize I'm trans, being away from society let me think and get to know myself better and learn who I really was." Another individual also realized felt "having this time to myself has allowed me to better find myself and my identity," and realized they no longer identify as a bisexual transman but a nonbinary lesbian. One individual who was not a part of the LGBTQ+ community before the pandemic but was questioning "had a lot of time to think about it and realized [they] are definitely attracted to men and women." Even those who were secure in their identity expressed a degree of self-reflection that resulted in improvements in their self-image. Vinta felt she "probably grew into myself a lot and like realized who I am and who I want to be." Scarlet as well felt as if she had "gotten more confident in who I am," which she believes might have been a response towards apathy about what other people think. Because a lot of events were moved online, one survey respondent felt as if "I've been able to engage with the queer community more than I did before the pandemic," which they were grateful for as they weren't able to meet many other LGBTQ+ individuals in high school. These responses may be highlighting a trend toward greater self-acceptance and positive self-image in the community. Interacting with individuals who are more accepting of other identities, such as friends, is arguably an essential protective measure for positive self-image in young LGBTQ+.

LGBTQ+ individuals, when faced with isolation, reported regular use of social media to connect and collect information about the pandemic. Scarlet primarily "used a lot of apps like house party and facetime, to communicate with them[friends] face to face." Lou and Petunia also reported the use of House party as a way of regular contact instead of merely texting. Blair utilized zoom to have "lunches" with their friends over the summer. Social media was the most preferred method that respondents used to de-stress, standing at about 63.2%, followed by quality time with friends at 61.8%. The need for social interaction with friends was clear, and social media provided an outlet for that. Coincidentally, social media is where a few interviewees reported they received their news about COVID. However, utilizing social media was used strategically in that when it became overwhelming, they either directed their feed away from it, or used other news agencies for validity. In Blair's case, they got most of their information from Twitter, acknowledged the possibility of false information, and eventually transitioned to the New York Times COVID page. However, when it became too much, they "tried not to spend too much time seeking things out that I know will make me feel bad," and only watch the news when their parents do. Ethan stated they don't use much social media much; when they do, it's Twitter, and he's made an effort to "really curate my timeline to be what I enjoy so it's different than what most people see." Instead, he got his news from international sources as he felt there "they give you like a perspective of they don't care about the U.S.…so they give a much more unbiased account of what's happening here." Thus, social media has become an outlet for stress, a source of information, and a way to connect with friends, essentially somewhat re-creating as much of LGBTQ+ youths preferred environment.

Discussion

This studies' guiding framework was that of Meyer's minority stress model, which states that minorities face unique stressors that accumulate and result in health disparities. According to Livingston et al. (2015), minority individuals experience "unique distal (e.g., victimization) stressors and associated proximal (e.g., concealment, internalized heterosexism) stress processes" (p. 321). One of the primary sources of stress discussed in this study was that of familial discrimination in the form of microaggressions and outright lack of acceptance. This study's findings on familial stress support McConnell's (2017) and Parker's (2018) results that familial support had a negative relationship with stress. Likely best exemplified by Blair's home situation and subsequent increase in both mental distress and physical ailments. However, Meyer's (2015) later application of his model to the LGBTQ+ community identified concealment of identity as a proximal stressor associated with internalized homophobia. Conversely, evidence in this report points to concealment as a positive strategy to avoid discriminatory experiences, which coincides with 81% of respondents expressing pride in their identity.

Meyer identified felt stigma as a specific proximal stressor in their model that mediates adverse health outcomes; and Quinn et al. (2015) explains how this type of stigma can inhibit treatment-seeking behaviors out of fear of discrimination. Interviews and respondents did underscore an underutilization of therapy and mental health services, but

this was not attributed to a felt stigma. Rather factors like being on family insurance, confusion on how to access, and lack of permanent residence had the most effect on young adult LGBTQ+. The use of telehealth, which has become more popular with social distancing, provided through one's college has been proposed by both Gonzales et al.'s (2020) study and Fish's (2020) study to remedy these issues. Still, it's important to note that one interviewee did not enjoy the virtual therapy sessions, which may mean that just because the option is provided does not mean students will still be able to access it or benefit. Felt stigma can also occur from institutional changes, as seen when laws banning same-sex marriage at the state-level before 2015 saw an increase in psychiatric morbidity in the LGBTQ+ community in the year following the law passage. (Williams & Mann, 2017). This supports our findings that Trump's removal of transgender protection laws for healthcare resulted in varying levels of outrage and fear about one's future in each of the interviewees.

Social support was also stated to "buffer the effect of the stressors so that negative health outcomes could be avoided or reduced" (Meyer, 2015, p. 210). This study was not longitudinal and thus cannot confidently state that social support from friends affected mental or physical health outcomes in the long-term. Nevertheless, our findings show that when familial support was lacking or harmful, LGBTQ+ youth actively surrounded themselves with tolerant individuals that provided a significant amount of social capital and support. This follows Watson's (2019) study, which found LGBTQ+ youth rated friend support as the most prevalent and vital. Youth were found to maintain this support through the use of social media during the lockdown, a discovery argued in Fish et al. (2020) study. Also worth mentioning from Fish et al. (2020) study is their findings that pandemic restrictions allowed opportunities to think about one's identity. The study did not elaborate on whether this rumination resulted in a positive or negative outcome, and Livingston et al.'s (2015) work stated rumination could be a stressor. Despite the small sample, there is a portion of evidence from this study that shows this self-reflection resulted in a more positive self-image and, in some cases, a redefining of one's identity to something they are more comfortable with.

Drinking and substance abuse as a coping mechanism was not discussed in this paper, despite the study collecting data on it. Meyer's framework emphasizes these factors as evidence of marginalization and stress theory being at play, hence why it is essential to mention in this report. This decision was made due to the low numbers reported by survey respondents about the utilization of drugs and alcohol, possibly due to most being under the age of 21, and the inability to compare them to the values of non-LGBTQ+ individuals as control. However, those that did report usage reported a decrease since the pandemic for drinking, nicotine products, and other substances, with an increase in use of marijuana. Previous studies report higher rates of drinking, substance abuse, and smoking among LGBTQ+, especially in times of stress, however, four out of six respondents referred to the loss of social aspect of drinking as the reason for the decline, and one respondent did not drink or use drugs anyway. While the sample may be small, the importance of the social factor in drinking and drug interactions was not mentioned in any of the articles discussed above in the literature review and may be an important area

for further study. The isolation created by the pandemic provides an opportunity to look at how social interaction influences the use of substances by the LGBTQ+ community.

Another limitation of this study exists in the lack of intersectional approach the paper takes. McConnell et al. (2018) found that those experiencing multiple intersecting forms of minority stress, such as racial-ethnic stigma coinciding with sexual minority stigma, resulted in different levels of stress and community resilience compared to White LGBTQ+. This study only received 18 respondents from those identifying as other than White and could not draw any major conclusions from this number. McConnell et al.'s (2018) study already argues the underrepresentation of an intersectional lens in LGBTQ+ studies, and the lack of findings stated here only serves to reinforce that message.

Conclusion

This study's objective is to hopefully provide background and baseline for future efforts on the unique experiences of the LGBTQ+ population that often go unnoticed in times of crisis. While these issues are present in the community regardless of the pandemic, the context of the pandemic elevates their effects and threatens an already at-risk population for adverse physical and mental health outcomes. The finding shows that young LGBTQ+ are likely to experience some form of familial discrimination or expectation of such and instead turn to friends and "chosen families" as their source of social support. This discrimination, among other sources, has resulted in varying levels of stress in the population studied, which has only been increased with the advent of lockdown and subsequently extended amount of time at home. This discrimination follows Meyer's (2015) minority stress model in which these stressors accumulate overtime into adverse physical and mental health outcomes, as was seen to some degree in this study. His theory also states that various forms of resilience are enacted at the individual's level, of which this study found evidence for the strategic concealment of identity, use of social media to maintain contact, and engaging in a period of self-reflection that improved self-image.

Future policy initiatives should address familial discrimination and provide easily accessible, anonymous care for LGBTQ+ students when they travel home. To some extent, this should be providing access to affordable virtual therapy for those who cannot tell their parents or resources to students looking to seek out therapy but do not know how to. Interventions garnered toward educating families on the importance of their social support for young LGBTQ+ well-being could be a promising education program but may benefit when LGBTQ+ are still in high school and below.

Further research is likely needed still on forms of resilience, both on the community and individual level, and how policy can best be targeted for intervention. The definition of resilience is still contested amongst research, but according to this study, the use of social media and strategic concealment of identity are promising possibilities. When researching forms of resilience, it is also essential to take an intersectional lens as previous studies have found that different intersecting identities benefit from some interventions more than others. More research is also needed on community-level resilience interventions, as currently most is based on the individual level, which risks individualizing risk and

health disparities for the community in policy makers' eyes. This research was conducted in a period following an extended break at home for LGBTQ+ in college and general isolation experience for young LGBTQ+ not in college. As students now head home for an extended winter break, with some uncertainty regarding how long their college will remain open next semester, the need is evident for mental health resources targeted toward the community. Because the pandemic is ongoing, most of the effects will likely not be understood until it concludes, but nonetheless, this paper seeks to add to the discourse on what needs to be done in future pandemics and isolation experiences.

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Samantha Ege: Revealing the Legacy of Black Classical Composers Through the Work of Florence Price

Allison North

sponsored by Monica Hershberger, PhD

Abstract

Dr. Samantha Ege is a musicologist-pianist and a leading interpreter of the African-American composer Florence B. Price. She is currently the Lord Crewe Junior Research Fellow in Music at Lincoln College. There, she also teaches courses in music and specializes in the influence of African American and female composers of the 19th and 20th centuries. Her research focuses on uncovering the history of African American women in classical music, whose works have been historically repressed. She has written multiple publications on Florence Price as well as released two albums featuring her compositions. Dr. Ege's work to amplify Florence Price through her publications and performances is significant because it provides representation of a Black female composer in classical music, which restores Price's place in history as well as provides inspiration to other musicians of color.

Dr. Samantha Ege is a musicologist-pianist and a leading interpreter of the African American composer Florence B. Price. She has written multiple publications on Florence Price as well as released two albums featuring her compositions. Ege's musical education growing up taught her that only White men belonged in the world of classical music. It was impossible for Ege to imagine Black women as classical musicians, but learning about Florence Price allowed Ege to see herself as part of classical music history. Specifically, it was Price's *Fantasie Negre* that helped Ege realize this. In a blog post from 2019, she writes:

> *Fantasie Negre* carried the message that there was nothing incompatible, and more importantly, nothing new about being black, classically-trained and a woman. Because of Price…I no longer had to dream up the impossible. I could see a very real classical music history before me that placed black women at the centre. And I could see myself. (Ege, 2019a)

Ege further explains that *Fantasie Negre* allowed her to realize what she was able to achieve: "It allowed me to see my potential in a powerful and uninhibited light. It gave me permission to wholeheartedly and unapologetically pursue whatever I decided that potential was" (Ege, 2019a).

Price was not the first Black classical composer; there were other women whose own achievements contributed to Price's success. Some of these women include Nora Douglas Holt, Estella Conway Bonds, and Maude Roberts George. Nora Douglas Holt was a music critic for the *Chicago Defender*, a Black newspaper. She also co-founded the Nation Association of Negro Musicians in 1919. Price was later a member of this organization, which would provide her a network of support both as a Black woman as well as a composer (Ege, 2020b, p. 16). Estella Conway Bonds hosted frequent gatherings in her home for various artists. This helped connect the Black musical community in Chicago. Price was friends with Bonds, and Price lived with Bonds for a period when she was having financial trouble. It was while living with Bonds that Price wrote her submissions for the Wanamaker Music Contest, along with the help of the tight-knit community Bonds had created. Maude Roberts George took over as the music critic for the *Chicago Defender* newspaper after Bonds in 1917. Her columns "provided one of the most consistent and thorough public documentations of Price's musical activity during this time" (Ege, 2020b, p. 13). George, who also became the president of the Chicago Music Association, used her influence to further Price's career. As president of the CMA, George helped raise funds for the 1933 concert where Price's Symphony in E minor premiered, performed by the Chicago Symphony Orchestra. Overall, Price would not have been able to accomplish the things she did without the work of those three women. According to Ege:

> Price was not an anomaly in the American musical landscape; behind the history that she made in 1933 lies an essential narrative that requires excavation—one that reveals how black women's collective agency, advocacy, and activism paved the way for Price's success. (Ege, 2020b, p. 7)

Learning about how these women paved the way for Florence Price inspired Ege to bring awareness to Price's legacy so that modern composers of color can see that they are not alone and that their work has a place in the mainstream classical repertoire.

Price reflects her identity in her music by using Black folk idioms from spirituals, which are a type of folk song originally sung by slaves in colonial America. In Ege's (2020a) thesis, she notes how "Price reconciled black folkloric traditions with classical conventions and vitalized her vision for a national musical idiom" (p. 78). In other words, Price combined these folk idioms with the traditions of classical music to create a new musical style. For example, the melody of Price's *Fantasie Negre* No. 1 in E Minor is from the spiritual "Sinner, Please Don't Let This Harvest Pass."

Ege's research on Florence Price has influenced the way she has interpreted Price's music. For example, in a podcast interview, Ege explains how the way she performs Price's Sonata in E Minor has changed:

> [In] the first movement of the sonata, there's the second theme where the musical idea is repeated three times…When I was able to…identify the three repetitions as something that you might hear in a slave song where three lines are repeated exactly then the fourth line is different, it completely changed the way I understood that section of the music.

In performing Price's music, Ege (2018) aims to spread Price's music so that other musicians of color will see how Price embraced her heritage by integrating it into her music and will be inspired to do the same (p. 2). In an article for a music review website, Ege (2021) writes:

> *Fantasie Nègre* is my realization of a history that I have longed for, and to which I now belong. For me, it has been quite a journey with Price's music giving inspiration and courage along the way. My hope now is that this glorious repertoire may do the same for you. (Broad, 2019, 19:25)

It is commonly said that Florence Price's music was recently rediscovered. However, this narrative is detrimental because, according to Ege, it takes away accountability and responsibility of fixing the obstacles that prevented the mainstream from wanting to access Price's music (Broad, 2019). Price's music has always existed in the Black communities, and these communities have constantly worked to keep her music alive. The rediscovery narrative erases this work. In her thesis, Ege (2020a) quotes another scholar, A. Kori Hill:

> The "rediscovered" Black composer is a tired, damaging trope. It reflects an active process, where certain histories and cultural memories are not considered "relevant" to the mainstream until they prove useful. Black musicians kept the name of Florence Price on their lips, in their minds, and under their fingers. She was not forgotten. (p. 149)

Therefore, Ege's work is a restoration of Price's accomplishments instead of a rediscovery. She aims to bring Price's music back to mainstream audiences.

Ege's main goal in performing the works of Florence Price is to restore Price's place in history so that other musicians of color can draw inspiration from Price. Without other precedence in history, there's the sense that you have to create a new territory in order to achieve something. Each generation can benefit by standing on the shoulders of those that preceded them, just as Price used the accomplishments of Holt, Bonds, and George to succeed. Ege's performance of Price's work ensures that Price's voice is heard and her accomplishments are seen by other musicians of color so that they too can realize their full potential.

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The Geneseo Literary Magazine Project

Lara Mangino

sponsored by Rachel Hall, MFA

Abstract

In its 150 years, Geneseo has seen the rise and fall of a number of literary magazines. Publications such as The Experimentalist, Opus, and MiNT Magazine demonstrate the hard work of countless students while simultaneously offering a glimpse into Geneseo's history. Although these magazines have been stored in the Special Collections in Milne Library, there is no digital repository of these magazines nor is their history widely known. This project seeks to correct that. Over this past year, I have been scanning and uploading old magazines to this project's WordPress site: https://wp.geneseo.edu/litmagproject/. The intention is to make these magazines widely available so they can be viewed by students, alumni, faculty, and prospective students. In addition, I am researching the history of literary journals at Geneseo by studying these documents and interviewing alumni about their experiences as student editors. When this project is complete, the website should include a detailed history of each journal in addition to all the issues I have uploaded over the course of the year. With this digital repository, these old publications will have new life breathed into them, inspiring future Geneseo students to continue to create extraordinary literary journals.

At the beginning of my freshman year at Geneseo, I joined *MiNT Magazine*—the student-run literary journal that published the art, photography, and writing of Geneseo students. During my time here, *MiNT* has been my creative outlet; I've been honored to hold the position of Editor-in-Chief since my sophomore year, and I've found a community in the Geneseo literary magazine world, eagerly engaging with readers, writers and artists, and with *Gandy Dancer*, our fellow magazine. However, despite my level of involvement, I knew very little about the history of *MiNT* or of any of the other literary journals that have been published at Geneseo. This inspired the Geneseo Literary Magazine Project—the culmination of my four years of work on student journals. Over the past year, I have scanned, edited, and uploaded over sixty magazines published by Geneseo students from 1955 to 2017. The purpose of this project was to make these magazines more widely available for the campus community to ensure that their legacy lives on, and the hard work of students is not lost to time. Furthermore, Geneseo's literary magazines are an important part of our campus's history, and they can act as historical documents, serving as a window to the minds of students from decades

ago. Thus, this project is incredibly important, and although I can never know what effect this will have on the future, I can only hope that it will spark a greater love and appreciation across the campus for literary journals, and for the hard work of creative and brilliant students.

A literary magazine, or literary journal, is a publication dedicated to the proliferation of literature that is driven by a mission, not the market, and it often publishes fiction, essays, poetry, art, and photography alongside many other genres of work. Student literary magazines, meanwhile, are journals that publish student creative writing and art and are run primarily by students. Although, sometimes this definition can be flexible—for example, early issues of *MiNT* published more informational and editorial content than creative work, and non-students have been published in past issues—it is these standards that I used to determine which publications to focus on.

Literary magazines are incredibly important to society in general as they often provide a voice for writers who go on to be major figures in the literary canon. They also have much more freedom than profit-driven publications to deviate from the mainstream and publish underrepresented voices or politically inflammatory content. On college campuses, they serve a similar purpose. Magazines can act as a time capsule, reflecting the particular moment that they are derived from. Just as contemporary issues discuss Donald Trump, Black Lives Matter, and the COVID-19 pandemic because they inform the creation of each magazine in some way, old issues discussed the 2003 invasion of Iraq (Lee, 2003, p. 17), the Iran-Contra Affair (Lockwood, 1986, p. 2), and the Vietnam War (Virtanen, 1966, p. 8). Additionally, they give a voice to students as they hone their craft, affording them an outlet for expression and a community for creative connections. These publications provide a backdrop to the contemporary love for literature at Geneseo, showing that students have always cared to put their pens to paper and produce some-

Figure 1. An art piece by Lexi Hannah, from Opus, 2012–2013, before and after editing it in Photoshop.

thing beautiful. These documents are important because students loved making them; thus, they deserve to be remembered.

As I originally intended this project, most of the fall semester would have been spent scanning and editing old magazines, and the spring semester would have been spent working on the website, studying the magazines to learn more about them, and contacting alumni to discuss their experiences. However, this past year, I have faced major setbacks that impacted the schedule and prevented me from spending as much time on the research and outreach. In January of 2020, Milne Library was closed due to asbestos, preventing me or anyone from accessing the Special Collections. The COVID-19 pandemic subsequently interrupted efforts to retrieve and clean the Collections, so I was unable to work with them until March of 2021. I was lucky enough to find some old issues in the English Department Office. However, most of these were copies of *Opus* from the last twenty years, and therefore, they did not accurately represent the campus's literary magazine history. Once I finally did gain access to the Special Collections, I was able to fill in the gaps in my research, but I then had to spend the majority of the spring semester scanning and uploading, preventing me from doing as much research or alumni outreach as I would have liked. Nonetheless, another student, Jessica Vance, will be taking over for me in the fall, hopefully being able to pick up where I left off and carry out the portions of the project I was unable to.

Figure 2. The spreadsheets where I detailed metadata and other important information.

The process of digitizing the magazines begins with scanning. Using a flatbed scanner accessible to me through Milne Library, I scanned each page of each issue into Adobe Acrobat. This process, while enjoyable, was incredibly time-consuming: scanning a single issue could take anywhere from thirty minutes to well over an hour, and Adobe crashed many times, interrupting the scan and forcing me to restart that issue. Then, using Acrobat, I cropped each page and added links so that the Table of Contents was clickable. This was designed to assist future readers in perusing these issues and to aid me in quickly navigating the documents. In addition, I often had to edit pages using Adobe Photoshop. Certain images, when scanned, featured boxes and discoloration on the page. Therefore, I edited them to appear more like the original image. Once each issue was fully digitized, I then uploaded it to Google Drive, where it was accessible for Tracy Paradis, Digital Collections & Archives Librarian, to upload to KnightScholar, the digital repository for Geneseo publications. In order for her to be able to add these issues to KnightScholar, I

also had to record extensive metadata on each issue, which I logged in a Google Sheet. I also had a second Google sheet, where I recorded information I felt was relevant to my research, such as what editorial positions each magazine offered, who created the cover of the magazines, and who each advisor was.

The second major part of this project was the website: "The Geneseo Literary Magazine Project," hosted by a Geneseo WordPress account. There are five pages on this website:

- "Home": This is a landing page for anyone first visiting the website. It displays the covers of old magazines; the main menu, which directs readers to the other pages; and a brief description of the project and its purpose.
- "About this Project": This contains much of the same content written in this paper, informing readers about my intentions and what the purpose of recording these old literary magazines is.
- "Learn About the Journals": Here, I briefly wrote about each of the nine journals I researched. I discussed what their lifespan was, what kind of content they published, any unique features, and how they fit into the larger Geneseo literary landscape.
- "Catalogue of Issues": Once all the magazines have been uploaded to KnightScholar, this page will provide links to that. I had wanted to upload the PDFs directly to this page, however, Geneseo WordPress's maximum file upload size is 1 mb. In the meantime, I've linked web viewers to the Google Folder containing all the PDFs. Hopefully the issues will be available on KnightScholar soon.
- "Missing Issues": While the Special Collections had a lot of copies of magazines, there are still many issues that I know to exist but do not have, such as *Opus*, 2011-2012; sporadic issues of *The Experimentalist* and *Our Time*; and all but one issue of *Subterranea*. The purpose of putting this page here is to

Figure 3. The homepage of the website, featuring the cover of Opus*, 2012–2013.*

draw attention to the missing issues in the hopes that patrons of the site will be able to add the missing pieces in the future.

In addition to these two primary focuses of this project, the other thing that I was able to do, if even briefly, was work with Tracy Gagnier of Alumni Relations in order to poll alumni on their experiences. I heard from five former editors, four of whom graduated in the years since 2000, and one of whom graduated in 1964. From these editors' poll responses, I was able to glean a little bit of insight into what editing was like for the various magazines I've been studying. I intended to reach out to these editors to follow up on some of their answers but was unable to given time constraints. Once again, this is an avenue that I hope Jess will pursue so as to discover even more about the history of the publications.

Over the course of Geneseo's history, the impact and engagement with literary magazines waxed and waned. From 1955 when the first known literary magazine at Geneseo was published, through the 1980s, *The Experimentalist* was the dominant literary publication on campus. Then, as computers and desktop publishing became more widely available, the campus began to see more publications, and the number of student literary journals grew from the 1980s to today. The 1990s and early 2000s in particular saw a proliferation of journals. As *The Experimentalist* shuttered around 1990, six new publications were founded between 1994 and 2003. I definitely attribute this to the accessibility of programs like Adobe InDesign, as well as the internet, which allowed for an easier time collecting submissions, advertising, and distributing.

One thing I was hoping to find when looking at Geneseo history through these publications was the discussion of current events and insight into the students' feelings at the time. The Vietnam War, for example, was a topic I kept coming back to as something I hoped and expected to find students discussing. From 1964 to 1973, many of these students might have been drafted, expected to be drafted, or had friends and family who were drafted; therefore, I thought it would be a common issue that students would attempt to grapple with through creative writing. Instead, I was surprised to find that it barely ever came up. Pekka Virtanen's poetry from *The Experimentalist*, 1966, discussed it briefly, and other students occasionally alluded to it, but it was not a common theme in those early issues. Politics did not generally appear in *The Experimentalist*; it was later journals like *Our Time* and *MiNT Magazine* that critiqued presidents, foreign policy, and social norms. My theory as to why *The Experimentalist* rarely discussed such pressing current events is that students were likely tired of thinking about them; to these students, literary magazines were an escape, so it makes sense that they were not eager to write about what troubled them. *MiNT* treats the COVID-19 pandemic similarly. Although we discuss it in the "Dear Reader," as it is important context behind the creation of the magazine, we have not published a single piece about COVID-19 in the past year and a half. Perhaps *The Experimentalist* might have discussed the Vietnam war in its own "Dear Readers," but it tended not to have such editorial notes, and when it did have them, they were usually shorter and did not provide much political and societal context.

Next, I would like to spend some time discussing each of the magazines I looked at as each has its own history and its own unique contribution to the Geneseo campus. This information can also be found on the "Learn About the Journals" page of my website.

The Experimentalist

Founded in 1955 by members of the Geneseo English Club, *The Experimentalist* is the first known literary magazine on Geneseo's campus. As the editors wrote in "Fatihah," the editorial that began the first issue,

> The purpose of *The Experimentalist* is to provide a medium of expression for the students of the College. We hope it will encourage people to write, to aspire to more articulate written expression, and to gain satisfaction from sharing thoughts and ideas with others. (Kashuba et al., 1955, p. 5)

The early issues published poetry, essays, and fiction, and were often interspersed with little doodles and drawings. However, beginning around the 1960s, art became more fre-

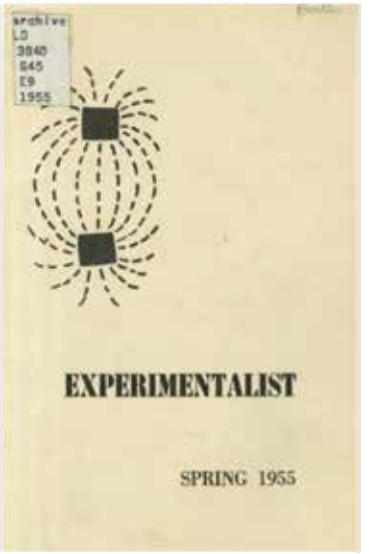

Figure 4. Cover of The Experimentalist*, 1955 by Alice Doorley.*

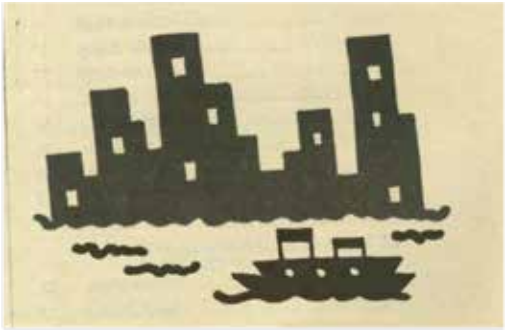

Figure 5. A drawing from The Experimentalist*, 1956 likely by Mary Lou Allgeier.*

Figure 6. Art by Carol Cherney and photograph by Dan Jandorf, The Experimentalist*, 1967.*

quent and covers more vibrant, replacing the simple doodles of the past. Meanwhile, the club published writing contest winners from 1957–1966, which were typically judged by faculty from other New York colleges. Categories included the Mary A. Thomas Poetry Award, the Lucy Harmon Fiction Award, the William T. Beauchamp Literary Award (for general contributions to English and the literary culture at Geneseo), as well as awards for playwriting and essays.

The 1967 issue of *The Experimentalist* is the first instance of photography published in a Geneseo literary magazine. In the center pages of the little blue-green booklet, five black-and-white photographs and three drawings are featured amidst the typical poetry and prose.

The last known issue of *The Experimentalist* was published in the fall of 1990. As both the earliest and longest-running literary magazine at Geneseo, it was the model upon which each future Geneseo journal would be based. One can see its influence on all the journals that came after it.

Figure 7. "Comet Rider" by Scira, featured as the cover of Our Time.

Our Time

Our Time was founded in 1985 by Kwadjo Boaitey as a "contemporary arts magazine where the student body may release their artistic talents." Though they coexisted, *Our Time* and *The Experimentalist* clearly filled different niches. *Our Time* appeared like a commercial magazine featuring editorials, reviews, and records of student quotations, upcoming concerts, and other events alongside poetry and prose. Though color still only appeared on the cover, the issues still managed to pop, filling up its larger pages with more artwork and photography. It also generated revenue through advertisements and sales.

This model continued for a few years; however, as *The Experimentalist* shuttered, *Our Time* moved in to fill its niche, publishing issues filled with more and more creative work and less editorials or advertisements. The last known issue, published in 1997, is a half-sized booklet and features only poetry and prose.

Our Time is another publication whose impact can be felt even beyond its lifetime. Its unique characteristics, its contemporary style, its engagement with pop culture, and its sense of humor would carry on into later publications such as *MiNT Magazine* among others. In the words of Shelli L. Stiverson, Editor-in-Chief of the fall 1987 issue, "When a group of intelligent, creative and determined students put their minds and efforts together, something special is bound to occur. That special something is *Our Time Magazine*."

Ruby Bayou

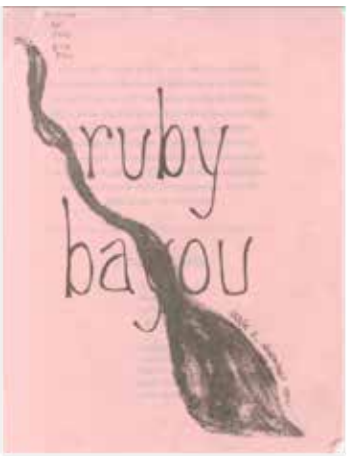

Figure 8. Cover of Ruby Bayou*, 1994.*

Ruby Bayou was a short-lived magazine of the mid- to late 1990s founded by the Womyn's Action Coalition. It was first published in November of 1994, and though they focused primarily on writing about race, gender, sexuality, and women's issues, they also covered a variety of subjects within their poetry, fiction, and essays. As its mission statement, printed in two different issues, reads,

> What is this publication about? This is for our readers to determine…. We solicit provocative and intelligent thinking, whether the medium be articles, poetry, essays, or black and white artwork, including photography. This is a forum in which students and faculty can express their concerns and creativity. Like so many other things, *Ruby Bayou* is going to be what we make of it. (Ferguson et al., 1995, p. 1)

Only five known issues of *Ruby Bayou* were published, its last issue printed in the fall of 1996.

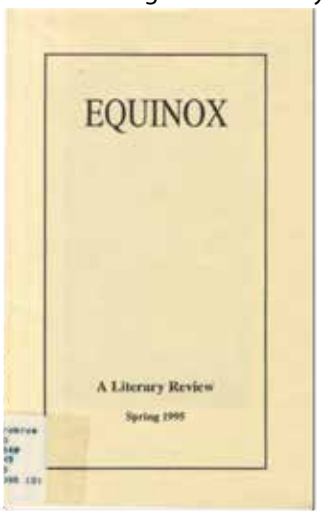

Figure 9. Cover of Equinox*, Spring 1995.*

Equinox

Only one issue of *Equinox* is known to exist, a spring 1995 issue, published by the English Club. Given its foundation shortly after the shuttering of *The Experimentalist*, it was likely founded to fill that void. It is small, crisp, professional-looking, and features only fiction and poetry. Not much else is known about this short-lived publication, but it is the second magazine run out of the English Club, being succeeded by *Opus* just a few years later.

Figure 10. Cover of Subterranea*, 1999 by Eileen Coughlin.*

Subterranea

Subterranea is another short-lived publication about which little is known. The only known issue was published in spring of 1999, though it claims to be "Subterranea's fourth emergence," implying that there are at least three missing issues of this magazine.

Subterranea billed itself as "an underground literary magazine." It published poetry and prose, some which was experimental in its structure, such as "(nonsent x message)s & time" (Mesmer, 1999, p. 6), which depicted four photo-copied poems with different orientations on the page.

Speak

Speak Magazine is another publication of which there is only one known issue that alludes to others. Issue no. 2 from spring 2000 contains poetry, political essays, and stories of studying abroad.

This issue is in many ways reminiscent of *Our Time* before it; it contains fun little cartoons and editorials and, on the very last page, a list of facts about Geneseo's history. It is unknown what became of *Speak* after 2000, but it does stand out for both its unique style as well as the fact that it was the first known magazine with an online component.

Opus

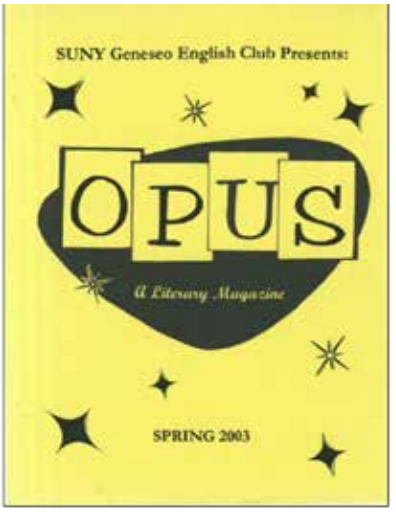

Figure 10. Cover of Opus*, Spring 2003.*

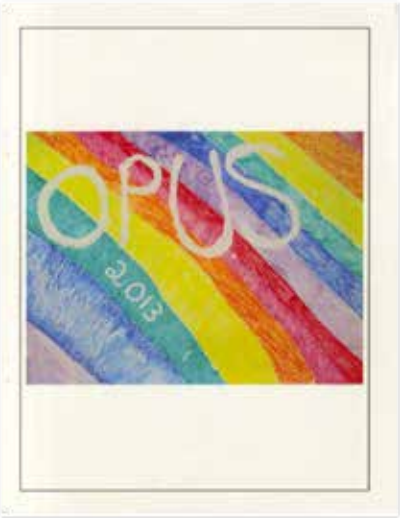

Figure 10. Cover of Opus*, 2012–2013.*

Opus is the latter of the three publications produced by the Geneseo English Club. Its first issue came out in spring 2003, and it published annually until 2017. Unlike many of the other journals cataloged in this project, *Opus* maintained a singular design and structure throughout its time as a publication; it is known for its full-size pages and covers eagerly bearing its name. Often, the title of the journal was incorporated into the cover image in some way, and the artwork or photography was attributed to the *Opus* Staff, or to a collection of students.

Opus published poetry, fiction, essays, plays, artwork, and photography. It tends to adhere to the same literary tradition as *The Experimentalist*; however, it displays a notable

sense of informality and humor that earlier English Club publications lacked. Letters to the readers in the opening pages often referenced *Opus*'s age by saying that it was entering its teenage years or that it was in high school, and one acknowledgement section memorably thanked one of the editors for "putting up with and not killing" her co-editor.

Although at one point *Opus* was the primary literary magazine for Geneseo, it began to decline as its contemporaries, *MiNT Magazine* and *Gandy Dancer,* became more of a priority for students. In addition, the retirement of its advisor Dr. Greenfield meant the end of the English Club, and *Opus* published its brief final issue in spring of 2017. Nonetheless, it is still remembered by students on campus as a beacon of literary talent, and alumni describe it as a lot of fun and an incredibly rewarding process.

MiNT Magazine

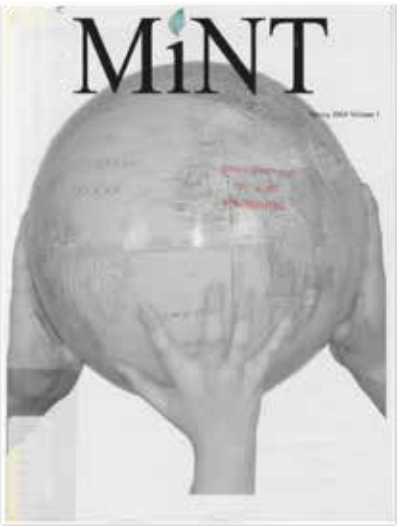

Figure 11. Cover of MiNT Magazine*, Spring 2003.*

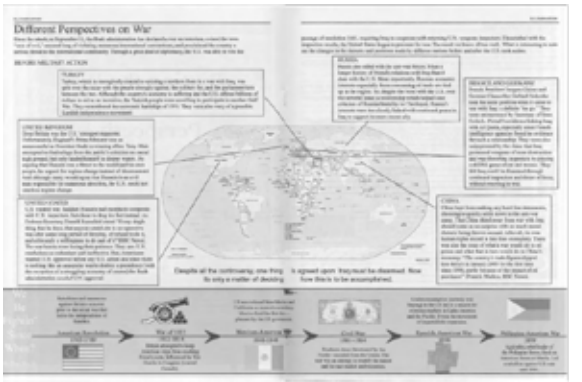

Figure 12. A spread on the Iraq War by Fiona Lee, Spring 2003.

MiNT Magazine is one of two ongoing publications at Geneseo. *MiNT*, like *Opus*, was founded in 2003; however, unlike *Opus*, *MiNT* did not initially appear to be a traditional literary magazine. In its early years, *MiNT* was funded by the Vice-President's Grant for Creating Community Through Diversity and, thus, was published with the intent of being a multicultural magazine. It was titled *MiNT* because:

> [a] mint is something refreshing, something you always want, something you usually need. It is that extra something you need after a meal. A mint leaf has healing properties. Something that's in mint condition means fresh and new. A mint is also a place or source of invention. (Lee & Pederson, 2003, p. 3)

Although it published some poetry and creative prose, in its early days it functioned as much more of an editorial publication, showcasing educational and opinion pieces about

politics and current events. For example, the first issue was published in 2003, so much of it focused on the Iraq War and George W. Bush. It drew a lot of inspiration from *Our Time*, sharing similar formats and a common advisor. *MiNT* is also notable for being the first—and only—Geneseo publication to feature themed issues.

Over the years, however, *MiNT* shifted away from editorials into traditional poetry, prose, and artwork; its 2012 issue "FulfillMiNT" was among the first known issues to feature this new style. *MiNT* still exists today as the oldest continuous student-run literary magazine.

Gandy Dancer

Figure 13. Cover of Gandy Dancer*, Issue 1.1*

Finally, we come to Geneseo's newest magazine. *Gandy Dancer* was founded in 2012 by Professor Rachel Hall and Suraj Uttamchandani. It began as an online-only publication but transitioned to printing copies shortly after. It was named in honor of the gandy dancers, a slang term for railroad workers who laid down the tracks.

Gandy Dancer, unlike the Geneseo publications that came before it, has a great deal of faculty oversight, being managed by Professor Rachel Hall through the Editing and Production class. The rotating students in the class make up the Masthead, and they are divided into genre groups which read poetry, fiction, and creative nonfiction, respectively. Also, unlike the Geneseo publications that preceded it, it is the only publication to welcome submissions from other schools. *Gandy Dancer* welcomes all SUNY students to submit, and as result, has created a literary community that has expanded even beyond Geneseo.

Conclusion

Sadly, the future of this project does not lie in my hands. I desperately wish I could keep going and do the things I wasn't able to, but I'm nonetheless excited to see where it goes, and I'm excited to hopefully come back and present this research at the fall Forum for Undergraduate Student Editors conference at Geneseo. This project has been incredibly rewarding, and I've loved doing it. I know how important preserving these documents is for the campus community, and I hope that after my time and Jess's time working on this project comes to a close, the campus continues to value its literary history, preserving and studying the old issues. The most validating part for me has been seeing where I fit in the fabric of writers and editors that came before me. Old editors have included funny quips in their magazines, referencing inside jokes and pop culture trends, and I see myself in them. Furthermore, mistakes are not infrequent in these old issues; however, the imperfection reminds us that these were just students, trying their best and loving what they do. One quote from *The Experimentalist*, Spring 1970, stood out to me in particular: "In an age of perfectionism, let this magazine stand forever, a living monument to the forces of anti-professionalism." Student editors know that our work is rarely perfect, but it is a labor of love, and we are honored to do it. I am honored to assist these old magazines in standing forever, just as *The Experimentalist* Staff requested.

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Muslim Integration in Sweden and The Netherlands in the Twenty-First Century

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sponsored by Robert Goeckel, PhD

Abstract

The Middle East has seen increased violence and revolutions in recent years, producing a surge of millions of refugees, many of whom made their way to Europe. In addition to fueling far-right populist parties, this phenomenon has challenged existing norms of religious freedom, toleration, and churchstate relations in Europe. I was eager to see how different countries handled this new Muslim minority. I chose to compare the response of both Sweden and the Netherlands. Unlike Eastern Europe, the Netherlands and Sweden share a long history of democracy and religious tolerance. However, Sweden differed from the Netherlands in that until 2000 the Lutheran church was the established church, whereas the Netherlands is characterized by "principled pluralism" of Protestant, Catholic, and a large non-religious sector of society. My findings indicate that, despite having less experience with Muslim immigrants, Sweden has done a much better job. The country refrained from passing laws that restricted religious practice by Muslims and mobilized the substantial infrastructure of the Swedish church to integrate new Muslim immigrants, whereas the Netherlands has restricted certain Muslim practices and the churches have lacked the resources in civil society to support integration.

Introduction

In the early 2000s the Middle East saw a massive increase in the amount of violence occurring in the region. This first began with the United States' "War on Terror" in response to the 9/11 terrorist attacks. Violence in the Middle East would persist into the next decade. The Arab Spring began in 2011 which resulted in attempted revolutions in several Middle Eastern countries, including Egypt and Syria. The Muslim world was then rocked by a resurgence of terrorist organizations in the 2010s, such as ISIL in Syria and Iraq as well as Boko Haram in Nigeria. The various revolutions and the presence of terrorist groups in the Muslim world created millions of Muslim refugees, many of whom would make their way to Europe en masse during the 2010s. This large influx of

Muslim refugees entering Europe brought to the surface variations in religious tolerance throughout the continent.

Contrary to the beliefs of people like Samuel Huntington, modernization in many European countries did not coincide with a strictly secular society. Instead, each would see a different relationship between church and state, highlighting the idea of Peter J. Katzenstein that modernity would look very different in various countries, and not every society would become a secular one. This is what Katzenstein defines as "multiple modernities" and is the basis for our understanding that each country has a different relationship between religion and state (Byrnes & Katzenstein, 2006, p. 5). The Netherlands and Sweden provide good examples of contrasting models of church and state relationships within Europe. These two countries also had different responses to the increase of their respective Muslim populations, which is reflective of their differing "modernities" and opinions on the issue of what the proper relationship between religion and government should be. These countries also had varying reactions in their civil societies. The Netherlands and Sweden are good countries to compare because of their similar historical backgrounds. While not identical, both have reputations of religious tolerance. They also did not have large domestic Muslim populations until well into the 20th century, and both countries would see a dramatic increase of their Muslim populations in the 21st century (Stutje, 2016, p. 125). Comparing the reaction to the new minority population (Muslim) in both of these countries also allows us to compare the reactions of two differing models of church-state relationship. The Dutch church–state relationship is one of positive neutrality, whereas the Swedish case is one of a de-facto establishment model (the church of Sweden was stripped of its title as a state-religion in 2000, but little has changed in the church's function in civil society) (Ideström & Linde, 2019, p. 5).

Government Reactions

Netherlands

The Netherlands is a country known for having a secular culture, as a majority of the country does not identify with a religious group. The Netherlands is also known for its system of positive pluralism between the state and the country's religions. The Dutch government has made their commitment to positive pluralism clear in their constitution, as the first chapter's first article reads: "All persons in the Netherlands shall be treated equally in equal circumstances. Discrimination on the grounds of religion, belief, political opinion, race or sex or on any other grounds whatsoever shall not be permitted" (*The Constitution of the Kingdom of the Netherlands 2008*, 2008). The Dutch constitution also provides the right to practice religion in a community, and the right to an education in the religion of your choosing, funded by the government. The constitution clearly sets out a charter for a country that values it positive pluralism, and we can see this in the initial Dutch response to the nation's first real encounter with Islamic terrorism. In 2004 a Dutch film and television director, Theo van Gogh, was shot and stabbed to death by a 26-year old radicalized Dutch Moroccan citizen (van Meeteren & van Oostendorp, 2019). For the next several years Dutch politicians spoke of terrorism as a community

problem that was not attributable to any one religion. This is highlighted in the 2007 'Actionplan Polarization and Radicalization' Which address terrorism of all shades, not just Islamic terrorism specifically (van Meeteren & van Oostendorp, 2019). This bill passed though the Dutch legislative body advocates for preventing terrorism through a "fix it in society" approach and aims to curb polarization or an "us v. them" dynamic developing in the country, as polarization is seen in a very negative light in the country. However, this tendency to not name Islamic terrorism by name and not singling it out will eventually change, breaking with the Dutch tradition of strict pluralism.

By 2014 the Dutch government had essentially done away with not addressing Jihadist terrorism by name. Before 2014 "terrorism" in government documents could have referred to anything from animal abuse to terrorism for any cause or religion. The language coming from the government clearly depicted radical Islamic terrorism as the enemy (van Meeteren & van Oostendorp, 2019). This was most evident in the debates held in Dutch parliament after the Paris terrorist attacks in 2015, where the blame was shifted from being a societal problem, to being a problem that the Muslim community must handle (van Meeteren & van Oostendorp, 2019). Some of the comments even started to become Islamophobic. This subtle difference in the wording used by the Dutch government to address the issue would coincide with a more direct approach to radical Islam in the country.

Over the past couple of years this harsh rhetoric led to a departure in government policy from the religious pluralism that the country was known for. The first is the proposed ban on ritual slaughter. This first passed the Dutch house of representatives with 80% in favor of the measure. When the bill made it to the Dutch senate, the Labor (PvdA), Liberal(VVD), and D66 (Democrats of '66) parties completely changed course and voted against the bill, recognizing it violated religious freedom too much to outweigh the claims of some animal rights groups that what these religious communities were doing should be considered animal abuse (Valenta, 2012, p. 28). Although an outright ban in 2011 was not successfully reached, restrictions on the ability of Muslim and Jewish delis to perform ritual slaughter have become stricter (Siegal, 2017). Ritual slaughter is necessary to create many of the hallal and kosher cuisine that is made by Muslim and Jewish people in the Netherlands. In 2017 with support from the right-wing party for freedom (PVV) lead by MP Geert Wilders, the Dutch legislature would place bans on the amount of animals that can be ritually slaughtered, and would also produce very strict guidelines on how it ought to be performed (Valenta, 2012, p. 28; Siegal, 2017). This political issue is one of the main issues concerning the new Dutch Animal Rights Party, which has a small share of the seats in the Dutch congress. Nonetheless it has not relented in its pursuit (along with far-right parties) to see a complete ban on ritual slaughter become law. The ritual slaughter controversy is important because it provides a glimpse of the changing relationship between religion and state among the various Dutch political parties. Since the second world war the Liberal and Labor parties had been staunch defenders of ritual slaughter and religious freedom in general, however many members of these parties now oppose ritual slaughter along with the other secular left and right parties. In this specific case, the secular parties were pitted against the Christian Democrats and other religious

parties and indicates a shift in public opinion of what the ideal relationship between minority religions and the state ought to be in the Netherlands (Valenta, 2012, p. 28).

The second instance of the Dutch government challenging the country's reputation of religious pluralism was when it became illegal to wear face coverings in public in 2018 (Hauser & Stack, 2018). Although the "Act Partially Prohibiting Face-Covering Clothing," known colloquially as the "Burqa Ban," was written to apply to face-coverings of all kinds, it was fairly obviously directed at preventing Muslim women from being able to wear their religious head covering, whether it be a Burqa or a Niqab (Gesley, 2020). Evidence for this lies in the statements made by PVV (party for freedom) party leader Geert Wilders, as he has been one of many voices stating that this bill was specifically made to stop Islam and the Islamization of the Netherlands (Hauser & Stack, 2018). This particular right wing party is in the current governing coalition. The party completely politicized Islam and voiced vehement opposition to it, making clear that they are Islamophobic.

Although examining legislation that effects Muslims and parties with anti-Muslim sympathies provides insight into Dutch relations with its Muslim minority, it does not provide the whole picture of what the integration of Muslims looks like in the country. Despite some controversial laws passed in The Netherlands over the past few years, the government has taken the lead role of trying to integrate its Muslim population in the country. For years prior to the first major integration project in the 21st century by the Dutch government in 2013, first generation Muslim immigrants were able to integrate at much lower rates of success than immigrants from other parts of the world. This is proven by several studies that have concluded that the level of religiosity amongst first-generation Muslim immigrants is negatively associated with their integration in West-European societies (Beek, & Fleischmann, 2020, P. 3656). There are several reasons for this, including the fact that sexual and gender norms are often recognized as being sources of conflict between Muslims and the European mainstream. Islam holds allegedly traditional views regarding these matters, especially compared to the views of the majority population in West-European societies (Beek & Fleischmann, 2020, p. 3657).

When trying to understand integration efforts in the Netherlands it is important to understand radical movements and ways that the Dutch government tried to curb them by promoting integration. In the advent of the 2010's a movement called Sharia4Holland and Sharia4Belgium emerged that advocated for Sharia law. These were groups of a couple hundred young Muslims who were creating "aggressive" confrontations against those that they saw as "enemies of Islam" in the Netherlands. The radical sentiments of these groups were aided by the fact that the mosques in the Netherlands were in-large funded by Salafist groups from Saudi Arabia. The Saudi's would bring a more "traditional" (which typically means illiberal) brand of Islam to these mosques that did not have the same level of tolerance that many in western societies have (Hoorens et al., 2015, p. 9). Many Dutch policymakers had fears that these radical groups could turn to armed violence. As these Dutch policymakers predicted, some of these Muslim-Dutch youths did, as some of them had fled the country to join the ranks of the terrorist groups in the

Middle East (de Koning, 2020, p. 132). This paired with several terrorist attacks (like the murder of Theo van Gogh) made the Dutch government realize action needed to be taken considering the sharp rise in Muslim population.

A major step was taken in 2013 when the Minister of Social Affairs and Employment rolled out an integration plan. The plan placed responsibility of integration on the newcomer to undertake necessary steps to succeed (European Union, n.d.). It aimed to increase participation in society and self-reliance, living together and dealing with other Dutch people, internalizing Dutch values, and making limits clear and educating the new immigrant. The Civic Integration Act (Valid as of February 2014) allows many of these migrants or refugees to begin this process before they even arrive in The Netherlands. The latest update to government integration protocols was enacted in 2017, which added an expectation that refugees and migrants learn the Dutch language. It also granted a three-year residency permit for refugees. Recognized refugees would also follow language courses at the state asylum center from day one and the supply in early education programs was increased (Netherlands: Highlights from the 2017 Coalition Agreement, n.d.). The new integration legislation implemented these changes by stripping funding from institutions in the civil society for the integration of refugees, as the government wished to "mainstream the integration process" (Euroepan Website on Integration). Considering how recent some of these changes are, data will more than likely be produced in the future to see if these changes have a positive impact on the country. One thing that can be inferred from this approach by the Dutch government is that government believes it will do a better job at integrating the Muslim refugees and other migrants than independent actors in the civil society can.

While the Dutch government has made attempts to improve the integration of the Muslim population into Dutch society, the restrictions on ritual slaughter and the bans on burqas in the Netherlands have tested the ideal of religious pluralism in the country. Before Muslim refugees began making their way to Europe in massive numbers and the threat of radical Islamic terrorism was on the minds of the Dutch, religious tolerance was virtually unquestioned in the country. However, this clash of cultures in the Netherlands has produced a sense of Islamophobia among some in Dutch society. These passions have led to parties like the PVV entering governing coalitions and attempting to deprive Muslim people of equal religious liberty under the law by justifying the banning of ritual slaughter and face coverings. Although government funding of religious education and programs is still very much plural, these two political issues are certainly eroding norms and institutions of religious freedom in the country. The amount of damage these efforts have done to the reputation of the Netherlands as a country that values religious freedom is still unknown, as the future could see a backlash to the anti-Islamic rhetoric that has existed in Dutch politics as of late, or it could see further attacks on the freedom of religious minorities to practice their religions.

The country of Sweden is very similar to the Netherlands in that it is a country with a reputation for religious tolerance as well as accepting and encouraging multiculturalism. The Constitution of Sweden makes it abundantly clear what the relationship between

religions and the state is in the country, stating that "Everyone shall be guaranteed… freedom of worship: that is, the freedom to practice one's religion alone or in the company of others" (S*weden's Constitution of with amendments through 2012*, n.d.). However, it should be noted that Sweden differs from the Netherlands in that until recently its model of church-state relationship was that of having an official national church, which was the Lutheran Church of Sweden until 2000 (Ideström & Linde, 2019, p. 4). Even though the Lutheran Church of Sweden is no longer the officially recognized religion of the state, its position in Swedish society has not changed much because of it.

Sweden

In recent history, the Swedish people have prided themselves as being a safe haven from violence for refugees (Brljavac, 2017, p. 96). This was not always the case though, as in the interwar period between World War I and II, the Swedish people derived their pride from a collectivist and ethnic type of nationalism and a sense of ethnic superiority (Åberg, 2019, p. 28). This was represented by the Swedish government creating a state-funded institute to study Eugenics at Uppsala university in 1922. After World War II this ethnic nationalism lost its appeal. By the 1960s' Sweden would become a progressive and modern nation, and in the 1970's the Swedish would embrace multiculturalism and immigration. This was a stark departure from Sweden's past as they no longer saw ethnic homogeneity as desirable. Sweden would first embrace labor force immigration and then refugees from all over the world (Åberg, 2019, p. 28). The country opened its doors to refugees from Augusto Pinochet's regime in Chile as well as those fleeing the Yugoslavian civil war. The Swedish people were also enthusiastic about accepting refugees from the Syrian civil war initially (Brljavac, 2017, p. 96). The country began taking in higher amounts of refugees than any other Nordic country as well since the early 2000s. However, attitudes began to sour as the number of asylum seekers began to explode during the Syrian Civil War and the refugee crisis that hit Europe during the mid 2010's.

Before the civil war, the country was taking in anywhere from 15,000 to 36,000 asylum seekers per year, and between 2000 and 2600 of those were unaccompanied minors (Brljavac, 2017, p. 97). After the outbreak of the Arab Spring and subsequently the Syrian Civil War in 2011 the number of asylum seekers began to skyrocket. In 2015 the number of asylum seekers had surpassed 162,000 that year in a country with a population below ten million (Sweden and Migration, n.d.). To make matters worse, 35,000 of those refugees were unaccompanied minors (Brljavac, 2017, p. 97). Before the refugee crisis, Sweden was already struggling to relocate below 3000 children a year (Brljavac, 2017, p. 97). However, because of the broad non-partisan support of immigration as an important part of the Swedish identity, the government and the people of Sweden gladly accepted this undertaking initially. This sentiment was highlighted in early 2015 when the Prime Minister of Sweden, Stefan Lovfen, stated passionately that "My Europe does not Build Walls" while simultaneously criticizing other European countries for not doing more to aid the refugees (Brljavac, 2017, p. 97; Ideström & Linde, 2019, p .4). By October of 2015 the Swedish government came to a nonpartisan consensus and finally recognized that it could no longer accept such massive amounts of refugees, as many feared that it

would collapse the welfare system, and the social tensions between the new immigrant population and the native Swedes began to rise (Åberg, 2019). The reintroduction of internal border controls to halt the flow of refugees into the country came as a sense of relief to some, but many others in Swedish civil society, including the Archbishop of the church of Sweden, voiced sharp criticism (Ideström & Linde, 2019, p. 5). The refugee crisis that reached its peak in 2015 would permanently change Swedish politics going forward and would bring forth a new problem of assimilating the new large Muslim refugee population into the country (Åberg, 2019, p. 28).

When it became apparent that the Swedish government needed help financially and needed help culturally assimilating the Muslim population in 2015, it looked to the Lutheran Church of Sweden for assistance (Ideström & Linde, 2019, p. 4). Even though the church of Sweden had lost its title of being the official church of Sweden 15 years prior, its relationship with the people of Sweden had not really changed (Ideström & Linde, 2019, p. 5). This was due to the fact that a majority of Swedish people (59%) still associated with the Lutheran Church of Sweden and was still recognized as the de facto church of the country (Ideström & Linde, 2019, p. 6). Throughout Swedish history the Lutheran church had played a large role in civil society, providing welfare services to the people of Sweden officially until the end of the 19th century, and education until the 20th century. The rise of the welfare state in Sweden in the late 20th century would replace the church as the primary source of welfare in Swedish society (Ideström & Linde, 2019, p. 5). However, the church of Sweden would see itself as "an active supporter" of the welfare state and would come to the Swedish welfare states' aid when it needed it most during the refugee crisis (Ideström & Linde, 2019, p. 6).

In 2015 when the refugee crisis reached its peak, the refugees were distributed all over the country. The Swedish Lutheran church had parishes across the country, and thus had the infrastructure to provide services to many of these refugees (Ideström & Linde, 2019, p. 6). The church as an institution saw itself having a duty to be "value guardians in the welfare state" (Ideström & Linde, 2019, p. 6). The church would act as that guardian by having eighty percent of their parishes engaged in providing welfare to the large refugee population (Ideström & Linde, 2019, p. 6). These parishes would provide many services by working in tandem with the Swedish government to provide assistance. An example of this was the municipality of Mölndal reaching out to the local parish to assist in relocating many of the unaccompanied minors who had reached Sweden and needed to be placed in a home. The Mölndal church enthusiastically agreed to this as the Vicar of that church saw it as the parish's duty (Ideström & Linde, 2019, p. 8). The Lutheran parishes would also provide shelter, food, and clothing to many of the refugees (Ideström & Linde, 2019, p. 4). The churches would gather these resources by asking for donations from the community which was generally supportive of the work that the church was doing.

The actions of the Swedish church were not just limited to providing welfare to the Muslim refugees, as they also tried to integrate the refugees into Swedish society. The churches did this by organizing language cafés with many of the locals and establishing sus-

tained connection between the refugees and the government (Ideström & Linde, 2019, p. 6). Perhaps the most important thing that the church of Sweden did was provide the Muslim refugees a place to worship in their own churches (Ideström & Linde, 2019, p. 10). This resulted in Muslims praying in one room of the church while Lutherans sang Christian chants in another room, this is a good example of the lengths to which the Church of Sweden went to provide welfare to the refugees. Since then, there are various examples of both the Swedish government paying for permanent places of worship and Middle Eastern groups providing funding and training to teach Islam in schools and within the Muslim community (Berglund, 2019, p. 226).

The refugee crisis of 2015 reinforced the role of the Church of Sweden in Swedish society. Although the Lutheran Church of Sweden was no longer the official church of Sweden, it recognized the immense sense of responsibility it had as an actor in the civil society (Ideström & Linde, 2019, p. 4). However, despite all of the church's efforts, Muslim integration into Swedish society has not been smooth, in fact it has been far from it.

The arrival of so many refugees into Sweden was bound to create social tensions of some kind from the beginning. The consequences of this have resulted in a changing political landscape in the country. For decades it was taken as a given that the Swedish people generally agreed that the country should take in a high number of refugees per capita and embrace multiculturalism. After the refugee crisis that dynamic has changed and has coincided with the rise of a far-right movement in the country. This far-right movement is embodied in the platform of the Swedish Democrat party which has risen from obscurity to become the third largest political party in Sweden, winning 62 seats in the Riksdag in the last national election in 2018 (Tomson, 2020). In other countries, being the third largest party in a country would often find you in a governing coalition. After the 2018 elections the right-wing parties (commonly referred to as the alliance) had won more seats in the Riksdag than the left-wing coalition of parties (called the red-greens or the Lofven cabinet). However, because the other right-wing parties viewed the Sweden Democrats as being too radical for their tastes, the center and liberal parties refused to create a government with them, and instead opted to allow the Social Democrats (seperate from the Sweden Democrat party) to make Stefan Lofven Prime minister in a government where he is governing as the minority (Tomson, 2020). This was significant because it highlighted the increasing polarization of Swedish politics and because over the past few decades Sweden hadn't seen a far-right movement like most other European countries had, making them an outlier. However, because of the Sweden Democrats this was no longer the case.

To understand the significance of the Sweden Democrats it is necessary to understand their origins. The Sweden Democrat party was founded in 1988 and had close ties to the former Swedish fascist and Swedish neo-Nazi movements. The first elected party chair had ties to the neo-Nazi Nordic realm party, and when old pictures of party members wearing Nazi insignia surfaced in the 1990s, the party banned the wearing of any kind of Nazi uniform and strongly denounced Nazism (Tomson, 2020). When their current party chair, Jimmie Akesson, was elected as party leader in 2005 he sought to modernize

the party and make it more acceptable to the public. Akesson had helped push the party away from openly racist groups to a more populist message, however the anti-Islamic message of the party was still very much alive (Tomson, 2020).

The anti-immigrant and anti-Muslim messaging of the Sweden democrats has been a hallmark of the party, with Jimmie Akesson himself claiming that "I see [Islam and Muslims in Sweden] as our biggest foreign threat since World War II" back in 2009 (Tomson, 2020). This kind of messaging is very similar to that of the Freedom Party in the Netherlands and would inevitably find supporters in Sweden after the refugee crisis. Many Swede's saw the cultural contrast between themselves and the new large Muslim minority as being undesirable, and is a stark contrast from the desire for multiculturalism in Sweden that has existed since the 1970's. A good example of this shift in thinking can be seen in a 2018 election debate when all of the parties were asked if they supported multiculturalism. All of the parties except the Christian Democrats and the Sweden Democrats said yes, showing that the once nearly unanimous desire for multiculturalism in Sweden is no more (Åberg, 2019, p. 29). One of the platform positions that has increased the popularity of the Sweden Democrats was their opposition to Muslim mosques issuing an adhan, calling it an "alien" practice which has no place in Sweden (Ringmar, 2019, p. 107). An adhan is a public call to prayer by means of a loudspeaker. When a local imam in the town of Vaxsjo applied for permission from local authorities to do this weekly, the issue was picked up by media outlets and quickly became the subject of an intense public debate. Although the local officials in this small town eventually solved the issue by allowing mosques to pray as long as they did not disturb their neighbors, the issue certainly drew concern from a growing number of people who would end up voting for the Sweden Democrats that year. Another platform position held by the Sweden Democrats would be a ban on the Burqa and Niqab, as Sweden Democrat MPs have made attempts to get a Burqa ban voted on in the Riksdag (Jakku, 2018). These policy positions played into a larger theme of the Sweden Democrats platform which emphasized a non-negotiable requirement of cultural assimilation in order to gain citizenship and full membership in a homogenous Swedish nation (Åberg, 2019, p. 29).

Although these actions taken by the party of Sweden Democrats do not constitute physical violence against Muslim refugees, the country has not been immune from far-right attacks against Muslims. In the aftermath of the refugee crisis, there were waves of arson attacks against refugee shelters, with the antagonists oftentimes claiming that they are protecting their citizens from "criminal immigrants" (Koehler, 2016, p. 97).The country has also seen some fairly vile public displays of Islamophobia in public that have resulted in violent riots in the country. One such display occurred in August of 2020 as a far-right group burned a Quran in a neighborhood that had a large minority population in it and posted a video of it online. In response, violent protests broke out in Malmo, seeing rioters set fires and throw objects at police and rescue services, slightly injuring several police officers and leading to the detention of about 15 people (*Riots in Sweden after Quran Burning by Far-Right Activists*, 2020). In Sweden the fear of violence perpetrated against Swedes by immigrants is high, so high that the Swedish government produced its own facts on crime in their country to try and dispel some of the misinformation that can be

found on the internet. The Swedish government produces its own crime statistics through a government agency called the Swedish National Council for Crime Prevention (Brå). In a 2019 study on patterns of criminal activity in the country, the government agency found that Muslims are over-represented in crime statistics. However, this government agency has concluded criminal activity has a strong correlation with an individual's level of income, and not their race or ethnicity; therefore Muslims are disproportionately represented in crime statistics because Muslims are poorer than native Swedes on average (Regeringskansliet, 2017). Although there have been a few instances of Muslim terrorists in the country, these hate crimes are rare and the common misconception that Sweden has a major Muslim crime problem doesn't hold up when the data is presented.

The last thing that ought to be considered when analyzing how well the Muslim population has integrated into Swedish society is to understand how the Muslim communities' opinions on Swedish society and what sort of societal changes they have demanded. In other European countries it has been suggested that the Muslim population ought to be able to enforce Sharia law amongst themselves. A similar proposal was brought forth by a member of the Swedish Muslim community back in 2006. Prior to the parliamentary elections that year, the leader of the Swedish Muslim Association (Sveriges Muslimska Förbund), Mahmoud Aldebe, wrote an official letter to the political parties. The letter was published in the newspaper Dagens Nyheter on April 27, 2006. In the letter, Aldebe asked for legislation giving Muslims the right to take leave on religious festivals, to have a mosque in every city, to have particular days for men and women in the local swimming pools, and to have sectoral legislation in family legislation issues. This article written by Aldebe advocating for Sharia law received nearly universal criticism from other members of the Swedish Muslim Association and other Muslim leaders in the country, as many publicly rejected his claims and stated that Aldebe is not the voice for all Muslims in the country (Roald, 2013, p. 127). The opinions of Adelbe, calling for laws which discriminate by gender, were soundly rejected. As this example shows, Adelbe is an outlier in the Swedish Muslim community. He was also a fairly recent immigrant to the country who lacked an understanding of its boundaries, which played a large role in the writing of his article. Many Swedish Muslims who reside in the country long-term tend to embrace Swedish culture and tend to harbor Swedish identities and loyalties. There are various reasons for this, chief among them is the rejection of the populist and Islamophobic Sweden Democrats by the current government (Roald, 2013, p. 128).

Discussion

The countries of Sweden and The Netherlands are two countries which have had to deal with integrating a large Muslim population into their societies in the 21st century. While both of these countries had similar backgrounds with respect to their history with the Islamic faith, the approaches of both of these countries looked quite different from one another. The Swedish government is a country best described as a defacto establishment model, because even though the Lutheran church of Sweden was no longer recognized as the official church of Sweden in 2000, its role in society did not change for the most part. The close relationship between the church and the state in Sweden allowed the

Swedish government to reach out to the Church of Sweden to assist with the integration of Muslims into Swedish society. The church subsequently used 80 % of the parishes in the country to help with sheltering the Muslim refugees. These local parishes would cooperate with local government officials to further help Muslim refugees establish themselves as being a part of Swedish society. On the other hand, the Netherlands was a vastly more secular country that did not have a religious body that acted as a strong actor in civil society. This may be part of the reason for the Dutch government not relying on any organizations in civil society at all, as the government has stripped integration funding from civil society actors. Instead, the Dutch government would prefer a much more streamlined approach that would be completely controlled by the government.

Despite the efforts of both governments to integrate the new Muslim populations into their respective countries, the arrival of so many foreign refugees into both countries certainly produced a backlash. Both countries would see the rise of far-right political movements over the past five years, and the catalyst for this is almost solely the refugee crisis that resulted from the Arab spring and the Syrian civil war. In the Netherlands the ironically named "party for freedom" lead by Geert Wilders has found themselves among the new governing coalition and has been successful in promoting bans on face-coverings and restrictions on the ability of Muslims and Jews to perform ritual slaughter in the country. The country of Sweden has seen a similar backlash to Muslim integration, which lead to the rise of the Sweden Democrat party. The Sweden Democrats are a party with origins that are related to the small neo-Nazi and fascist movements that still existed in the Nordic realm post World War II. This party has become the third largest party in Sweden and has pushed for restrictions on public Muslim prayer and face-coverings like the burqa in the past. In these regards the Sweden Democrats are a populist far-right movement that is very similar to the freedom party in the Netherlands.

Conclusion

Providing a metric to measure which integration method has seen more success in each country is a challenge. However, using the information gathered on the government responses to the influx of Muslim refugees and comparing it to electoral and legislative responses, we can get a rough idea of which country did a "better" job. The Dutch government in large part was not supported by a large civil society actor and chose to take a much more government-oriented approach to integrating its refugees and Muslim immigrants. The Dutch government has also successfully passed laws restricting the wearing of the burqa and many restrictions on the practice of ritual slaughter. Additionally, the Netherlands has seen radical Muslim movements such as Sharia4Holland which have advocated for Sharia law in the Netherlands and have been quite aggressive. On the other hand, Sweden has not seen its far-right party join the governing coalition. In addition, the Riksdag has so far rejected any attempts at a Burqa ban, and has thus far been able to avoid passing controversial legislation that some could accuse of restricting the rights of the Muslim minority to practice their religion. Lastly, the country of Sweden has not seen a radical Islamic movement develop, and a vast majority of the Muslim community does not support the Swedish government imposing Sharia law to any extent. With this

background information, if the "better" response is the one which has seen less infractions by the government on the religious freedoms of its minority religion and less radical activity, then the Swedish government has arguably done a better job.

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Identifying Potential RNA Binding Domains in the Thumb Region of R2 Protein

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Abstract

Transposable elements are selfish mobile genetic elements able to replicate in the host genome and are classified as either DNA type elements or retrotransposons. In our study, we focus on R2 retrotransposable elements. Retrotransposable elements can reverse transcribe an RNA intermediate into DNA either before or during integration into the target genome. The R2 element exclusively inserts in the 28S rRNA genes via the mechanism of target primed reverse transcription (TPRT). For the TPRT mechanism to occur, the 5' and 3' ends of the RNA intermediate must bind to R2 protein before cleavage and insertion into a new genomic site can occur. Despite its importance in TPRT, RNA binding sequences of the R2 protein are not well understood. The objective of this study was to create single alanine replacements via site-directed mutagenesis in both the RYGLV and KPQQR sequences, which are highly conserved in the thumb domain of the R2 protein, and to isolate this mutated R2 protein for use in future assays. By examining the RNA binding properties of the R2 protein, we can further understand the TPRT mechanism and its overall role in retrotransposon success.

Background

When considering the importance of DNA, it is first regarded for its instructional role in the production of proteins, which is critical to sustaining life. However, only 1.5% of the human genome actually encodes for proteins, meaning that 98.5% of the human genome is composed of non-protein encoding genes (Gregory, 2005). Of these 98.5% of non-coding genes, roughly 45% are composed of transposable elements (TE), sometimes referred to as "mobile genetic elements," "jumping genes," "selfish DNA," and "junk DNA" (Belancio et al., 2009). TE are mobile genetic DNA sequences that are able to insert themselves into different sites throughout

the genome and are present in almost all prokaryotic and eukaryotic organisms, accounting for vast amounts of genetic material.

TE are classified as either DNA type elements or retrotransposons, as these respective subtypes differ in the mechanism of which they transpose themselves. Whereas DNA type elements move via a DNA intermediate, retrotransposons move via an RNA intermediate, through a mechanism known as retrotransposition. Retrotransposons encode their own reverse transcriptase (RT), allowing them to reversely transcribe the RNA intermediate into cDNA when transposing themselves to the target site (Brooker, 2018). Retrotransposons are further classified into two groups: Long Terminal Repeat (LTR) and non-LTR retrotransposons. For our study, we are focusing on non-LTR retrotransposons, specifically R2 retrotransposable elements.

Retrotransposons are highly abundant and found in many eukaryotic genomes. In fact, retrotransposons compose roughly 41.8% of the human genome, with non-LTR retrotransposons representing 17% of the human genome, highlighting the importance and applicability of retrotransposon research in the study of human genetics (Cordaux & Batzer, 2009; Eickbush & Jamburuthugoda, 2008). In fact, understanding the way that retrotransposons move and insert within the human genome has important applications in medicine because many types of cancers and other diseases can be caused by insertion of these TEs within critical genes. For example, a study found that frequent somatic insertion of L1 elements (abundant TE in the human genome) into critical genes may play a role in lung-tumorigenesis (Iskow et al., 2010).

Additionally, there are many applications of TE research in the field of human genetics, such as its promise in gene therapy as a gene delivery tool. R2 retrotransposable elements exclusively insert into a conserved region of the 28S rRNA genes (Eickbush et al., 2013). Since this R2 28S rRNA insertion site is conserved across all eukaryotes, including humans, this integration consistency allows for detailed analysis of its retrotransposition mechanism, thereby helping researchers further understand how the R2 integration mechanism can be used as a potential gene delivery tool (Christensen et al., 2006; Jamburuthugoda & Eickbush, 2014). Therefore, by studying the R2 integration mechanism, it can provide insight into how other retrotransposons with similar integration mechanisms integrate into the genome and how this could be exploited for gene delivery purposes. The goal of our study is to learn more about the integration mechanism of the R2 element, specifically, the domains of the R2 protein that are important for RNA binding and the R2 elements' overall success. In our study, we are using the R2 protein encoded by *Bombyx mori* to study the integration mechanism of the R2 element into the host genome.

R2 elements encode a single open reading frame (ORF) with a central RT domain, C-terminal restriction-like endonuclease (RLE) and cysteine-histidine rich domain, and N-terminal zinc-finger (ZF) and Myb nucleic-acid binding domains (Jamburuthugoda & Eickbush, 2014; Khadgi et al., 2019). When the R2 element gets inserted into a new location, the 28S rRNA gene in the eukaryotic chromosome is first transcribed into mRNA in the nucleus. This mRNA then leaves the nucleus and enters the cytoplasm

where the R2 RNA is translated into protein by the ribosomes. After translation, the newly formed R2 protein binds to the same RNA strand that it was translated from, forming an integration-competent ribonucleoprotein (RNP) complex that goes back into the nucleus and inserts into a new site within the 28S rRNA gene in the eukaryotic chromosome. R2 integrates via the mechanism of target primed reverse transcription (TPRT), where target DNA is first cleaved at the bottom strand by the upstream bound R2 protein subunit and the released 3' OH group is used to prime the reverse transcription of the element RNA onto the target site (Khadgi et al., 2019). Next, the downstream bound R2 protein subunit cleaves the top DNA strand and the released 3' OH group is used to prime second-strand DNA synthesis, displacing the RNA strand as the newly synthesized DNA is extended. This newly synthesized double stranded DNA is then inserted at the target site, and the nicks that were created during the double stranded breaks in DNA are repaired by a host repair mechanism (Yamaguchi et al., 2015).

Important to the TPRT mechanism is the activity of the R2 protein, which directs RNA binding of the protein upstream and downstream of the target site upon association with the 3' and 5' end of R2 RNA, respectively, as well top and bottom DNA strand cleavage to prime reverse transcription (Jamburuthugoda & Eickbush, 2014). In our study, our goal was to mutate two highly conserved regions within the thumb domain of the R2 protein to identify whether these specific regions are important in R2 RNA binding of the R2 protein, and therefore can be classified as an RNA binding domain. If the mutant R2 protein has decreased TPRT activity compared to that of the wild type R2 protein, then these conserved regions can be identified as an RNA binding domain.

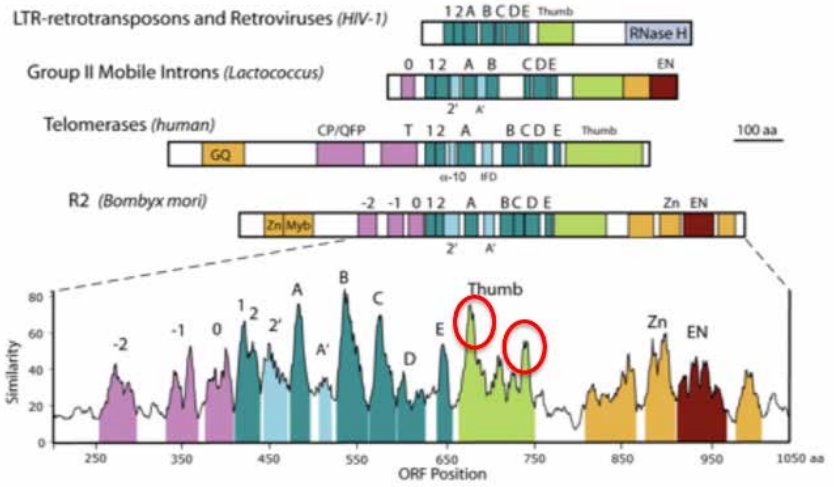


Figure 1. Comparison of R2 protein reverse transcriptase domain with retroviruses, group II introns and telomerases (Jamburuthugoda unpublished figure)

As displayed in *Figure 1*, phylogenetic studies have shown highly conserved protein sequences of RT domains in the fingers, palm and thumb domain encoded by TEs, telomerases and group II introns (Jamburuthugoda & Eickbush, 2014). Previous research has characterized two highly conserved protein motifs N-terminal to the RT domain in

R2, the 0 region and -1 region, as an RNA binding region (Jamburuthugoda & Eickbush, 2014). By analogy to group II introns, the putative thumb domain of R2 protein is a candidate for RNA binding (Eickbush & Jamburuthugoda, 2008). In this study, we are focusing on the thumb domain of the R2 protein, specifically both the RYLGV and KPQQR sequence, as potential RNA binding regions of R2 protein to the 3' and 5' end of R2 RNA.

Our goal was to perform site-directed mutagenesis of the RYLGV sequence and KPQQR sequence. Specifically, we sought to create single alanine replacements of arginine to alanine in the RYGLV sequence, and lysine to alanine in the KPQQR sequence. After confirming that the single mutation was successful, we ultimately want to use this single mutant as a template to create a second mutation within the RYGLV sequence (tyrosine to alanine) and KPQQR sequence (glutamine to alanine). If site-directed mutagenesis of the RYLGV and KPQQR sequences is successful, we can then express the mutant protein to study its RNA binding ability compared to that of the wild type R2 protein. We hypothesize that the mutant R2 protein will have significantly reduced ability to carry out activities that require specific RNA binding, such as the TPRT integration mechanism. Additionally, the functionality of R2 protein, such as its ability to carry out its reverse transcriptase activity and endonuclease activity, should be retained after mutagenesis.

Experimental Design

pR2cdn-B plasmid construct. Our goal is to identify additional RNA binding protein motifs important in the R2 RNA binding ability of the R2 protein and its subsequent integration into the host genome. In order to mutate the R2 protein and to produce this mutant protein for use in future biochemical assays, we used a pR2cdn-B plasmid construct obtained from our collaborator, Dr. Shawn Christensen, from the University of Texas at Arlington (*Figure 2*). The pR2cdn-B plasmid is a genetically modified plasmid that can be transformed into different *Escherichia coli (E. coli)* cell lines, such as JM109 and BL21, to produce the R2 protein within *E. coli* cells. The pR2cdn-B plasmid is 7.3 kilobases and contains the open reading frame of the R2 protein, which has the same exact amino acid sequence as that found in the R2 protein of *Bombyx mori.* However, since the pR2cdn-B plasmid construct is codon optimized for *E. coli,* meaning that the DNA sequence was altered to match the codons most frequently used in *E. coli* when synthesizing R2 protein, the pR2cdn-B plasmid allows for effective production of the R2 protein within *E. coli* cells.

Important features of pR2cdn-B include the T5-lac promoter, *lacI* gene, and Kanamycin resistance gene. The hybrid T5-lac promoter is recognizable by the *E. coli* RNA polymerase and is important for the transcription of the R2 protein. This hybrid promoter contains three *lacI* binding sites, where the *lacI* repressor will bind and prevent transcription of the R2 protein. In normal circumstances, when the lac repressor is bound to the operator site, transcription and subsequent translation of the plasmid genes is prevented. Therefore, in order to induce R2 protein production in *E. coli* cells, IPTG

Figure 2. Plasmid/template contain R2 protein sequence, codon optimized for E. coli, with open reading frame (ORF) of R2 protein (red)

(a lactose analog) is added, which will bind to the lac repressor and thereby remove it from the *lacI* binding sites, ultimately inducing subsequent R2 protein transcription and translation. Additionally, the Kanamycin resistance gene allows for selection of successful transformants of the pR2cdn-B plasmid grown on LB/Kanamycin plates. *E. coli* cells that did not successfully uptake the plasmid will not have the Kanamycin resistance gene and therefore would not survive on these plates.

Primer design. The forward and reverse mutagenic primers for the RYGLV and the KPQQR sequence of the thumb region of the R2 protein of the pR2cdn-B plasmid construct were designed (Invitrogen) (*Figure 3A*). Primers were designed such that within the RYLGV sequence, arginine (R) was mutated to an alanine (A), and within the KPQQR sequence, lysine (K) was mutated to an alanine (A) (*Figure 3B*). After confirming that the single mutation was successful, we ultimately want to use this as a template to create the second mutation, tyrosine to an alanine, within the RYGLV sequence, and glutamine to alanine, within the KPQQR sequence (*Figure 3C*).

Creating more template DNA. A streak plate was made on LB/ Kanamycin plates using the WT R2 glycerol stocks obtained from our collaborator, Dr. Shawn Christensen. After incubating overnight at 37°C overnight, a single colony was selected and suspended in a 50µg/mL LB/Kanamycin stock solution to allow the plasmid to amplify overnight. 3mL of bacterial overnight culture was used in the QIAprep Spin Miniprep Kit to extract

the WT R2 plasmid DNA. DNA was quantified using the NanoDrop Spectrophotometer and an aliquot of the plasmid DNA sample was also ran on a 0.75% agarose gel.

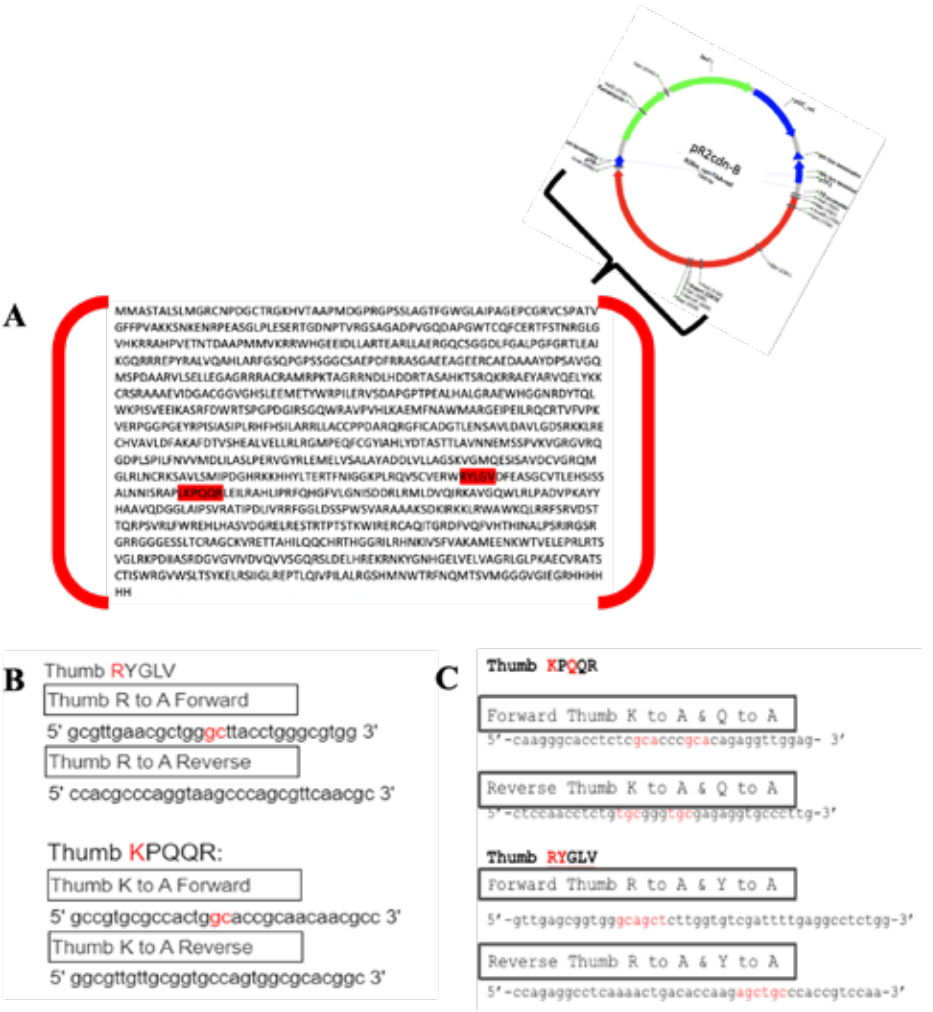


Figure 3. Mutagenic primer design for site-directed mutagenesis of conserved sequences within the thumb domain of R2 protein. (A) Open reading frame of R2 protein. (B) Single mutant primer design. RYGLV sequence: arginine (R) to alanine (A); KPQQR sequence: lysine (K) to A. (C) Double mutant primer design. RYGLV sequence: R and tyrosine (Y) amino acids mutated to A; KPQQR sequence: K and glutamine (Q) amino acids mutated to A.

Site-directed mutagenesis

For the site-directed mutagenesis reaction, the pR2cdn-B plasmid construct was used as a template that the mutagenic primers annealed to. After preparation of the plasmid, the double stranded DNA of the plasmid was first denatured, followed by annealing of the mutagenic primers. At 68°C, the mutagenic primers were extended by *PfuTurbo* DNA polymerase to synthesize the mutant DNA strand. *PfuTurbo* DNA polymerase was used

because it does not have strand displacement properties and extends at a higher fidelity than the commonly used *Taq* DNA polymerase for PCR. It is important to note that once the primer starts to get extended, it will extend throughout the entire plasmid until it reaches the primer, which generates the full-length linear product of 7.3 kilobases. Only when transformed do the nicks in the plasmid become repaired by the ultracompetent cells, thereby reforming the circular plasmid. After temperature cycling, the PCR reaction was treated with *Dpn1* endonuclease to digest the parental DNA strand. Unlike the newly synthesized strand, the parental strand is methylated and thus cleaved by *Dpn1*, allowing for selection of the newly synthesized template with the desired mutation. After the *Dpn1* digest, the reaction was transformed into XL10-Gold ultracompetent cells.

QuikChange XL site-directed mutagenesis kit. For the initial set of site-directed mutagenesis attempts, we used the PCR cycling parameters outlined by the QuikChange XL method with the annealing phase at 68°C (segment 2) for 7 minutes for the first trial and 10 minutes for the second trial. However, when visualizing the PCR on 0.75% agarose gel, no bands were present for both the PCR control product and the PCR reactions and the transformation reaction we performed to confirm whether or not the cells had the plasmid was also unsuccessful. Since the pR2Cdn-B plasmid has the Kanamycin resistance gene, successful transformants should be able to grow on the Kanamycin plates.

Therefore, for the second site-directed mutagenesis trial using the QuikChange XL method, we increased the amount of template DNA from 3ng to 9ng and used a 10-minute extension phase at 68°C rather than the 7-minute extension phase used previously. However, as we saw previously, no band around 7.3 kilobases was present for the PCR product for the mutagenesis reactions, indicating that our site-directed mutagenesis did not work. *DpnI* endonuclease was added to the PCR reaction to digest the parental DNA template and thereby select for the mutation-containing template only. After the *DpnI* digest was incubated for 1 hour, the reaction was transformed into XL10-Gold ultracompetent cells. For controls, the R2 template DNA was directly transformed into the competent cells, as well as the pET8a plasmid. However, both transformations were unsuccessful.

Two-step PCR. Since the transformations from the previous site-directed mutagenesis reactions performed using the kit parameters were unsuccessful, for the next site-directed mutagenesis reaction a two-step PCR was used. The rationale for using a two-step PCR was that possibly lowering the initial annealing temperature would help the primers adhere better to the template. Additionally, more cycles were utilized than the kit recommended. However, like the previous site-directed mutagenesis reactions, there was no band around 7.3 kilobases for the PCR reaction and the transformation reactions were unsuccessful.

Gradient PCR. Since the site-directed mutagenesis and transformation reaction using the two-step PCR parameters was also unsuccessful, for the next set of reactions instead of using *PfuTurbo* DNA polymerase, we used a new polymerase, Platinum SuperFi DNA polymerase. Platinum SuperFi DNA polymerase is better at copying larger templates than *PfuTurbo* DNA polymerase, which might be helpful with the R2 template that we

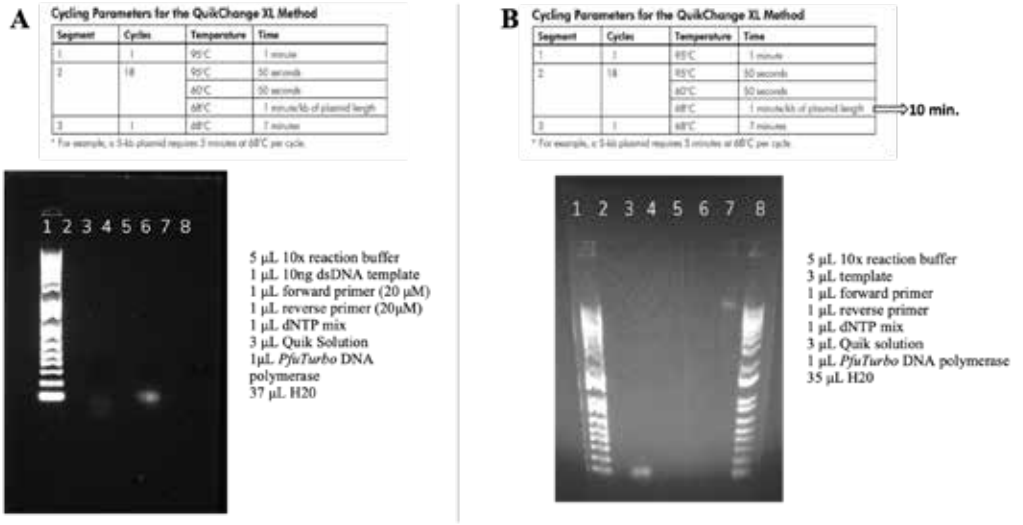
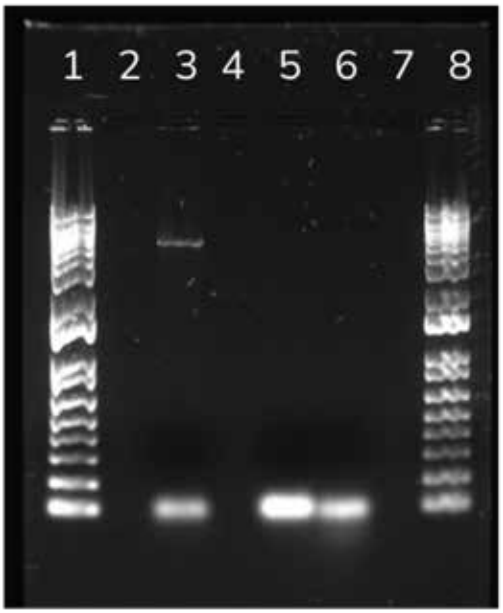


Figure 4. Site-directed mutagenesis using QuikChange XL kit. 0.75% agarose gel stained with Gel Red. (A) PCR cycling parameters and gel analysis for first trial of site-directed mutagenesis. Lane 2, DNA ladder; Lane 4, PCR reaction (RYGLV); Lane 6, PCR reaction (KPQQR). (B) PCR cycling parameters and gel analysis for second trial of site-directed mutagenesis, with extension phase at 68°C for 10 minutes. Lane 1 and Lane 8, DNA ladder; Lane 3, PCR control; Lane 4, PCR reaction (KPQQR); Lane 5, PCR reaction (RYGLV); Lane 7, template DNA.

are using since it can form concatemers. Additionally, Platinum SuperFi DNA polymerase has higher fidelity than *PfuTurbo* DNA polymerase and is more cost effective for the amount of reactions that can be performed. In addition to changing the polymerase, a gradient PCR was performed. Gradient PCR involves incremental increases in temperature for the annealing step, which is when the mutagenic primers bind to the template. As such, gradient PCR allows for multiple reactions to take place at a time, but these separate reactions are subjected to different annealing temperatures. For our gradient PCR, eight PCR reactions for each conserved thumb region were performed, with incremental increases in annealing temperature from 53°C to 63°C (*Figure 4*). The PCR reaction was visualized on a 0.75% agarose gel stained with Gel Red at long exposure. As shown in *Figure 4*, faint bands and smearing were present in lanes 5-12 and in lane 20, indicating that there was something amplifying in the PCR reactions.

Since a faint band located around the expected 7.3 kilobases in lanes 5-12 and in lane 20 was present, we concentrated the PCR product by combining some of the reactions that were run separately. Specifically, for the mutagenic reactions of the KPQQR sequence, the PCR reactions in lanes 9 and 10 were combined, as well as lanes 11 and lanes 12. For the mutagenetic reactions of the RYGLV sequence, only the PCR reaction in lane 20 was used since it was the only lane with a visible band present. The purpose of concentrating the PCR product was to yield a stronger band when running these reactions again on a different 0.75% agarose gel stained with Gel Red, which we could then extract from the gel and purify (*Figure 5*). Each combined sample was subjected to *DpnI* digest to



Segment	Cycles	Temp. (° C)	Time
1	1	95	1 min
2	10	95	50 sec
		50	50 sec
		68	7 min
3	25	95	50 sec
		60	50 sec
		68	7 min
3	1	68	7 min

5 µL 10x reaction buffer
1 µL template
1 µL forward primer
1 µL reverse primer
1 µL dNTP mix
3 µL Quick Solution
1 µL PFU Turbo
37 µL ddH20

Figure 5. Site-directed mutagenesis using two-step PCR.0.75% agarose gel stained with Gel Red. Lane 1 and Lane 8, DNA ladder; Lane 3, PCR control; Lane 5, PCR reaction (RYGLV); Lane 6, PCR reaction (KPQQR)

eliminate any template DNA, and then the concentrated samples were run on a 0.75% agarose gel. The gel was visualized at quick exposure to avoid prolonged exposure to ultraviolet light, which could damage the DNA. Stronger bands around the 7.3 kilobases were present for the combined gradient PCR for the KPQQR sequence in lanes 4-6, as well as for the gradient PCR reaction at 62.2°C for the RYGLV sequence in lane 11 (*Figure 5*). These PCR products were then cut out from the gel, and DNA was purified using the QIAquick Gel Extraction (QIAGEN) kit. Purified plasmid DNA was then transformed into JM109 cells.

Transformation and plating of gradient PCR. As shown in *Figure 6*, two different controls were used, the pET28a control (*Figure 6A*) and the WT R2 plasmid DNA itself (*Figure 6B*). Since both control plasmids have a Kanamycin resistance gene, the JM109 cells that take up either of these plasmids should survive on the LB/ Kanamycin media, growing and forming colonies, which did occur. When transforming into the JM109 cells, serial dilutions of both the pET28a control plasmid and the R2 control were created and 100 µL was directly plated into each of the petri dishes. Next, for each control a 1/10 dilution, a 1/100 dilution, and a 1/1000 dilution were created starting with 100 µL. The transformation efficiency of the JM109 cells was calculated by multiplying the number of colonies grown on each plate by their dilution factor and plating dilution, which was determined to be 2 x 10^7 colony forming units per microgram (cfu/µg) when using the 1/10 dilution plate for the wild-type template. Although this transformation efficiency was slightly lower than the expected 2 x 10^8 value, overall, the transformation of the PCR reactions was successful (*Figure 7*), indicating that the PCR products minimally have the Kanamycin gene, which allowed the transformants to survive on the LB/ Kanamycin media.

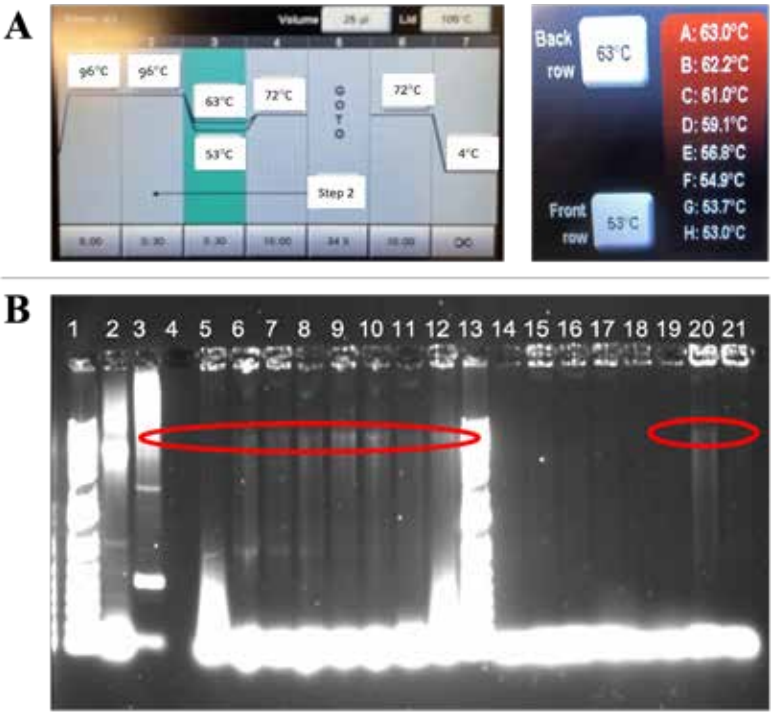


Figure 6. Gradient PCR. (A) Cycling parameters for gradient PCR. Each PCR reaction underwent 35 cycles in the thermocycler with a 10-minute extension phase. The annealing temperature spanned 53°C to 63°C. (B) Long exposure image of gradient PCR. The PCR reaction was visualized a 0.75% agarose gel stained with Gel Red to try and find the ideal annealing temperature for the mutagenic primers for each conserved region. Red circle indicates faint bands present around 7.3 kilobase mark. Lane 1 and 13, DNA ladders; Lane 2 and 3, positive controls. Lanes 5-12, PCR reactions for the KPQQR sequence with increasing annealing temperature (53°C→ 63°C); Lanes 14-21, PCR reactions for the RYGLV sequence with increasing annealing temperature (53°C→ 63°C). For lanes 5-12, 5 μL of the PCR sample and 2 μL loading dye was loaded into each well. For lanes 14-21, 5 μL PCR sample and 4 μL loading dye was loaded into each well.

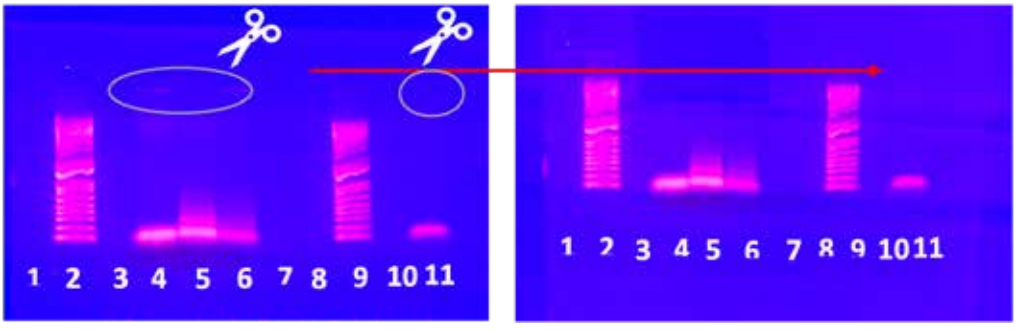


Figure 7. PCR product concentration (left) and gel extraction (right). PCR ran on 0.75% agarose gel. Lane 2 and 9, DNA ladder; Lane 4-6, combined gradient PCR for KPQQR sequence (30 μL sample and 6 μL of loading dye in each lane); Lane 11, gradient PCR reaction at 62.2°C for RYGLV sequence (30 μL sample and 6 μL of loading dye).

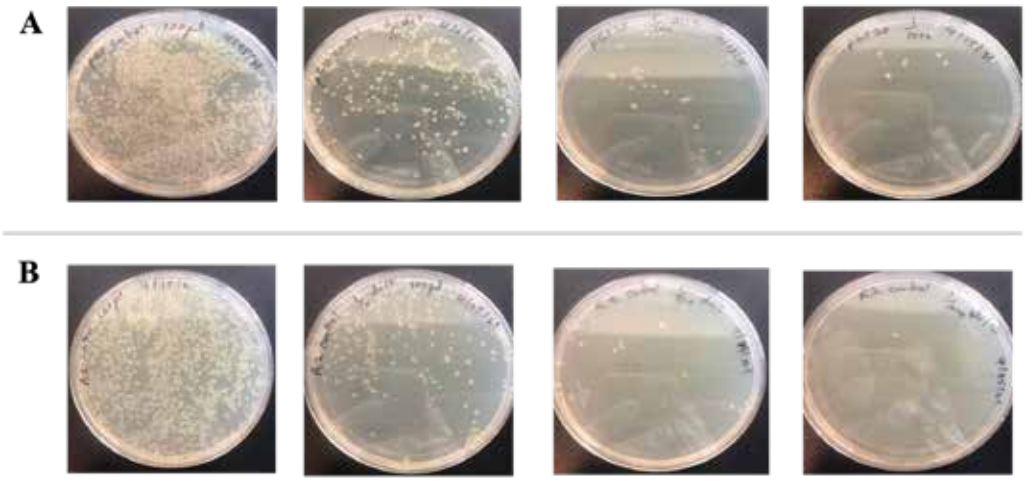


Figure 8. Serial dilution of gradient PCR concentration transformation for controls (from left to right: 100 μL → 1/10 μL → 1/100 μL → 1/1000 μL. (A) serial dilution of pET28 control (B) serial dilution of wildtype template control. Transformation efficiency: 2 x 107 cfu/μg.

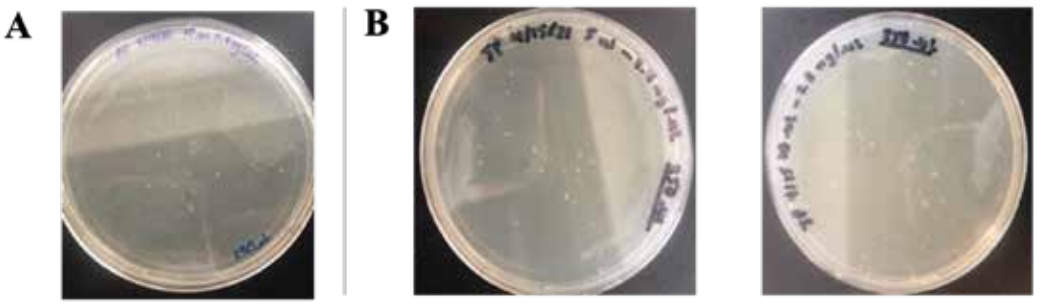


Figure 9. Gradient PCR concentration transformation of PCR products for (A) RYGLV sequence and (B) KPQQR sequence. Transformants plated on LB/Kanamycin.

Since the transformations were successful, a few colonies from these successful transformants of the mutant plasmid were selected and grown in an overnight LB/Kanamycin broth, and then miniprep protocol to extract plasmid DNA was performed. After, the DNA was quantified using the nanodrop spectrophotometer before sending the mutants out for sequencing to confirm that the desired mutation was achieved. We will first sequence the thumb region and once the mutation is confirmed in that region, the entire plasmid will be sequenced to confirm that there are no other mutations. Once we confirm the mutation, we will then use this as a template to generate the second mutation to make the double mutants in the thumb region. Then we will transform those cells for protein expression and purification.

Conclusions and Future Directions

Future research will focus on expression and purification of the mutant protein. Once expression and purification of the R2 protein is achieved, biochemical assays can be performed to compare mutant R2 protein's ability to bind RNA to that of the WT R2

protein. First, strand DNA cleavage and primer extension assay will assess if the endonuclease activity and reverse transcriptase activity of the R2 element has not been affected by the site-directed mutagenesis of the thumb region of the R2 protein. This would mean that the functionality and structure of the R2 protein was retained. After confirming that the thumb domain does not affect these other activities, a TPRT assay will be conducted to examine the effect of mutating a specific amino acid within each of the conserved regions of the thumb domain on RNA binding. Additionally, we will also perform an electrophoretic mobility shift assay (EMSA) to study R2 protein binding ability to 3' UTR RNA.

Performing these assays will allow us to test our hypothesis which is whether the thumb region is a potential RNA binding domain, as well as our understanding about the TPRT mechanism, which is how the R2 element integrates into the host genome. By understanding this mechanism, many new innovations can arise in the prevention and treatment of human disease.

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The Effects of Biological Controls on Soil Seedbanks and the Habitat Restoration of a Secondary Successional Forest

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sponsored by Suann Yang, PhD

Abstract

Invasive plant species are a major threat to the biodiversity of a habitat. Biological controls, on the other hand, have been implemented in such areas to eradicate or reverse the effects of invasive plant species. *Capra hircus* (Goat) are being used increasingly as biological controls for eradicating invasive plant species from natural areas. In Fall 2020, we investigated the magnitude to which Goats can alter the dominance of invasive plant species in a secondary successional forest environment near Conesus Lake in Lakeville, NY. To measure this extent, we compared the soil seedbank to the seed rain at our site, along a gradient of browsed to unbrowsed plots along 2 transects (n = 20) that were 18 m apart laterally and 46 m apart longitudinally. We quantified the soil seedbank by identifying the seedlings that emerged from soil samples extracted using a soil auger to a depth of 15 cm at each plot. We also collected the seed rain using 25 cm x 25 cm Astroturf seed traps at each plot. Our preliminary results, such as a higher amount of *Alliaria petiolata* (Garlic Mustard) in the seedbank than in the seed rain, indicate that the use of *Capra hircus* as biological controls is effective, yet the alteration is not as rapid as it might seem because of regeneration from soil seedbanks. Comparing and quantifying plant species results found above and below ground in the presence or absence of biological controls may aid in managing the restoration of an area. Future considerations may include revisiting this area over a longer time frame (in years) to examine if the implementation of biological controls can completely eradicate invasive species in a habitat.

Introduction

Throughout the world, invasive species are an ever-present threat towards native species and the overall biodiversity of an area, often creating harmful ecological impacts. While many solutions have been created to combat invasive species, such as pesticides or other harmful toxins, the use of biological controls would not only

decrease the abundance of invasive species but be non-harmful towards the environment as well. In our research experiment, we are investigating how the implementation of the domesticated goat affects a secondary successional forest's seedbank and seedrain. We predict that there would be more invasive species found in the seedbank than in the seedrain and that over time, the goats will be able to eradicate all invasive species from both the seedrain and seedbank.

To date, there is a slowly growing number of studies that investigate the effect of the domesticated goat on eradicating invasive species. None have focused on a secondary successional forest environment, which is why we created this study to show the effects of goats in a habitat that has yet to be investigated. One study, however, shows the effects of goat grazing on invasive species and their abundances above ground and below ground in an environmental research environment in Kellogg, Iowa. It studied how goats change the abundance of *Lespedeza cuneata* (Sericea Lespedeza) and found that they reduced the abundance of this invasive species above ground, but that the biomass below ground might take several years to decrease significantly (Barnewitz et al, 2012). Our study was modeled closely after this one, investigating the effects of goats as biocontrols on both the seedbank and the seedrain. Additionally, a study by Williams and Prather (2006) showed that goats can control the spread of *Rosa multiflora* (Multiflora Rose), which is a prominent invasive species at our study site. This study helped us to understand and predict what our outcomes might be in our research.

We have already seen the effects of goats as biocontrols through the use of a plant survey. *Lonicera morrowii* (Morrow's Honeysuckle), a once very prominent and invasive plant in the woodlot of our research site, has been almost completely eradicated throughout the one year that the goats have been used as biocontrol agents. Due to this short-term biocontrol treatment, we hypothesized that this was not nearly enough time for the goats to successfully eradicate all invasive species, but that they should have cleared a substantial amount, creating fewer invasive seeds in the seedrain than would be expected in the seedbank. It has been discovered that seeds may be viable in soil for up to 20 years, which would help account for the greater abundance of invasive seeds in the seedbank that we are predicting (Wenning, 2012). Over time, we expect goats to lower aboveground invasive species vegetation, therefore lowering invasive species in the seedrain which will, in turn, lead to lower new invasive species growing and an even lower aboveground vegetation until eventually, all invasives are eradicated.

Methods and Materials

The experiment was conducted in a secondary successional forest located in Lakeville, NY starting in September of 2020 and continued until February of 2021. To begin, we performed a plant survey of the forested land and identified over 20 different herbaceous species (*Figure 1*). Pictures of the mature plant, seeds, and seedlings were documented for future identification.

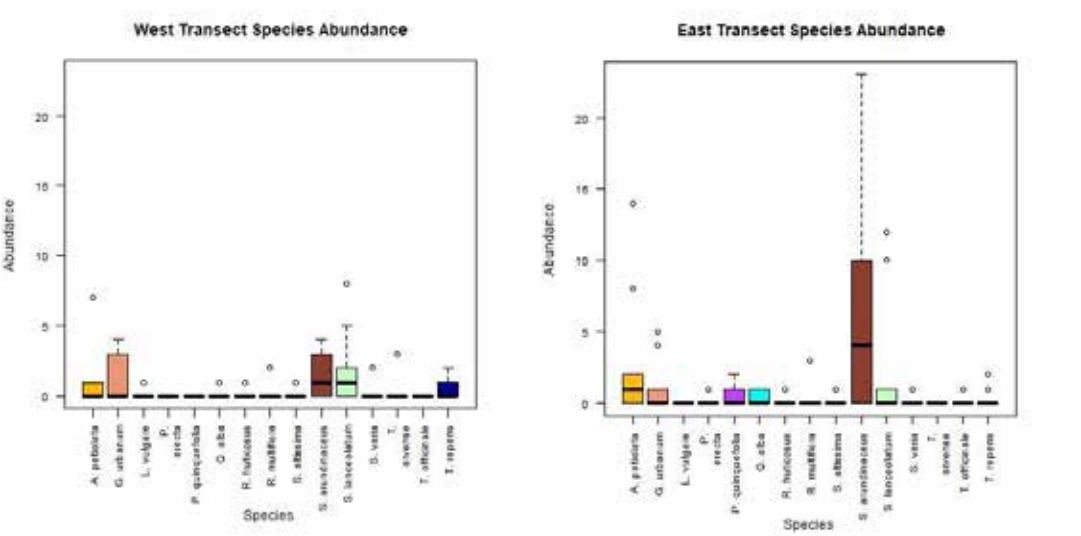


Figure 1. A representation of the plant species' abundances that were identified on the woodlot on the West and East transects

Next, we marked out where the soil was going to be taken from, marking each location with a flag and creating two transects (West and East). Each marker was placed 18 m apart longitudinally while making sure the flags in each transect were latitudinally the same distance apart, 46 m. These locations were labeled as West 1-10 and East 1-10, respectively. After marking out the locations of each spot, the soil was collected using a soil auger. 15 cm of soil was collected, which is classified as a depth that is deep enough to gather all seeds that may be in the ground. The soil that was collected was placed into labeled plastic bags and placed into a freezer at 30 °F for two weeks which was the recommended time to leave seeds in a freezer to mimic an "overwintering" process and to decrease the time before germination. Once the two-week period had been reached, the collected soil was placed into labeled square containers in a greenhouse with a combination of potting mix. The soil was watered once a day by an automated watering system, and was checked on three times a week. When a new seedling emerged, we would label and record it. The seedling was left to continue growing until it could be identified, after which it was then removed from the soil to make room for any other seedlings to emerge. This procedure was repeated from November 2020 through February 2021.

Once the soil seedbank was collected, we then collected the seedrain in October 2020. This was done through the use of 25 cm x 25 cm seedtraps, created out of Astroturf, which were placed at each soil collection location and fastened to the ground by metal garden stakes. This procedure was modeled after a study that used 45 cm x 45 cm Astroturf seedtraps, but showed that the traps were effective at collecting different seeds (Wolters et al., 2005). I collected the contents of the traps once a week for two weeks by emptying everything that was on the traps into labeled brown paper bags that had their contents analyzed and identified.

Results and Statistical Analysis

Based on the experiment data, a box plot revealed that invasive species richness is higher in the seedbank than in the seedrain on both the West and East transects (*Figure 2*). This was further supported by the use of the Kruskal-Wallis test, which gave us a p-value of 0.09 and to which we set the alpha at 0.1 instead of 0.05.

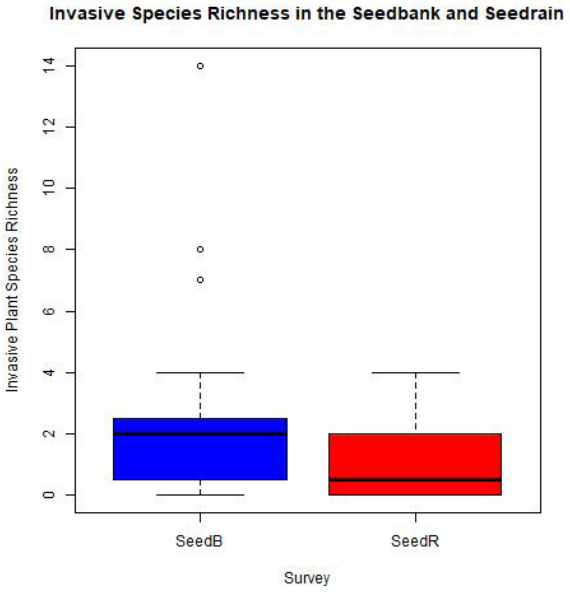
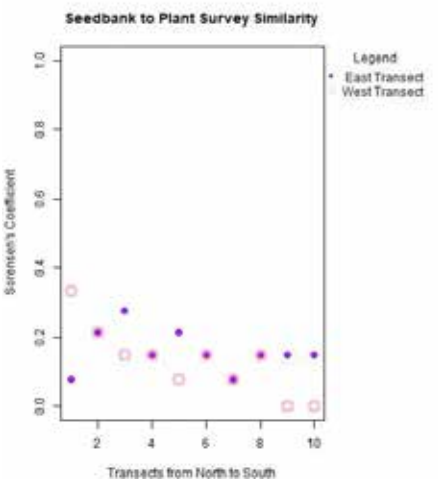


Figure 2. Greater invasive species richness is found in the seedbank than in the seedrain.

Sorensen's Coefficient compares the seedrain, seedbank, and total plant similarity on both the East and West transects. We found that the seedrain is the least similar to the seedbank on both transects (*Figure 3)*. This supports our hypothesis that the seedrain has been altered by the biocontrols. It is important to keep in mind, however, that these are high values of similarity because of the low species richness and the coincidence of there being the same one or two species.



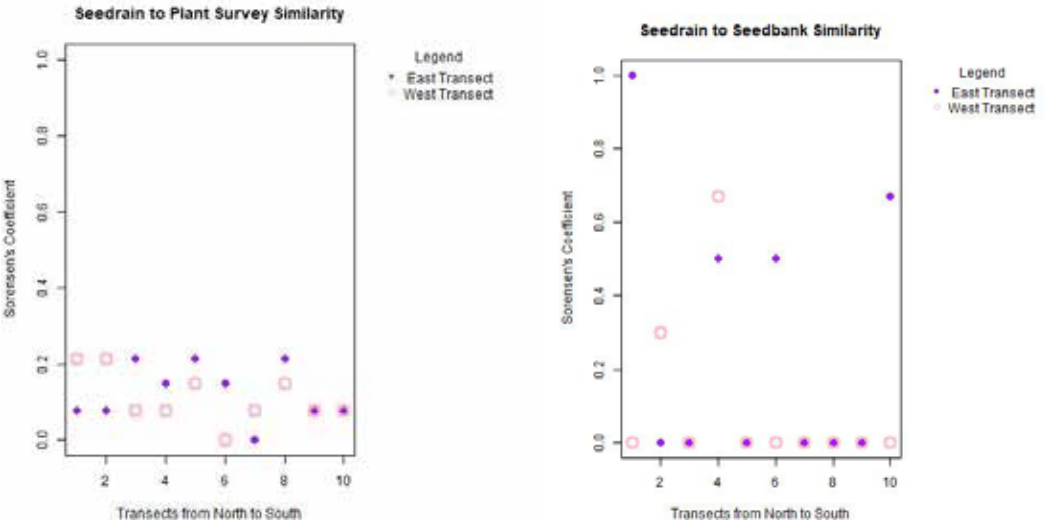


Figure 3. Sorensen's coefficient of similarity; the seedrain is least similar to the seedbank.

The Shannon Diversity Index characterizes the diversity of plant species in both the seedrain and seedbank, using species richness and abundance. Results from this test show that there was no significant trend in differentiating abundances between seedrain and seedbank (*Figure 4)*. This is because multiple sites have a low species richness of only one species, which would result in a zero on the Shannon Diversity Index. This may be a result of various factors, including the time the goats have spent grazing each side of the habitat and a lower overall seed collection.

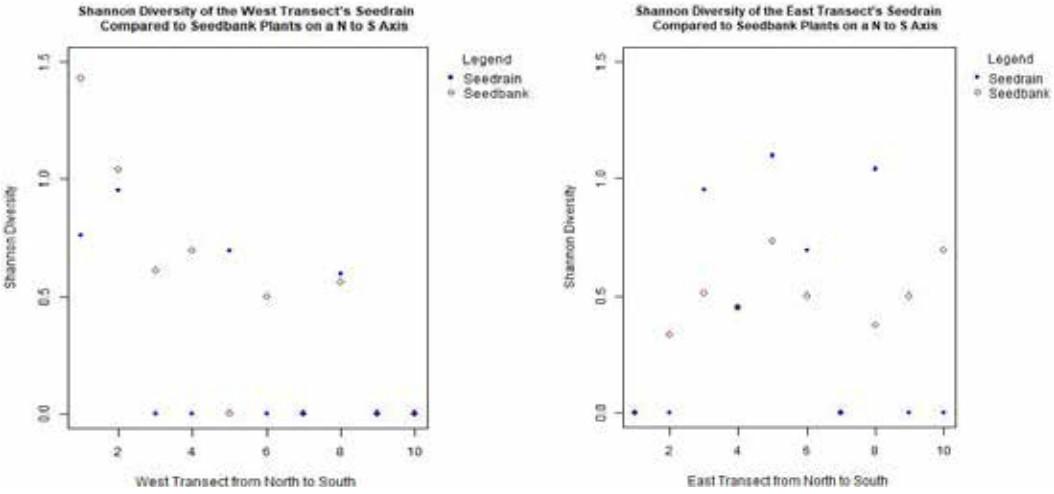


Figure 4. Shannon Diversity Indexes for West and East Transect; no significant trend.

Discussion and Ecological Implications

In our experiment, we were able to support our hypothesis that goats would be effective biological controls and alter the aboveground vegetation, therefore changing the

amount of invasive species found in the seedrain. The box plot (*Figure 2*) and Sorensen's Coefficient (*Figure 3*) both show that there is a lower abundance of invasive species in the seedrain than in the seedbank. Although goats are seen as effective, the alteration of above ground species is not as rapid as it might seem due to regeneration from soil seedbanks. In other words, there are still many seeds of invasive species in the seedbank that will grow and may produce more seeds before goats are able to mow them down.

Future research may help look at this problem such as revisiting this area over a longer time frame or gathering larger sample sizes. Coming back to this site each year, as well as comparing aboveground vegetation at the time of the study to the plant survey data from Fall 2020 (*Figure 1*) will additionally help to reveal if goats are effective biocontrols and can successfully eradicate all invasives from a habitat. This information will help future ecologists understand if they will be able to use the implementation of goats into an area with certain invasive species to successfully get rid of such invasives without further harming the environment. Finally, it is important to consider a few alternative explanations to how we reached our conclusions. The first is the time of year. This study had seeds being collected from September through November, a time when summer-produced seeds had already fallen. This, in turn, may lead to a lower seed abundance and richness, which is what we saw in our study. A small sample size may have also led to Shannon Diversity Index producing no significant results (*Figure 4*).

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Environmental Education: An Active Pedagogy to Integrate Environmentalism, Engagement, and Equity

Olivia Whitmarsh

sponsored by Robert Feissner, PhD

Abstract

The environmental and climate changes occurring on our planet are largely the result of human actions. In concert, rampant bias and inequity exist in many human spheres, including—but not limited to—social, academic, and civic. Environmental education (EE) is a methodology and mindset that integrates systems thinking, hands-on learning, and social justice work across a cohesive curriculum. EE empowers educators, learners, and community members in many ways. Whether it is taking an active role in learning, protecting and restoring the environment, or dismantling biases, EE provides tools for success. I provide five lesson plans that serve as a basis for the development of a science curriculum based in EE principles at the 7–12 level. These lessons may be personalized in a number of ways to suit a variety of learners and learning needs. Ideas to help educators meet students' needs and gradually reduce dependence on teacher-centric learning, is provided throughout. This allows scaffolding of the curriculum for a variety of levels. I provide pedagogical and EE principles to accompany each lesson and detail the process of development of this curriculum.

Climate and Environmental Change

Recall the familiar bedtime tale of Goldilocks, the young girl who sampled bowls of porridge, finding one too hot, one too cold, and one of a suitable temperature. Our planet Earth is much like this perfect bowl of porridge; any colder, and we would be unable to grow the food we need to survive; any warmer, and humans ourselves would not fare well. The World Health Organization (WHO) describes the Earth's climate as "life support," without which humans would not be able to exist in our present capacity (World Health Organization, n.d.). But our climate is rapidly changing, and human activities are at fault.

A wide variety of climatic and environmental changes are occurring at this very moment. The United Nations (UN) reports a rapid rise in global temperatures, beginning with the era of the Industrial Revolution, and accelerating through the present day (United Nations, n.d.-b). Associated with this rise in temperature are warmer winters, leading to melting ice caps and less polar sea ice. These in turn lead to sea level rise, putting the lives and livelihoods of coastal organisms—including humans—at risk. Seas are warming as well, causing the destruction of coral reefs, one of the richest and biodiverse biomes on our planet. Unusual temperatures have led to changes in weather patterns, the most notable of which are increasingly violent storms around the globe. As the planet heats, many fertile regions may become unsuitable for agriculture, leaving both farmers and consumers strained. And this is only the tip of the melting iceberg: temperatures are continuing to rise, and it is difficult to predict exactly how this changing climate will impact our lives and our planet in the years to come.

Although there are people who believe that our climate is fluctuating naturally, that humans have not caused any changes in the climate, or even that there are no changes at all, scientists are working diligently to educate the public about this perilous issue and its potential solutions. While there is no panacea, there are certainly human actions that could significantly slow or prevent some climate and environmental changes. The impacts of human activities manifest as increasing temperatures through the concentration of heat-trapping greenhouse gases, brought about by the extraction and burning of fossil fuels, industrialized agriculture, and anthropogenic chemical production (World Health Organization, n.d.). By reducing these practices, humans could slow the rise in global temperature and associated changes in climate and environment. Although these changes have been described as "rapid, far-reaching, and unprecedented" (United Nations, n.d.-a), they are necessary to ensure the continuing vitality of life on our home planet, and even its improvement. In fact, the Intergovernmental Panel on Climate Change (IPCC) reports that limiting global warming often involves "ensuring a more sustainable and equitable society" (United Nations, n.d.-b). Additionally, the effects of climate and environmental change are likely to persist beyond any actions humans take to slow or stop them. This makes it all the more pressing that the necessary measures be taken immediately to mitigate climate and environmental changes. Climate activists and environmental organizations have risen to the task of combatting climate and environmental changes: "without drastic action today, adapting to these impacts in the future will be more difficult and costly," according to the UN (n.d.). In the words of UN Secretary-General, Antonio Guterres, "we have a long way to go" (United Nations, n.d.-a), but taking action to combat and mitigate the effects of climate and environmental change must be undertaken in order to preserve our planet.

Along with the obligation to preserve a livable planet, the need to mitigate climate and environmental changes also involves human health. Those living on or near coastal areas could face flooding and other natural disasters as sea levels rise, posing an obvious safety risk. Increasingly severe storms pose a similar threat. As temperatures change, and local and regional environments change with them, the ability to grow and produce food as we currently do will be compromised. A lack of access to nutritious food is already a per-

vasive issue, particularly in cities, and environmental changes to food production itself will prove disastrous to all consumers. The changing regional climate will also impact the spread of diseases. Some areas may see unprecedented rates of previously-rare illnesses as their vectors, such as mosquitoes, find suitable residence in areas previously too cold to inhabit. Finally, it comes as no surprise that living in close proximity to an industrial plant or similar facility comes with health risks related to air and water pollution, causing a wide variety of health problems from asthma to miscarriages. Higher temperatures themselves have even been linked to pregnancy- and infant-health-related concerns (Flavelle, 2020). As our environment changes, so too will our health. In order to protect humans and other organisms from the loss of their health, safety, and wellbeing, it is of vital importance to combat anthropogenic climate and environmental changes.

Finally, as if all of these devastating changes in our lives and health were not enough to cause concern and inspire action, there are a variety of social injustices that must be addressed, in part, through environmental activism and the mitigation of climate change. Minority communities, women, and pregnant persons (and their infants) are at an even greater risk for adverse life and health impacts due to climate change. The increased likelihood of negative pregnancy and infancy outcomes discussed above is particularly devastating for minority communities. In particular, African Americans are statistically more likely to live near sources of air and water pollution, in cities significantly warmer than surrounding areas, with reduced access to air conditioning systems, health insurance, and medical support (Flavelle, 2020). These factors lead to greater risks of stillbirth, premature birth, or other complications for African American families. In his op-ed "Climate Justice is Racial Justice, Racial Justice is Climate Justice," Reverend Lennox Yearwood Jr., a social justice activist, poignantly states, "The climate crisis and environmental justice play out within the same systems of white supremacy and structural racism that are at the root of police brutality" (Yearwood, 2020). In the academic realm of environmental education, much research and work is yet to be done on the power of equitable education to close the achievement gap between African American and other minority students, and their white peers (Rizzo, 2018, p. 299; Staples et al., 2019, p. 217; Briggs et et al., 2019, p. 46; Camasso & Jagannathan, 2018, p. 30). The necessary societal changes that accompany climate and environmental activism go hand-in-hand with racial activism and social justice, making it all the more sensible to pursue environmental activism as a society.

In addition, women often bear a disproportionate load of the emotional work tied to climate and environmental activism, despite being overlooked in favor of male peers. Many women care deeply about the environment and climate, and often feel an emotional connection to both—and this bond is more prevalent in feminine-identifying people than in masculine-identifying people (Gough & Whitehouse, 2019; Rizzo, 2018; Maina-Okori et al., 2018; Mitten et al., 2018; Bajracharya & Maskey, 2016, p. 10). This connection is often exploited by the patriarchal social and political structures prevalent throughout the globe, in which exploitation of feminine entities includes both women themselves and the environment (Mitten et al., 2018, p. 321–322). Blenkinsop, et al. (2018) find that masculinity is often associated with violence against nature, or inflicting pain on other

humans by harming nature in some way. These patriarchal systems and structures also mean that women are disproportionately more impacted by climate and environmental change than men are, and receive less assistance and support when making change in their communities (Gough & Whitehouse, 2019, p. 339–341). Even women in science working directly to combat climate and environmental change, mitigate its effects, and educate the public about these phenomena are often overlooked in favor of men. Publication opportunities, conference appearances, merit- based awards, and countless other accolades are often given disproportionately to men, and this wealth of injustice in academics is only a part of the marginalization women in the field of environmental research, activism, and education experience (Gough & Whitehouse, 2019, p. 335–338; Mitten et al., 2018). Mitten et al. (2019) eloquently summarize this phenomenon:

> In many respects, women have been the silent achievers, heavily involved within nurturing, conservation, and preservation movements over the past century…many women have contributed to the development of the OEE [outdoor and environmental education] profession while being relegated, marginalized, and undervalued. (p. 320)

The contributions of women to the work to combat climate and environmental change, and the disproportionate impact of these changes on women and minorities, add another layer of urgency to the present climate and environmental crisis.

The planet is warming, at an alarming rate. Species' existences are threatened, including our own. Fellow humans face a loss of livelihoods, homes, access to food and water, and personal safety. Our own actions have brought about this crisis, but it is also within our power to slow and stop these effects. Coupled tightly to the climate and environmental crisis are issues of social justice. Non-white persons, particularly African Americans, are disproportionately impacted by the changes in climate and environment. Also disproportionately impacted are non-male persons, whose emotional, academic, and activist work is ridiculed, overlooked, or even exploited for patriarchal gain. In a situation where it seems the Earth, our only home for the foreseeable future, is not a guaranteed safe haven; where marginalized communities feel the pressure of this crisis more acutely; and where human action to tackle all of these environmental, health, and social justice issues would need to be sweeping, large-scale, and radical, where are we to turn? In a word: education.

Environmental Education

In the face of the ecological crisis, there is a viable solution, involving the very thing responsible for these changes: humans. Environmental education (EE) provides an opportunity for humans to mitigate climate and environmental changes, assess biases, and resolve issues of social justice and inequity that are intricately tied to climate justice. EE serves many purposes, chief among them the education of school-aged children and their families about the climate crisis and its effects and possible solutions. Through a variety of hands-on, active learning methods, environmental educators have the potential to slow climate and environmental change one student at a time. The impacts of EE reach

far beyond the climate crisis; indeed, EE may just be the structural and conceptual revolution the American education system needs in order to move forward as a sustainable and equitable learning system.

Purposes

EE serves a wide variety of purposes, from a practical response to climate and environmental change, to an opportunity to improve the pedagogical practices of the American public education system. Of course, chief among these is the titular promise of education about the environment and ecology in which we live. Tarrant and Thiele (2016) provide an excellent summary: "the primary purpose of sustainability education remains the instruction, mentoring and training of students, as future stakeholders, to take an active part in the conservation and adaptation of their natural and social environments" (p. 60). The principle of "ecological literacy" is often incorporated as a goal and learning outcome for students of EE. Ecological literacy encompasses "the ability to understand the basic principles of ecology, coupled with the values, skills, and conviction to act on that understanding" (Stone, 2010, p. 35). Evans et al. (2017) add, EE "aims to help learners develop the necessary knowledge, understanding, skills, values, capabilities and dispositions to respond to the complex socio-ecological issues of the 21st century" (p. 406). These goals of responsibility, action, and ecological literacy are core principles of EE.

Bowers (2010) describes the exercise of ecological intelligence (a term related to ecological literacy) as enacting systems thinking, or considering information in as many contexts as possible, in order to gain the fullest understanding of its implications. Nelson (2010) emphasizes this systems-thinking perspective, describing ecological literacy as requiring "a comprehensive and contextual view of a fragile earth, and how science, society, and policy combine and lead to either problems or solutions" (p. 5). Approaching problem-solving from the multiple viewpoints of systems thinking "requires synthesis rather than separation of content knowledge" (Nelson, 2010, p. 6). Incorporating ecological principles into education at any level brings about the use of systems thinking and problem-solving from multiple viewpoints, which provide additional opportunities for positive student outcomes.

Coupled tightly with EE's goal of education about the environmental crisis and the use of systems thinking to approach problems is the cross-curricular opportunity that EE provides educators of every level and subject. As Nelson (2010) reminds us, "exercising ecological intelligence is a collaborative process" (p. 20). This collaboration enables educators from a wide variety of backgrounds, grade levels, and subject areas to work together on EE curricula, projects, and service opportunities. For example, curricula across several elementary grades might build upon knowledge about a local watershed, while in a high school, students might combine knowledge from biology, chemistry, and earth science with skills from English, public speaking, and business classes to present a comprehensive plan to protect that watershed. Perhaps best described by Hart (2010) as "a challenge to complacency in the field of education" (p. 166), EE is a powerful tool for enacting cross-curricular systems thinking within the schooling system. This cross-cur-

ricular impact is often sought after by educators, and is required by some educational standards.

Especially when implemented in multiple classrooms, ecological intelligence and literacy become the norm, creating a social climate in which being environmentally-minded is rewarded and encouraged. Social climate strongly influences behaviors and attitudes; creating a social climate of ecologically-intelligent students encourages ecologically-literate behaviors (Bajracharya & Maskey, 2016, p. 2). This systems-thinking shift from educational complacency to action in the face of the climate and environmental crisis is necessary to preserve our planet. By moving from compartmentalized, scattered classes to a model of integrated, unified curricula, schools will provide the structural change necessary to educate the students they serve in the best way possible, while also ensuring a sustainable future, both locally and globally.

As if these goals of planetary preservation and school system improvement were not enough, EE also strives to provide a way for educators, and society as a whole, to begin the work of recognizing and repairing inequities related to race, class, gender, and numerous other identities. By using systems thinking to analyze both the environmental impacts of anthropogenic climate change and the academic realm of environmental research, it becomes easier to find shortcomings related to social justice and our climate and environment. These shortcomings are opportunities for societies and institutions to learn about their past failings, remedy their current systems, and prevent future harm to historically marginalized communities (Mitten et al., 2018, p. 321–322). Communities of color are disproportionately affected by climate and environmental change through air pollution, proximity to urban heat and pollution, proximity to and lack of assistance during and after major storms, and countless other health and well-being implications (Maina-Okori et al., 2018, p. 290–291; Flavelle, 2020; Yearwood, 2020). These problems are systemic, brought about not solely by environmental changes, but also by social, political, and economic structures, among other factors. The compartmentalization of school subjects prepares students to view these factors in isolation. However, the systems-thinking approach of EE prepares students to tackle these issues with a holistic approach, viewing these factors as intensely intertwined (Capurso, 2010, p. 84).

For students who belong to minority communities themselves, EE is deeply relevant. Racial—and economic—minority students tend to fare worse academically than their middle-class, suburban peers, particularly in STEM fields. This unfortunate reality sets these students up to achieve less than their peers, because of the unjust political, social, economic, and environmental conditions currently biased against communities of color and low-income communities (Camasso & Jagannathan, 2018, p. 30). EE programs and curricula may prove instrumental in reducing this achievement gap, particularly in STEM fields, and empowering disadvantaged students (Camasso & Jagannathan, 2018, p. 37–38). Addressing the needs of an underserved minority of students may have a positive ripple effect upon the larger community through peer-to-peer and/or intergenerational transmission of knowledge, skills, and values (Briggs et al., 2019, p. 46). Social

justice work is a critical goal of EE, to support and empower minority communities and marginalized individuals.

Of particular note, the knowledge and lifestyles of Indigenous peoples have often been overlooked, disregarded, or belittled in Western cultures. EE demands not only recognition of this prejudice and injustice, but serious acceptance of Indigenous culture and knowledge. Some scholars propose a synthesis of Western and Indigenous knowledge to create a more thorough, multifaceted understanding of the environment. Once again, systems thinking abilities are crucial to understanding the environment and the groups of people who live in it. The collaborative efforts of Indigenous and non-Indigenous people will be of utmost importance to this new, synthetic understanding. As Maina-Okori et al. (2018) write:

> The goal to incorporate Indigenous perspectives into ESE [environmental and sustainability education] is the responsibility of both Indigenous and non-Indigenous peoples. The aim is that such collaboration will lead to a closer examination and dismantling of the power dynamics inherent in our field and in wider society. (p. 293)

Indigenous knowledge has long been ignored by fields such as history, ecology, and anthropology, among many others. Additionally, the great emotional distance created between humans and the environment in a Western society makes it particularly difficult to appreciate Indigenous ways of life which are fundamentally connected to the environment (Capurso, 2010, p. 71–78). This distance makes it easier for many people to excuse their actions to degrade the environment and reduce accountability for such activities (Bowers, 2010, p. 21). EE strives to repair not only the environment, but humans' relationship to it, importantly by drawing upon Indigenous knowledge and culture closely tied to the environment.

Another marginalized group, women, benefit greatly from EE and its goals of equity and social justice. Within the academic realm of environmentalism, a movement dubbed "ecofeminism" has arisen to address the related causes of environmental degradation and women's rights. As explained by Rizzo (2018), "analysis of interlocking oppressions and intersectionality is central to critical ecofeminism" (p. 299). Further explored by Maina-Okori et al. (2018), "ecofeminism recognizes and makes linkages between the oppression of women and the exploitation of nature and suggests that although women are often more likely to be involved in environmental protection, they are underrepresented in decision-making processes" (p. 289). In these cases, the term "intersectionality," first created by Kimberlé Crenshaw to describe the interacting prejudices against Black women, is used to describe the overlap between environmental degradation and oppression of women (Maina-Okori et al., 2018, p. 288). Through the examination of related "social, ecological, and economic issues," ecofeminism "can help to inform a critical and inclusive conceptualization of societal problems and to reveal just and sustainable solutions to these problems" (Maina-Okori et al., 2018, p. 293). As can be observed for many other cases, the fights for environmental justice and gender equity are remarkably interrelated.

In the academic realm itself, women's contributions to EE are also chronically underappreciated: "histories of OEE [outdoor and environmental education] and current practices tend to document the efforts and achievement of men—especially white men—whereas the many contributions of women are infrequently recorded or celebrated" (Mitten et al., 2018, p. 318–319). Women are frequently underrepresented in a wide variety of opportunities, as discussed above. In addition to these problems, women of color face even greater challenges in the EE field because of the intersection of race with both gender and environmental issues (Flavelle, 2020).

All of these concerns barely scratch the surface of deep-seated biases and prejudices that interact to cause harm to both marginalized communities and our environment. Clearly, a large body of social justice concerns may be addressed through EE and its critical work to dismantle systems of oppression that affect our planet and ourselves.

Methods

Educators enlist a wide variety of pedagogical methods to best implement these EE practices and knowledge within their classrooms and communities. Chief among these are project-based, hands-on learning opportunities, often through service projects or other community-oriented learning (Stone, 2010, p. 38; Lowenstein et al., 2010, p. 1010–104; Rizzo, 2018, p. 306; Bowers, 2010, p. 22; Riordan & Klein, 2010, p. 120; Camasso & Jagannathan, 2018, p. 32; Tarrant & Thiele, 2016, p. 57; McClaren, 2019, p. 423; Jeronen et al., 2017, p. 3–4). Teachers have a particularly important role in passing along the cultural norms of their societies, and by including environmental norms in their classrooms, they pave the way for students to realistically consider how their actions as humans impact their environment, both natural and cultural (Bajracharya & Maskey, 2016, p. 1–3; Bowers, 2010, p. 14–15). Teachers also (consciously or otherwise) pass along the hidden curriculum, the information students gain from schooling that is not explicitly taught. Hidden curricula often include values, ethics, and biases. By implementing the active learning necessitated by EE, teachers are tapping into the power of the hidden curriculum to intentionally involve their students in caring for and protecting the environment from anthropogenic harm. Field experiences, such as outdoor lab work, field trips, and on-site observations, have proven extremely successful in boosting students' knowledge of and engagement with the curriculum, as well as a number of soft skills such as self-efficacy and communication (Jeronen et al., 2017, p. 3–10). Student involvement in their own learning allows students to control their learning experience, often tailoring it to their needs without even realizing they are doing so. Such an experience facilitates collaboration, discussion, and interest in the curriculum.

McClaren describes students of EE as "active element[s] and co-designer[s] of… [their] learning environment—not just an audience or speaker" (McClaren, 2019, p. 420). This perspective shift—from the student as the quiet, docile recipient of knowledge, to the active, engaged learner creating their knowledge from experiences—teaches students that they are capable of tackling complex issues and solving lengthy problems. This phenomenon is possible no matter the age, grade level, or background of the students. This type of learning increases engagement not only in the classroom where it is implemented, but

throughout the students' schooling experience. It also serves to uplift marginalized students, who may have previously received the message, direct or otherwise, that schooling is not for them. Active students are invested in their own learning, eager to see problems carried through to solutions, and excited to partake in academic opportunities.

Camasso and Jagannathan lament the underuse of active pedagogical methods, and advocate for their use in classrooms much more frequently. The use of such methods must be undertaken for a sustained period of time, perhaps over the course of several grade levels, to ensure lasting results for students academically, civically, and socially (Camasso & Jagannathan, 2018, p. 32–33). This makes it all the more enticing for whole schools to adopt EE pedagogy, rather than a lone teacher or grade level. Additionally, problem-based and hands-on learning experiences allow teachers and educators to easily emphasize relationships, systems, and concepts in harmony, as they are in the natural world, rather than relying upon a curriculum of atomized facts and standards (Bowers, 2010, p. 23). This has the added bonus of making it much easier for students to understand material conceptually, through tangible involvement in the learning process, no matter how intangible concepts might seem (Stone, 2010, p. 38; Riordan & Klein, 2010, p. 134). This system of learning reinforces students' abilities and interests throughout their entire academic career, and models our human systems on self-sustaining natural ones (Stone, 2010, p. 34). Little else could be as intricately tied to the environment as pedagogy modeled upon the natural world itself.

In addition to these pedagogical practices, teachers of EE are engaged in supporting each individual student upon their academic journey. EE facilitates this practice in a variety of ways. EE can take the form of a curriculum framework, and because sustainability and environmental education involve many disciplines, EE serves as an excellent bridge between otherwise-separated school subjects and departments (Stone, 2010, p. 36–37). By helping students to connect previously-separated subjects, teachers prepare students to enter a world of interconnected phenomena, where nothing happens in true isolation. Furthermore, EE is intricately linked to cultural and location-based knowledge, allowing educators to customize their practices to incorporate local phenomena (Lowenstein et al., 2010, p. 107). In action, this could be a field trip to a local environmental organization, a project about a local environmental feature, or the use of knowledge from local Indigenous groups and leaders to better understand the ecological processes active in the area. EE "offers teachers and students ways of responding in their own communities" (Lowenstein et al., 2010, p. 101) to injustices and changes. The emphasis upon Indigenous and cultural knowledge in the classroom creates a learning environment in which students from a wide variety of backgrounds feel welcomed and heard, despite a society that holds Western scientific methodology to a higher standard than Indigenous and place-based knowledge (Briggs et al., 2019, p. 45–46). In addition to this local-scale individualization, EE intrinsically supports overlooked communities. Rizzo (2018) notes that "ecofeminist theory…rooted in community-engaged learning has the power to disrupt binary thinking" (p. 306) and uplift the struggles of women in a patriarchal society. Students with learning obstacles of various types benefit from the multiple modalities that EE naturally takes, especially the cross-subject bridges and hands-on experiences

(Staples et al., 2019, pp. 208–217). Goleman, Barlow, and Bennett (2010) note the significance of EE as an opportunity for educators to accommodate a wide variety of intelligences, based upon Gardner's multiple intelligence theory and Goleman's social and emotional intelligence theory (p. 91–92). EE educators "offer a wide range of conceptual and material content" (Jeronen et al., 2017, p. 4). The multiple modalities and tangible quality of EE make it ideal for catering to students who learn and are intelligent in a variety of ways.

EE supports students through the use of equitable assessment, and the validation of the emotional aspect of learning. In EE, assessment can be seamlessly integrated into the curriculum, without the need for anxiety-producing and inequitable testing procedures. Project- and service-based learning opportunities allow students to demonstrate their knowledge in the real world, where it makes the most sense for knowledge to be applied (King, 2014, p. 36–37). Indeed, Cassell and Nelson (2010) remind readers that "tests have evolved to become measures of learning accomplishments rather than of native intelligence…they not so much test as they sort, categorize, classify, and label" (p. 181) students.

Furthermore, EE provides a tremendous opportunity for educators to move away from traditional testing and toward project-based assessment that is far more relevant and meaningful. Students who would normally test poorly because of cultural biases, learning obstacles, or other issues directly related to the tests themselves are freed from the burden of the traditional exam. This in turn boosts students' own self-efficacy, positively influencing their academic and emotional well-being (Jeronen et al., 2017, p. 9–10). Students' emotional connections to the environment are also heavily considered in EE, allowing students to connect with the material and share their experiences and feelings in order to create a shared trust in the classroom and schooling experience (Smith, 2010, p. 50–51; McClaren, 2019, p. 428). The support EE provides for students of different abilities, intelligences, experiences, and backgrounds creates a classroom in which learners can flourish both personally and academically.

Impacts

Through the use of EE's hands-on, personalized approach, educators achieve not only the major purposes of EE discussed above, but far more. Of course, EE provides students with a greater understanding of and appreciation for nature, the environment, and the climate, as well as skills and strategies to be a conscientious member of our ecosystem. Beyond this basic ecological understanding, however, EE achieves even greater objectives. The use of hands-on learning methods generates interest and excitement in a variety of academic areas, and encourages students to improve their academic habits and abilities (Ardoin et al., 2018, p. 12; Camasso & Jagannathan, 2018, p. 32–37; Jeronen et al., 2017, p. 13). Stone remarks upon the increased abilities of students both within and outside of the subjects covered by EE. By framing coursework around sustainability and interactive discovery, students become better learners and citizens simultaneously (Stone, 2010, p. 35–38). Teachers are able to incorporate many previously disparate subjects into a single classroom, lesson, or project, helping create multi-disciplinary understandings

and cross-cutting principles that are increasingly sought-after in an educational atmosphere of rigorous standards (Evans et al., 2017, p. 406; Staples et al., 2019, p. 215–217).

Beyond academics, students become more emotionally connected with nature and the environment, embracing a natural desire to see the world holistically and refuting social taboos related to environmental activism and passion (Blenkinsop, et al., 2018, p. 351–355). Teachers, too, benefit from similar phenomena that arise from a deep consideration and critical examination of one's place in our complex ecological and social network, as well as biases related to this complex system (Lowenstein et al., 2010, p. 105–107; Hart, 2010, p. 168). As the lines between in-school learning and larger community learning become blurred, a variety of biases are interrupted for the betterment of all community members (Lowenstein et al., 2010, p. 107; Rizzo, 2018, 306; Staples, 2019, p. 217; Briggs et al., 2019, p. 46). Binary, patriarchal, colonizing, and domineering methodologies are disrupted by ecofeminism, the empowerment of women, queer pedagogy, Indigenous place-based knowledge, and grassroots organizing inherent to EE (Rizzo, 2018, p. 306; Maina-Okori, 2018, p. 289–291; Flavelle, 2020; Yearwood, 2020). Even beyond these illustrious achievements, EE provides students with a wide variety of soft skills, such as communication, problem-solving, cooperation and teamwork, service learning, and more (Ardoin et al., 2018, p. 1–12; Stone, 2010, p. 38; Lowenstein et al., 2010, p. 105–107; Briggs et al., 2019, p. 38–45). These skills are perhaps best summarized by Goleman, Barlow, and Bennett (2010): "ecological intelligence applies these capacities [sympathy and empathy] to an understanding of natural systems and melds cognitive skills with empathy for all of life" (p. 92). Importantly, "institutional environment… seems to be a significant factor in students' awareness and, ultimately, behaviors toward" EE (Bajracharya & Maskey, 2016, p. 11). In other words, making environmental justice and protection the norm combats social and cultural taboos related to environmental activism, and supports and celebrates countless members of minority communities whose welfare is intricately tied to the environment and climate. EE provides a myriad of positive impacts for students, educators, community members, minorities, and countless individuals in unique and profound ways.

Current State of Environmental Education

EE boasts lofty goals, a game-changing pedagogical approach, and impacts far beyond the science classroom. But what does EE look like in our world right now? Unfortunately, EE is far from well-incorporated into public school curricula. It is extremely difficult to change long-held traditions and frameworks that have supported public school curricula for years (Greenwood, 2010, p. 142). Educators trying to incorporate environmentally-oriented courses and curricula often face biases, bureaucracy, and a deep-seated fear of the unknown. Many cite a lack of planning time, misunderstandings of curricula and intent, and constraints from both standards and administrators, among other roadblocks (Evans et al., 2017, p. 412–413; McClaren, 2019, p. 416–418). Schools are often unwilling to make the major changes necessary to thoroughly and effectively incorporate EE into the public school curriculum. Teachers themselves often express resistance to the enormous undertaking required to implement EE (Hart, 2010, p. 155–157).

As it stands now, both public schooling and teacher education programs send graduates out into the world to uphold the status quo, rather than combatting harmful norms (Nelson, 2010, p. 3–4; Cassell & Nelson, 2010, p. 184). Worse yet, the general public has often been educated to monetize or commodify nature, and students and educators are no exception (Bowers, 2010, p. 9). Young people are introduced to a world motivated by economics, rather than ecology (Greenwood, 2010, p. 139–140; Cassell & Nelson, 2010, p. 183). This necessitates a massive overhaul of the public school system and teacher education programs to fully incorporate EE as a framework for learning, rather than the increasingly-common, one-time course on sustainability. This phenomenon, in which an institution adds surface-level changes to appear more environmentally-conscious, without making substantial, impactful changes, has been termed "greenwashing" (Bowers, 2010, p. 11–12). Such limited courses are insufficient to overhaul the state of public schooling, but are indeed a step in the right direction if any change at all is to occur (Greenwood, 2010, p. 145–146). As highlighted by Evans, et al., "there is a clear need to extend the curricula and pedagogical work that is in progress beyond 'patches of green' towards more systemic approaches" (Evans et al., 2017, p. 413).

The human, social, cultural world mimics the natural one, in that all systems are parts of larger, nested systems. Schools are therefore connected in a variety of ways to the communities, governments, and world around them (Stone, 2010, p. 35). Schools and educators have a unique opportunity and responsibility to save the planet through EE practices. The current state of public education pushes sustainability aside in favor of rigorous standards and exams, quantitative performance metrics, and a dense web of bureaucratic hoops through which no single educator can be expected to jump (Evans et al., 2017, p. 406–407). College—and university—level programs have seen some significant improvements over time, as EE and sustainability begin to garner greater attention in standards and institutional policies (Greenwood, 2010, p. 149; Rizzo, 2018, p. 306; King, 2014, p. 36–37). However, EE "does not always address the underlying structures that perpetuate race, class, and gender inequality" and thus, its implementation must be further developed (Rizzo, 2018, p. 299). Because curriculum is "essentially…a conversation about shared values, cultural beliefs, and what and whose knowledge is considered of most worth" (Nelson, 2010, p. 4), it is necessary for EE to be incorporated robustly and swiftly in order to combat climate and environmental change, as well as prejudices and biases tied to these changes.

Of course, the prognosis is not all doom and gloom; EE has demonstrated a wide range of positive impacts in its current capacity (Camasso & Jagannathan, 2018, p. 32–33). It is also important to remember that sustainability and EE "are not final destinations, but paths of learning" (Tarrant & Thiele, 2016, p. 62), and there are no rules for implementing EE in a right or wrong way. Small victories at the post-secondary level, and within some schools and local governments, fuel a movement toward widespread implementation of EE. The achievement of EE's many goals and positive impacts for students, educators, and communities will soon follow.

Why Environmental Education?

EE is a massive change from the status quo, for students, educators, school systems, and communities. Every aspect of the education process, at all grades and levels, is impacted by a shift toward EE, and every community member feels its effects. EE addresses the environmental and climate changes brought about by human actions, and provides the next generation of learners with the means to combat and mitigate these changes to preserve our planet, our environment, our climate, and our own health and safety. But EE does so much more: challenges to racism, sexism, homophobia, colonization, classism, and other social justice issues are essential elements of EE. Social justice is intricately tied to EE, through its reliance on Indigenous knowledge, the work of local community leaders, the contributions of long- overlooked women and minorities, and even students themselves. EE will provide the environmental safety and stability we need to collectively and systematically combat social justice issues, both present and future. As the climate and environment change, our need to implement EE accelerates rapidly. The best time to implement EE was yesterday; the next-best time is today. There has never been a moment in our modern history that has needed environmental activism more, and opportunities to advance social justice are unfolding around us every day. Whether it is through the stabilization of the climate and environment, access to education and resources, commitment to grassroots organizations and local governments, uplifting of minority communities, appreciation of the contributions of overlooked minorities and women, the personal and civic development of students, or the countless other positive impacts EE brings about, every individual will be positively impacted by EE.

Of course, the transition from traditional curricula to EE will be sweeping, often overwhelming at first, and will likely garner negative reviews from those who are not committed to its installation. However, once EE programs and infrastructure begin to arise across the country and world, the many benefits of EE will become readily apparent. Children will experience higher-quality academics, learn from hands-on experiences, and create practical and meaningful knowledge. Educators will collaborate, across grade levels and subject boundaries, to support their students and communities in ways that are currently not possible. The voices of the overlooked will finally be uplifted, sparking change for countless persecuted and underrepresented communities worldwide. All of these changes will continue into the future as well. Our collective understanding of the climate and environment will improve, along with best practices for protecting them. We will learn how to listen to and celebrate the work of underrepresented communities, and over time, these communities will finally see equitable treatment, representation, and opportunity. The learners of today will be inventing the life-saving, planet-preserving technologies of tomorrow. If we are lucky, a few might even become the next generation of environmental educators. Widespread and thorough implementation of environmental education is our best chance to preserve our planet, expand our knowledge, uplift the overlooked, and support a future that is stable both ecologically and socially: "it is in school classrooms that a new world must be born, if it is to be born at all" (Cassell & Nelson, 2010, p. 196).

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Black Geographic Possibilities in Higher Education

Kazon Robinson

sponsored by Jennifer Rogalsky, PhD

Abstract

Past geographical research and Whiteness impact the current course content and demographics of the discipline in the United States. In fact, there is still a disconnect between how "black matters are spatial matters" (McKittrick, 2006). In this paper, I will analyze the current state of geography programs in the United States. I begin with a literature review on the intersection and removal of Blackness in geography. I use the AAG's Guide to Geography Programs to examine geography programs in New York that have course content on Blackness. I also analyze the 107 historically Black colleges and universities (HBCUs) using the same process and synthesize a map using QGIS. While HBCUs overwhelmingly have limited geography programs, I also expect to find that NY geography programs lack the desired course content. The significance of this research is beyond "adding Black subjects to geography syllabi" for diversity (Hawthorne, 2019). My research will continue to open up alternative ways that academics and organizers can create knowledge that realizes that Black experiences are spatial experiences.

Introduction

Geography as an academic discipline is rooted deeply in colonialism and imperialism. Organizations like the Royal Geographical Society in London functioned as extensions of colonial reign and position. This impact translates into the earliest geographical paradigms, ideologies, and theorems that build the geography discipline. One paradigm in question is environmental determinism (ED), a paradigm that asserts that physical geographic features influence socio-cultural and political development (Meyer, 2020). This paradigm influenced leaders of the earliest geographical associations in the U.S. like the American Association of Geographer's (AAG) first female president, Ellen Semple. Additionally, other geography scholars of the 19th century wrote extensively racist and even racially essentialist pieces connected back to geography. Ellsworth Huntington wrote how the climate had stagnated Black people, leaving them in a primitive state with the expectation that such people [Black people] should not "rise very high on the scale of civilization" (Cresswell, 2018, p. 50). This theory of inferiority, laziness, and racial superiority served in the interest of colonialism. This long trend of racism impacts geography by otherizing Blackness as separate from geographical and spatial matters.

Blackness is separated from spatial matters because of colonialism. Nikole Hannah-Jones, the founder of the 1619 Project, remarks on the continued uprising of Black communities in 2020. She says:

> It should devastate us all that in 2020 it took a cellphone video broadcast across the globe of a black man dying from the oldest and most terrifying tool in the white-supremacist arsenal to make a vast majority of white Americans decide that, well, this might be enough. (Hannah-Jones, 2020)

In terms of Spatiality (virtually and physically), it took much of the entire world to motivate the vast majority of Americans (again) that Black Lives Matter. However, and to a lesser extent, geography as a discipline otherizes and despatializes lives that are "necessarily geographic" (McKittrick, 2006, p. xiii). McKittrick is a vital Black geographer with her ability to discuss how Black lives are necessarily geographic to the foundation of the United States and the West's infrastructure.

Black lives are necessarily geographic because of the sociopolitical context that formed the United States. McKittrick (2006) says that Black lives are "produced in conjunction with race, racism, captivity, and economic profit" (p. 9). Places of domination like slave ships, plantations, minstrel shows, and other physical spaces were created to meet material needs of countries like the U.S. and the U.K., while dehumanizing and subsequently despatializing Blackness (Hartman, 1994). This trend is because of the geographical work that denied Blackness humanity in favor of spatializing and upholding Whiteness (Harley, 2015). Unfortunately, the ramifications for anti-Blackness are not singular and are still present.

In fact, Blackness' "'twoness" of being both undesirable and despatialized while "necessarily geographic" (McKittrick, 2006, p. xiii) motivates this research. The research attempts to understand the separation of how "Black matters are [not] spatial matters" (McKittrick, 2006, p. xii). This research studies the spatial relationship between geographic course content in NY State and historically Black colleges and universities (HBCUs), and whether there is existing course content related to Blackness and/or topics of anti-racism within geography programs. In fact, the project shows how Black studies in geography needs to be improved extensively, and that starts by analyzing geography programs in New York and HBCUs.

Methodology

This study examines Black Geographic coursework in 22 NY State colleges and within the 107 HBCUs in the United States (*Figure 1*). The research is preliminary and includes only schools listed within AAG's Guide to Geography Programs in the Americas 2020-2021, and the thirteen SUNY Comprehensive Colleges. What constituted a program was more than simply a bachelor's degree. This included certificates, concentrations, or associate degrees at the HBCUs. Ultimately, this study is based on a categorical collection and the categories are:

1. Existing Geography Department at the university.

    a. Example Question: "Does this university have a geography department? Yes, or no?"

        i. If yes, it would be labeled blue while red indicated the university did not have a geography program (*Figure 2*).

2. Existing Bachelor's, Master's, and/or PhD Programs

    a. Example Question: Does SUNY Geneseo have a Geography Bachelor's Program? Master's Program? PhD Program? Yes, or no? (Figure 3 and Figure 4).

        i. If yes, then the symbol would indicate a blue book to show which universities had existing programs. If not, then the symbology would be a red book to indicate no existing programs for that level of education.

3. Existing "Black Geographic" Course Content

    a. Here I examined what classified as Black geographic course content. That included using specialized keywords and terms to see which programs had courses, degrees, or content that had a focus on geography and Blackness. I divided this portion between specific keywords and general keywords (Figure 5).

        i. Specific keywords included:

            1. "Racial Geography"

            2. "Racism and Geography"

            3. "Racialized Geographies"

            4. "Geography and Anti-Racism"

        ii. General Keywords included:

            1. "Race"

            2. "Racism"

            3. "Blackness"

The biggest constraint was separating what was relevant course content and what was not relevant. For instance, general education requirement courses like human geography or urban geography would not be included. This even included regional geography courses like "Geographies of Sub-Saharan Africa," or the "Geographies of Cuba." The courses are generalized courses that *do not* focus on the specific experiences of Blackness that this research needed for results. Whereas, Syracuse University's course, "Race and Space," would meet the criteria. Ultimately, using these categories I inputted this data into QGIS

(an open-source application that can view and edit geospatial data), where it was overlaid onto maps.

Results and Discussion

Overall, the data collected showed that Black Geographic course content was severely limited. At all levels of education, there was a severe lack of Black geographic course content. NY state has a plentiful number of bachelor's programs, and subsequently fewer master's and PhD programs. However, of the 22 New York state colleges, only four colleges had Black geographic coursework. Those colleges are:

- Binghamton University
- Albany University
- Syracuse University
- CUNY Graduate Center

Each of these universities had specific courses focusing on race and geography. For instance, Binghamton University has coursework like "GEOG 336. Environmental Health: Race and Place," and "GEOG 233. Urban Geography: Race and Place." This applied with similar universities at the graduate level like the CUNY Graduate Center. Ultimately, my data and figures showed four universities with markers that aligned with Figure 5.

As for HBCUs, most do not have geography programs. There are over 107 HBCUs in the U.S. and its territories, with the vast majority of them being in southern states and the northeast. Out of 107, there are only nine programs, and specifically, six bachelor's programs. Finally, when looking for master's programs, there was only *one* master's program in Geography. The university that had this program is Chicago State University, with an MA in Geography.

This research shows that Blackness in geography academia needs extensive improvement. Despite the lackluster results, Blackness has always been spatial. If Blackness were not, then the question of who and what created the West would not exist. It is a contradiction that has taken up too much space. This change must mean more than "adding Black subjects to geography syllabi" (Hawthorne, 2019). To care about Black lives means improving the material and virtuous conditions of our space.

That means that every geographer has their place in contributing to Black lives. If we recognize that Black Lives Matter, then Black and Spatial Matters must be a part of our study if we want to continue correcting our wrongs and build new spaces. I think that an excellent starting point means including more authors from the Black diaspora into geography. For instance, much of the current geography scholarship is from high income countries, while research from low-income countries is underrepresented (Skopec et al., 2020). That means that a significant portion of the world (which is largely Black, Latinx, and Asian) is opted out by a combination of bias and a lack of resources. Thus, this research is a starting point to redirect our attention to creating space within the field of geography.

Figures

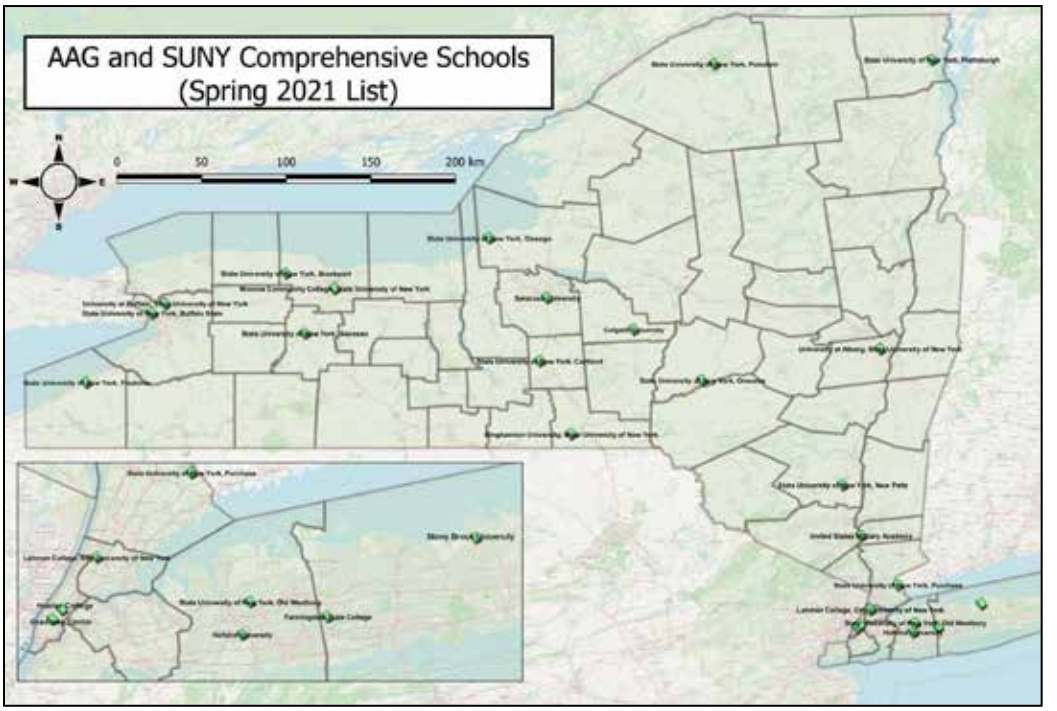

Figure 1: American Association of Geographers and SUNY Comprehensive Schools Map

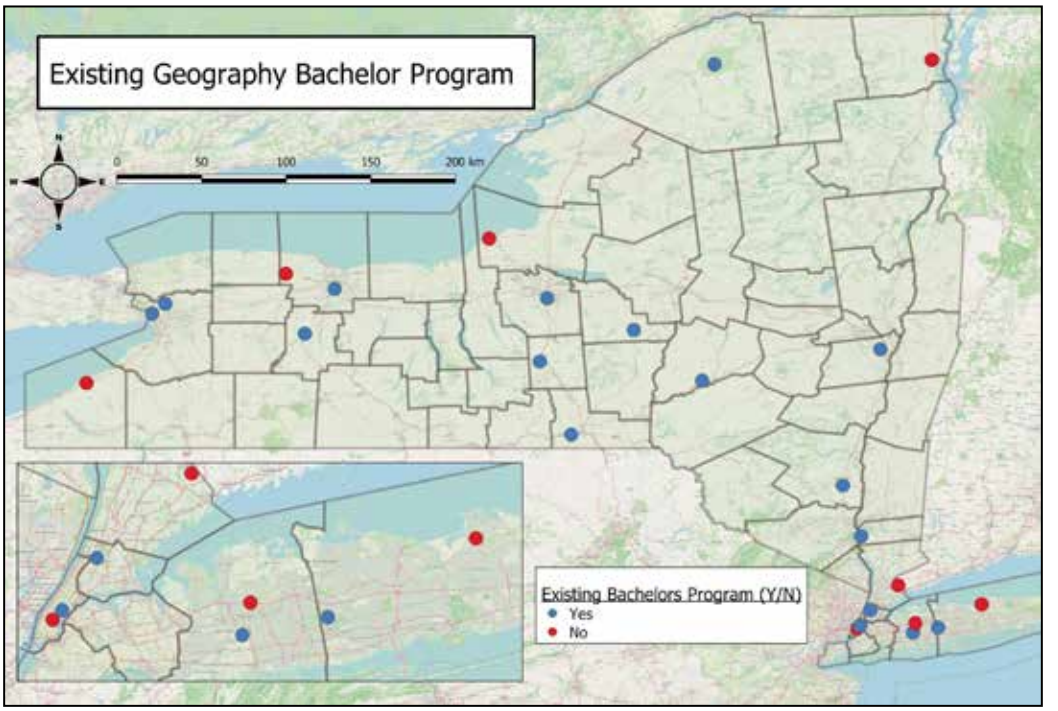

Figure 2: Existing Geography Bachelor's Programs in NY State

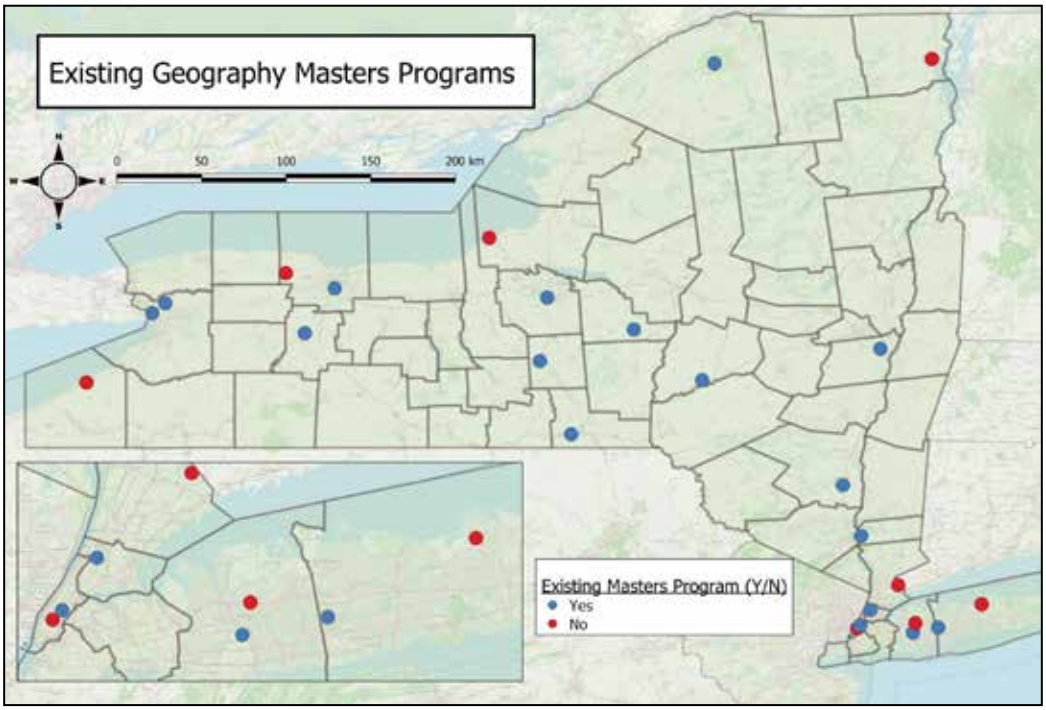

Figure 3: Existing Geography Master's Programs in NY State

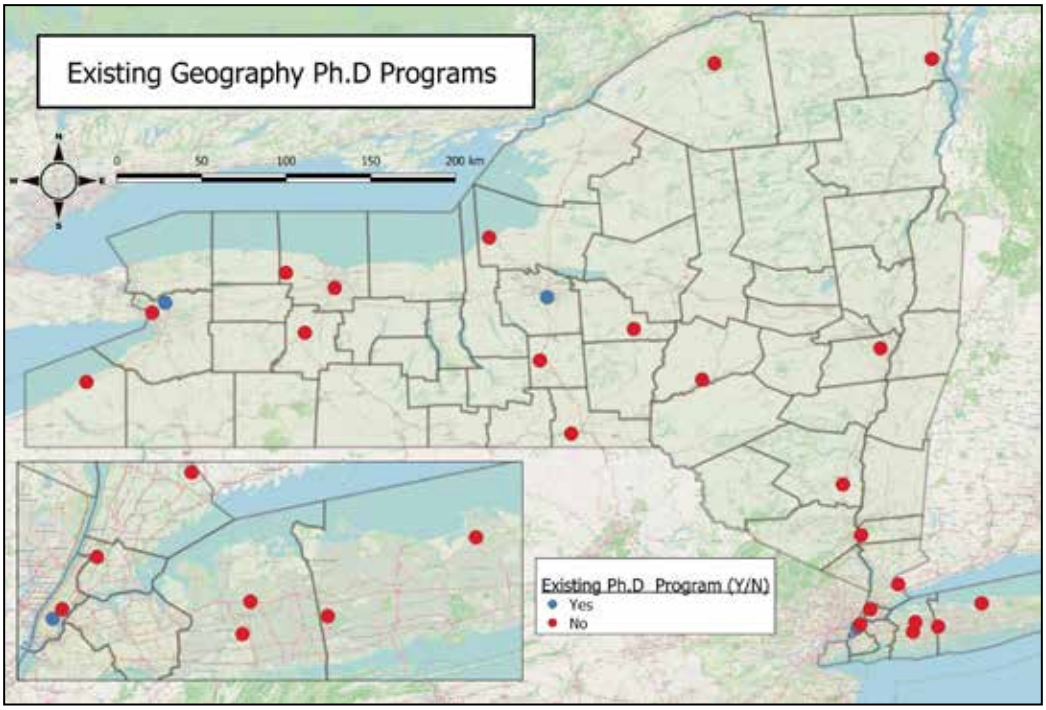

Figure 4: Existing Geography PhD Programs

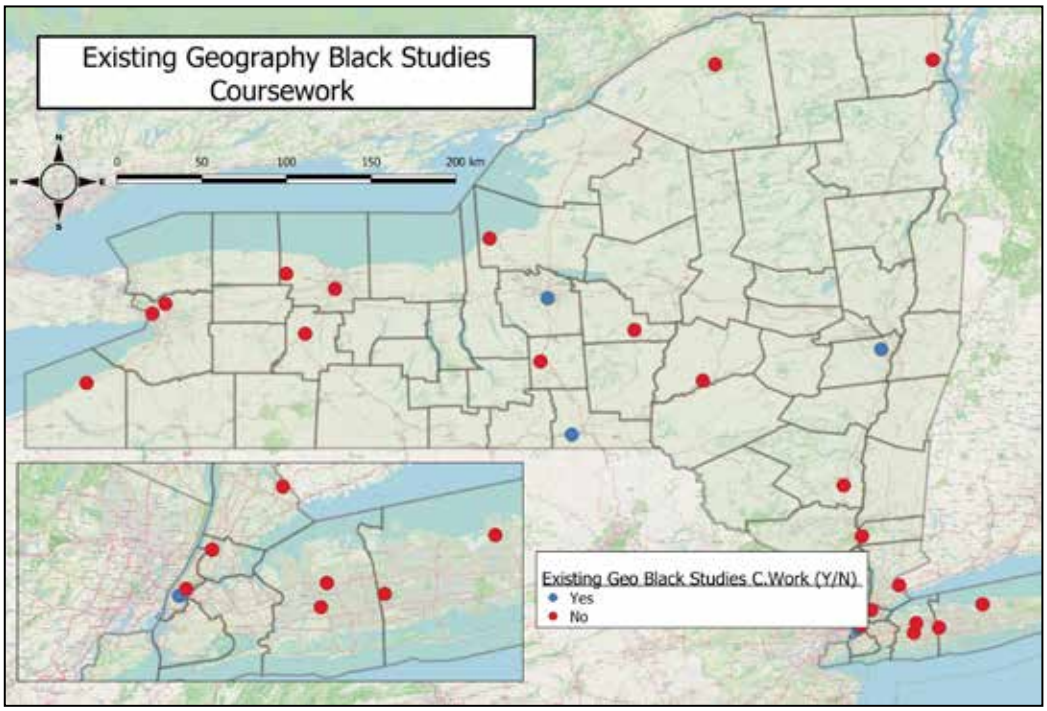

Figure 5: Existing Universities with Geography Coursework containing Black Studies

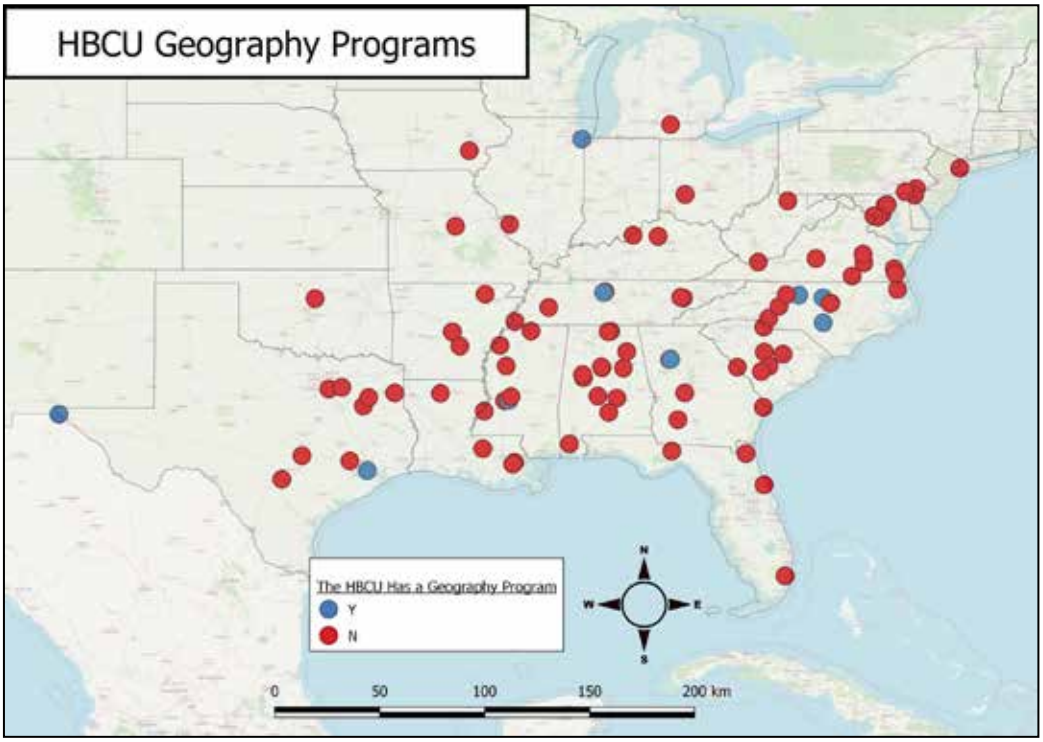

Figure 6: HBCUs with Geography Programs

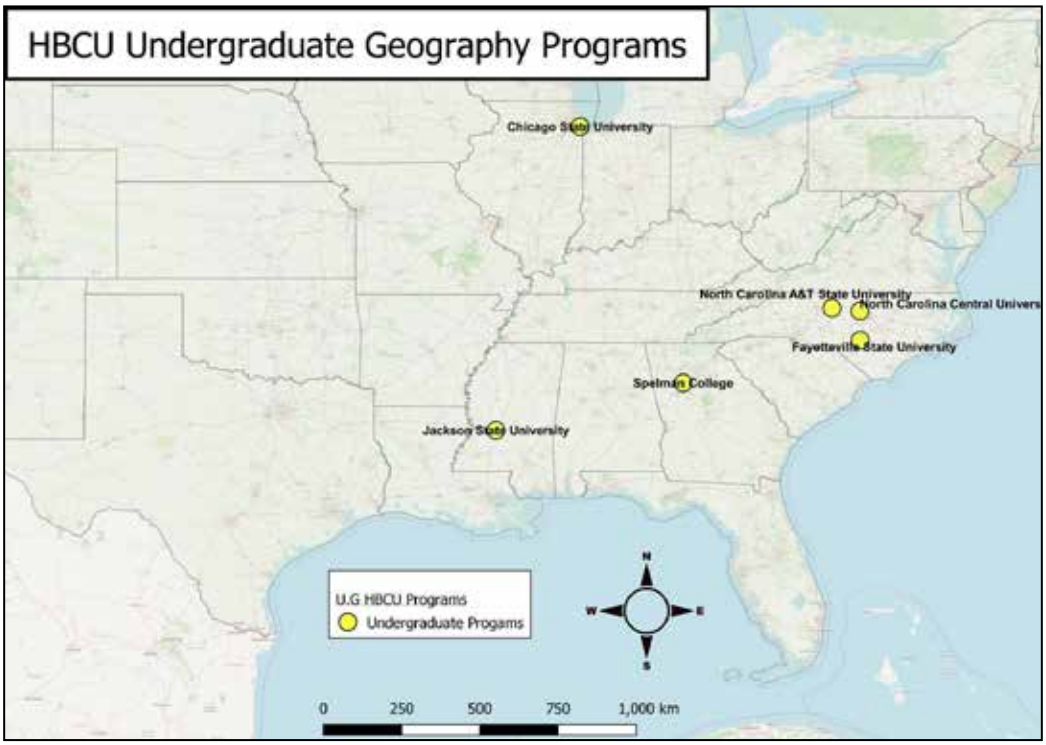

Figure 7: HBCUs with Undergraduate Programs

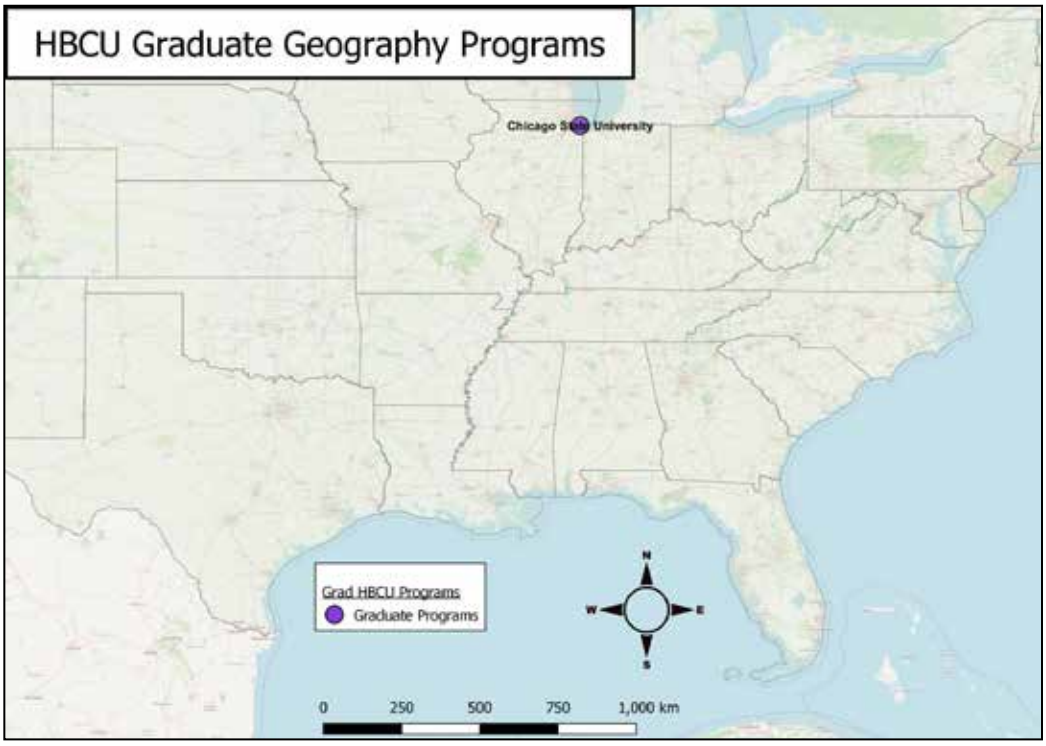

Figure 8: HBCUs with Graduate Programs

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Rainwater Harvesting on Geneseo's Campus

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Abstract

A rainwater system will help SUNY Geneseo to become a more sustainable campus. In order to do this, several differential and algebraic equations are utilized. From these calculations, the dimensions, cost, and payback period for the project are determined.

Introduction

One of the best ways that Geneseo can become more sustainable is by introducing a rainwater harvesting system. The first step to introducing such innovation to our campus is to start with a smaller scale project to set a measure for the costs, planning, and overall direct benefits. For this reason, the following paper focuses on what would be needed to make a harvesting system to provide for the campus's gardens from April to October each year.

What is Rainwater Harvesting?

Rainwater harvesting is the process in which the water that gathers on rooftops is guided through gutters into a cistern where it will then be sent through pipes to wherever the water is needed—such as for drinking or sinks and toilets in a bathroom (Vale, 2017). Mesh coverings are typically placed along the gutters to stop large debris from entering the system and, before the water is sent to its destination within a building, it is filtered using a type of UV radiation to clean it on a microbial level, making it safe to consume. This project shall focus on creating two aboveground tanks that will be used from April to October to provide water for the school's gardens during the summer. As these will only be used for plants rather than human consumption, the filtration needed for these is minimal to none; the most that could be needed is a mesh screening over the gutters to prevent large debris. One tank shall be placed near Brodie Hall while the other shall be placed between Newton Hall and the Integrated Science Center (ISC)—since Newston and the ISC are connected, it would make sense to use both buildings to provide for one tank.

Collection Potential for the Summer Gardens

Using the estimated roof areas of each building and the average precipitation during the months when the tanks will be in use, we can estimate how much water these tanks can potentially collect (Map Developers, n.d.). Brodie Hall has a roof area of 62,347 square-feet, Newton Hall has a roof area of 38,611 square-feet, and the Integrated Sciences Center has a roof area of 44,651 square-feet. According to the statistics provided by U.S. climate data (n.d.), the Geneseo area receives about 21.95 inches of precipitation from April to October. When inputting the roof sizes in conjunction with the amount of precipitation during this period, we learn the harvesting potential of these buildings to be the following: Brodie could collect 852,585.87 gallons, Newton could collect 527,999.63 gallons, and the ISC could collect 610,595.73 gallons (Innovative Water Solutions, n.d.). This means that the tanks can collect an average total of 1,991,181 gallons of water during this time period, which is equivalent to 68.91% of the total water that the gardens currently use. Geneseo uses approximately 14,447,651.90 gallons of water each year with the summer gardens accounting for about 20% (or 2,889,530 gallons) of the total usage. This results in the gardens costing the school about $13,496.99 a year. With the amount of water we can save annually by harvesting our own, the school only needs to take approximately 898,349 gallons of water from the county, the equivalent of $4,196.19. This means that with a water harvesting system, the school can save $9,300.80 annually.

Creating a Harvesting Tank

Since this is a dynamic system the volume of the tanks does not have to perfectly equate to the amount of water that could be potentially harvested over the whole time period. The best-case scenario would be that these tanks are in a constant median range rather than always at full or low capacity. As such, simple mathematical equations can be used to derive the specifications needed for our tanks' volumes, diameters, and outlet diameters; these will all be calculated using the formulas included in the "Design of a Rainwater Catchment System" (Cammardella, 2011). For these calculations, we will also consistently work under the assumptions that the cistern will be about 9.84 feet tall, that it already holds approximately 3.28 feet of rain within it, and that a heavy rain event will produce a maximum of 0.08 feet of rain.

Diameter and Volume

In order to calculate the diameter of the tanks needed, we must first derive the amount of water that will be collected during a heavy rain event. A heavy rain event will be the time when the most water will enter the system at a certain time, meaning that the tanks will have to be ready for such a maximum intake at any time. To find the amount of water collected during such a storm, the area of the roofs must be multiplied by the height of the precipitation. Brodie could collect approximately 4,987.76 cubic feet of water while Newton and the ISC can collect 3,088.88 and 3,572.08 cubic feet of water, respectively. Since Newton and the ISC will be sharing a single tank, their maximum intact will be

combined to be 6,660.96 cubic feet. In order to find the diameters, we first set the volume of the heavy rain event equal to the formula for the volume of a cylinder, where in which the height will be the height of the empty space within the tank. From there we can modulate the equation until we have a formula for the diameter of the tanks.

$$
\begin{aligned}
V_{max} &= \pi \times (height_{tank} - height_{water}) \times (\frac{D_t}{2})^2) \\
(\frac{D_t}{2})^2 &= V_{max} \div (\pi \times (9.84 - 3.28)) \\
\frac{D_t}{2} &= (V_{max} \div (\pi \times (6.56)) \\
D_t &= 2 \times (V_{max} \div (\pi \times 6.56))
\end{aligned}
\tag{1}
$$

Using *formula 1* we can conclude that Brodie will need a diameter of 31.11 feet and the Newton-ISC tank will need a diameter of 35.96 feet. Now that we have the diameters needed for each system, the volumes needed for each tank can be calculated. This is done with the standard equation for a cylinder, where in which our height will be the total height of the tank itself. Thus, we discover that the Brodie tank could withstand a volume of 7,479.71 cubic feet (or 55,952.12 gallons) while the Newton-ISC could withstand a volume of 9,993.66 cubic feet (or 74,757.77 gallons).

Diameter of the Outflow Orifice

In the case of an emergency, the cistern must have an outlet orifice for the water to drain out. To estimate the diameter of this outlet, a scenario is proposed in which the water within the tank is at a height, *h*, of 3.28 feet and must be drained in time, *t*, of 6 hours. For this we will also use our newly discovered diameters for each tank, d_{tank}, is 7.94 feet for Newton and 34.78 feet for Brodie.

The first step to calculating the outlet orifice, the time it takes for the water to drain. This can be done with a basic rate of change formula where *Rate of Change = Rate In - Rate Out*. For this scenario, our rate of change, $\frac{dh}{dt}$, is multiplied by the area of a circle, $\pi \times \frac{d_{\text{tank}}^2}{4}$, to obtain "mass water balance" (Cammardella, 2011, p. 7). Since such an emergency would shut off all intake, the rate in will be 0. The rate out will be a modification of Torricelli's Law, that results in the following equation:

$$
RateOut = O_a \times d_{coeff} \times \sqrt{(2 \times g \times h)} \tag{2}
$$

Where *Oa* is the area of the outlet, d_{coeff} is the discharge coefficient (1.97 feet), *g* is gravity (32.17 ft/s²), and *h* is the height of the tank (9.84 feet). The components to the rate of change formula are then combined to create the following:

$$\frac{\pi \times d_{tank}^2}{4} \times \frac{dh}{dt} = 0 - O_a \times d_{coeff} \times \sqrt{(2 \times g \times h)}. \quad (3)$$

Our goal here is to get O_a on its own—from there we can plug the resulting number into the formula for the outlet area and find the diameter. First, we must separate and integrate our variables in order to get rid of $\frac{dh}{dt}$. When we separate the variables, we get:

$$\frac{1}{\sqrt{h}} dh = -\frac{(4 \times O_a \times d_{coeff} \times \sqrt{2 \times g})}{(\pi \times d_{tank}^2)} dt. \quad (4)$$

We then integrate *equation 4* on both sides. The $\frac{1}{\sqrt{h}}$ will be integrated from 3.28 to 0 to represent the change in the water's height, in feet, as it drains. On the right side will be integrated from 0 to 21,600 to represent the change in time in seconds. Since gravity is measured in seconds, we translate our time so the units align. When we integrate *equation 4* we end up with the following:

$$\begin{aligned}
\int_{3.28}^{0} \frac{1}{\sqrt{h}} dh &= -\frac{(4 \times O_a \times d_{coeff} \times \sqrt{2 \times g})}{(\pi \times d_{tank}^2)} \times \int_{0}^{21,600} dt \\
-\int_{0}^{3.28} \frac{1}{\sqrt{h}} dh &= -\frac{(4 \times O_a \times d_{coeff} \times \sqrt{2 \times g})}{(\pi \times d_{tank}^2)} \times \int_{0}^{21,600} dt \\
\int_{0}^{3.28} \frac{1}{\sqrt{h}} dh &= \frac{(4 \times O_a \times d_{coeff} \times \sqrt{2 \times g})}{(\pi \times d_{tank}^2)} \times \int_{0}^{21,600} dt \\
2 &= \frac{86,000 \times O_a \times d_{coeff} \times \sqrt{2 \times g})}{(\pi \times d_{tank}^2)} \quad (5)
\end{aligned}$$

Equation 5 is then rearranged so that O_a is on its own:

$$O_a = \frac{(\pi \times d_{tank}^2)}{(43,200 \times d_{coeff} \times \sqrt{2 \times g}}. \quad (6)$$

The equation for the area of an outlet orifice is $O_a = \pi \times \frac{d_{or}^2}{4}$. Therefore, to find the diameter of the outlet orifice for each building we set *equation 6* equal to the equation of the area of an outlet orifice:

$$\pi \times \frac{d_{or}^2}{4} = \frac{(\pi \times d_{tank}^2)}{(43,200 \times d_{coeff} \times \sqrt{2 \times g}}. \quad (7)$$

The variables are separated once more so that d_{or} is on its own, giving the final equation needed to find the diameter of the outlet orifice:

$$d_{or} = \sqrt{\frac{d_{tank}^2}{10,800 \times d_{coeff} \times \sqrt{2 \times g}}}. \quad (8)$$

We plug in our variables for the discharge coefficient, gravity, and the respective tank diameters. This results in Brodie needing an outlet orifice with a diameter of 0.075 feet while the Newton-ISC tank requires one of 0.087 feet.

Cost

Since these tanks will be used strictly during the warmer season and only used for gardening purposes, many of the typical costs for rainwater harvesting systems are void. Instead, the major cost that is to be focused on is for the tank itself. An aboveground tank with a maximum volume of 50,000 gallons will be considered as the one chosen for this experiment. While this number may be much lower than those found earlier, they would still be perfectly amenable for the uses needed. Two aboveground, 50,000-gallon tanks bought from and installed by Aquamate (n.d.) costs about $64,000. The time that it would take to pay back the costs of these tanks can be found by sampling dividing the total cost by the amount saved per year ($9,300.80). By this calculation, the school would be able to pay back this project in approximately 7 years.

Conclusion

Overall, it would be highly beneficial both monetarily and in our efforts to be a more environmentally conscious campus to install a rainwater harvesting system. The minimum dimensions can be easily computed and the wide variety of buildings on campus lends itself to the possibility of creating an entire network of rainwater harvesting. The best outcome of this would be to have a system that will pay for itself in a handful of years and ultimately make the campus completely self-sufficient in terms of our water usage.

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Disentangling Nature Versus Nurture in a Mouse Model of Alcohol Use

Laura Bauer

sponsored by Allison Bechard, PhD

Abstract

Alcohol use disorder (AUD) is a major societal concern and so understanding how it develops is an important topic of research. Epigenetic mechanisms induced by mother-infant interactions can turn genes on or off in response to being reared in a different environment. This research attempted to disentangle the roles of nature and nurture on the development of AUD. Two strains of inbred mice were cross-fostered to see if the postnatal rearing environment can reduce alcohol consumption in the strain of mice genetically predisposed to drink alcohol. Researchers recorded mouse maternal care, pup anxiety, and pup alcohol consumption. It was hypothesized that mice that are predisposed to drink alcohol (B6 strain) will drink less when reared by mothers not predisposed to drink (FVB strain), potentially via maternal care differences. It was also hypothesized that mice that are not predisposed to drink alcohol (FVB strain) will drink more when reared by mothers predisposed to drink (B6 strain). These data tested the ability of the early maternal environment to shift the behavior of offspring genetically predisposed to drink alcohol. Results showed that FVB mice and cross-fostered mice were less anxious overall, and that female mice, B6 mice, and non-fostered mice tended to drink the most of any group. These findings imply that early life trauma alongside epigenetics can influence anxiety and alcoholic tendencies later in life.

The lifetime prevalence of alcohol use disorder (AUD) in the United States is 29.1% (Grant et al., 2015). Thus, understanding the complex etiology of AUD has the potential to benefit those suffering from AUD. Disentangling the role of genetic, epigenetic, and environmental influences on behavioral outcomes can be studied using animal models.

Inbred strains of mice have relatively fixed genetic sequences, so phenotypic differences between strains of mice are often ascribed to differences in genetic background. It is known that B6 mice will voluntarily drink alcohol (10% EtOH unsweetened) in much greater amounts than other strains. In a comparison of 22 inbred strains, B6 mice drank

the most, and five times more than FVB mice (Yoneyama et al., 2008). This study also found that the proportion of the variance in consumption of unsweetened alcohol that could be explained by genotype was 44–60% (Yoneyama et al., 2008). It has also been found that female B6 mice tend to consume more alcohol than their male counterparts (Middaugh et al., 1999). However, several impactful animal studies investigating the effects of early environment on behavior suggest mother-infant interactions lead to long-term developmental changes via epigenetic changes (Liu et al., 1997; Weaver et al., 2004).

This research will investigate the interaction between genotype and environment on the development of alcohol use in early adulthood. One strategy used in rodents to investigate the effects of rearing environment on strain differences in behavior is postnatal cross-fostering. The mouse strains used are two well-characterized inbred mouse strains: C57BL6/J (B6) and FVB/NJ (FVB) to investigate this interaction by examining the influence of postnatal cross-fostering on the behavioral development of offspring. Thus, researchers aim to explore the interaction between pup experience (fostered B6, fostered FVB, or non-fostered) and maternal strain (B6, FVB) on offspring alcohol use during early adulthood. This research will assess maternal care as one potential mediating mechanism. As previous data suggest females may suffer more from the shifts in early environment that reduce maternal care (e.g., Bechard et al. 2012). Sex-dependent effects of fostering on alcohol use will also be explored.

This research is composed of two hypotheses. The first hypothesis claims that B6 (i.e., genetically predisposed to prefer alcohol) mice reared by FVB dams will consume less alcohol during early adulthood than B6 mice raised by their biological mothers. The second hypothesis claims that FVB mice (i.e., that are not predisposed to drink alcohol) will show a slight increase in alcohol consumption when reared with B6 mothers compared to FVB mice reared by their biological mothers.

Methods

Cross-Fostering

Cross-fostering is when mouse pups are weaned from their biological mothers at birth and swapped with similarly aged pups from a different dam, so the pups are reared by the opposite dam. Parent mice were set up in groups comprised of one male and two females of the same strain (i.e., 8 dams/strain). Mating was timed to produce litters within 3 days of each other. Matings that did not result in coinciding births were assigned to the control (non-fostered) group where they were reared with their biological dam. Whenever possible, coinciding whole litters were swapped between a B6 and FVB dam until 12 pups (about 2–3 litters) of each strain were cross-fostered.

Offspring subject groups:

1. B6 pups reared with B6 mothers (n=18)
2. FVB pups reared with FVB mothers (n=19)

3. B6 pups reared with FVB mothers (n=14)
4. FVB pups reared with B6 mothers (n=17)

Table 1: Ethnogram for specific behviors and their definitions

Behavior	*Definition*
Resting with pups (RP)	Mother is resting in contact with pups including nursing (solely tail contact not included).
Active (A)	Mother is moving around, nesting, eating, or drinking and not in close contact with pups.
Inactive (IA)	Mother is not moving around and is still for at least three seconds and not in contact with pups.
Licking/grooming pups (LGP)	Mother is licking or grooming a pup.
Licking/grooming self (LGS)	Mother is licking or grooming herself.

Maternal Observations

Once the pups were cross-fostered, maternal care was observed for the next seven days per dam and observations were recorded for days one, three, and five. An ethogram for specific behaviors was generated (see *Table 1*). Maternal observations were carried out through live scoring in which a researcher was physically present and recorded specific maternal behaviors. Maternal observations were carried out for an hour each day until pups were seven days old. Within the hour, one mouse was observed for each minute as the researcher recorded the first behavior they saw for that designated minute. This led to 12 behaviors for each dam in an hour and this data was recorded for maternal observations. It is important to note that behaviors recorded from the ethogram are mutually exclusive.

Light Dark Box

Once pups reached 42 days, they were then tested in a Light Dark Box (LDB) as a measurement of general anxiety. Mice who explore the light side of the chamber are typically seen as less anxious than mice that spend more time in the dark side of the chamber (Bourin & Hascoet, 2003). Each mouse was placed in a chamber for 10 minutes where one side of the chamber is uncovered and flooded with light, while the other side is covered with dark paneling. To start the trials, the mouse is placed in the center of the chamber and this initiates an automatic recording of the mouse's path sequence through a computer processing system connected to the LDB, and they are free to roam. The chamber is cleaned between each session to ensure that there are no olfactory confounds. The time spent in the light and dark side by each mouse was automatically recorded through the computer processing system. All subjects were handled prior to the start of the experiment and habituated to the environment for at least 30 minutes prior to any session to control for any anxiety and to ensure the accurate recording of baseline behavior.

Drinking in the Dark

Intermittent Drinking in the Dark (iDID) is an established mouse drinking paradigm (e.g., Rodriguez-Ortiga et al. 2018) and was used to quantify alcohol consumption for each mouse. During a 2-hour test session that occurs during the dark (i.e., lights off) cycle, all mice were removed from their standard environment and placed in separate cages with access to 10% alcohol. The alcohol is delivered via 10 mL modified pipettes so that pre-session and post-session volumes can be used to calculate the individual alcohol consumption for each mouse per day, and escalation of use over time. Mice were tested in five sessions/week for 20 sessions in total. Sessions were held Monday, Tuesday, Thursday, and Friday from 9–11 and 12–2. Both B6 and FVB mice were equally balanced in sessions for both control and fostered sessions; this was to ensure that time of the sessions was not a confound in the results. All subjects were handled prior to the start of the experiment and habituated to the drinking environment for at least 30 minutes prior to any session to control for any anxiety and to record accurate baseline behavior.

The hypotheses for this research are as follows: B6 mice reared with FVB mothers will show a decrease in alcohol consumption compared to their non-fostered conspecifics (B6 reared by B6). FVB mice reared with B6 mothers may show a slight increase in alcohol consumption compared to their non-fostered conspecific (FVB reared by FVB). It was also predicted that B6 mice reared with B6 mothers would drink alcohol, while FVB mice reared with FVB mothers would not.

Results

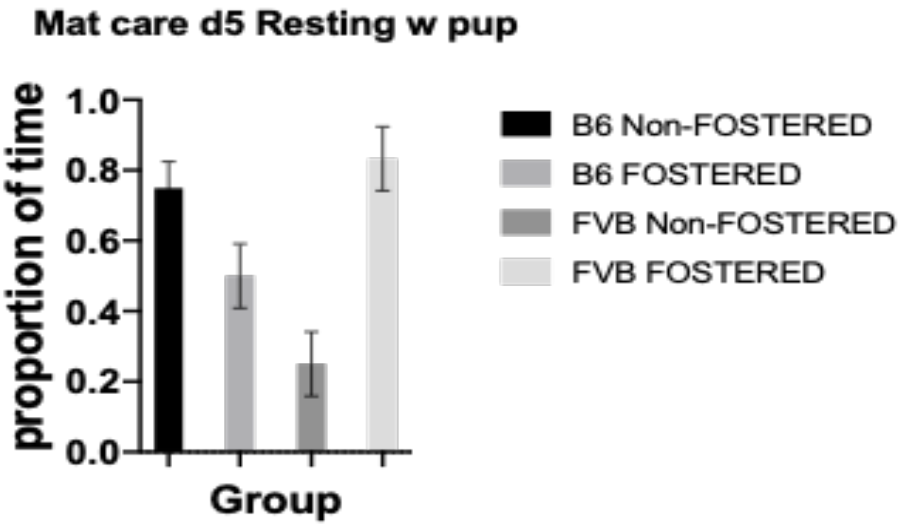

Figure 1: Maternal Care Day 5 Licking/Grooming Pups. Shows the amount of time dams were licking and grooming their pups across non-fostered groups on Day 5. FVB dams exhibited more licking and grooming behavior towards their pups slightly more than B6 dams ($F(1, 5) = 9.16$, $p = 0.029$). There were no differences in the amount of time dams spent self-grooming ($p>0.05$).

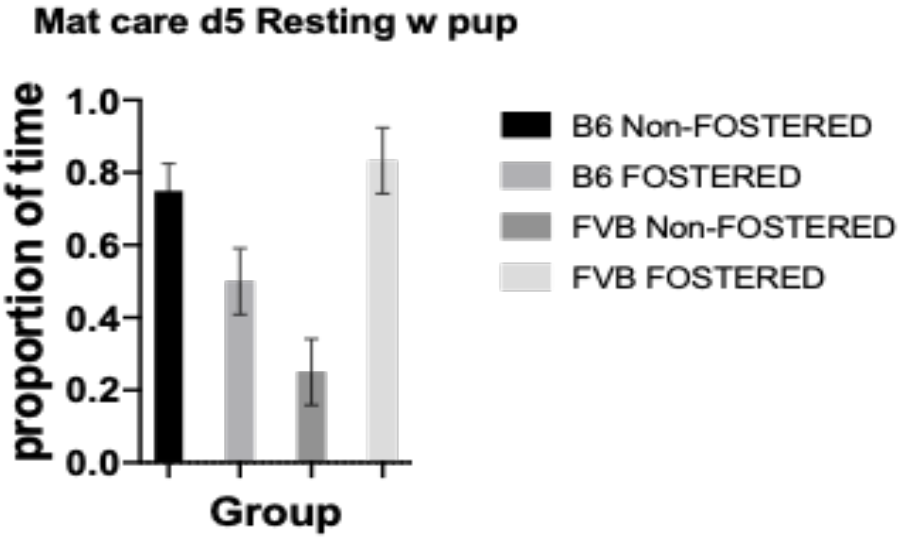

Figure 2: Maternal Care Day 5 Resting with Pups. Shows the amount of time dams were resting with pups across non-fostered and fostered groups on Day 5. The amount of time spent resting with the pups resulted in a strain by group interaction ($F(1, 5) = 22.72$, $p = 0.005$).

Maternal Observations

Unfortunately, due to COVID-19 restrictions, maternal observations were not able to be completed consistently. In one group, we were able to perform live observations of maternal care. With Covid restrictions, we did not complete maternal observations of non-fostered mice on days 1–4. Moreover, for the fostered mice we were forced to video record the maternal care observations made of this pre-recorded behavior. Thus, we present day 5 maternal care behavior only and acknowledge this confound prevents us from reliably interpreting the current data. This is a limitation to interpreting our findings, and we are currently aiming to repeat the maternal observations using simultaneous live and pre-recorded observations in a separate group of control mice to strengthen our interpretation of findings. Results on day 5 are as follows: dams with non-fostered litters were the only group to be observed spending time licking and grooming their pups in which no significant differences were observed (see *Figure 1*). The amount of time spent resting with the pups resulted in a strain by group interaction in which dams with B6 pups rested with them more than dams with FVB pups (see *Figure 2*). There were no differences in the amount of time dams spent self-grooming.

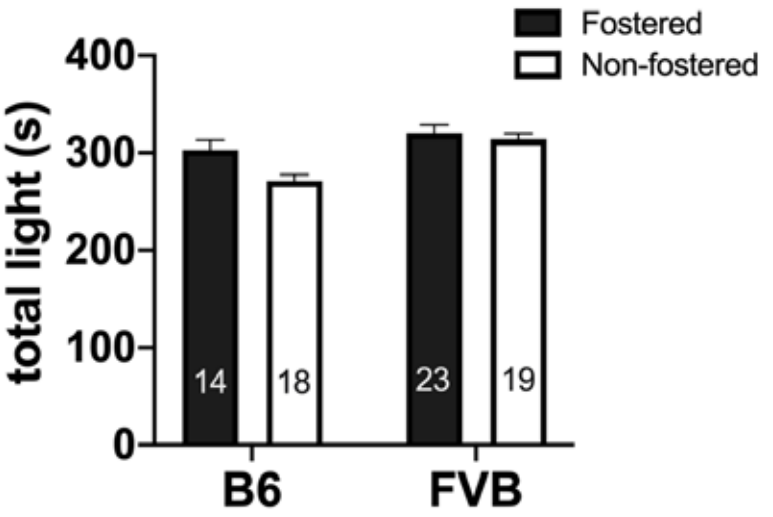

Figure 3: Total Time in the Light in Control and Fostered Mice. Shows the amount of time in the light side of the Light-Dark Box during a 10-minute test. Fostered mice spent more time in the light side than non-fostered mice (Fostered: $F(1, 97) = 5.75$, $p = 0.018$) and FVB mice spent more time in the light side than B6 mice (Strain: $F(1, 97) = 14.35$, $p < 0.0001$). No effect of Sex or interactions.

Light Dark Box

The LDB yielded interesting results. It was found that fostered mice spent more time in the light side of the chamber than non-fostered mice (see *Figure 3*). From this it can be deduced that fostered mice were less anxious and more exploratory than non-fostered mice. This is a significant finding as it implies that the act of cross-fostering mice in early life may reduce anxious tendencies later in life compared to mice reared with their own mothers. Another significant finding is that the FVB mice spent more time on the light side of the chamber than the B6 mice (see *Figure 3*). Similarly, the result concludes that FVB mice are less anxious than B6 mice. This data from the LDB yielded no effects of sex and also no interactions.

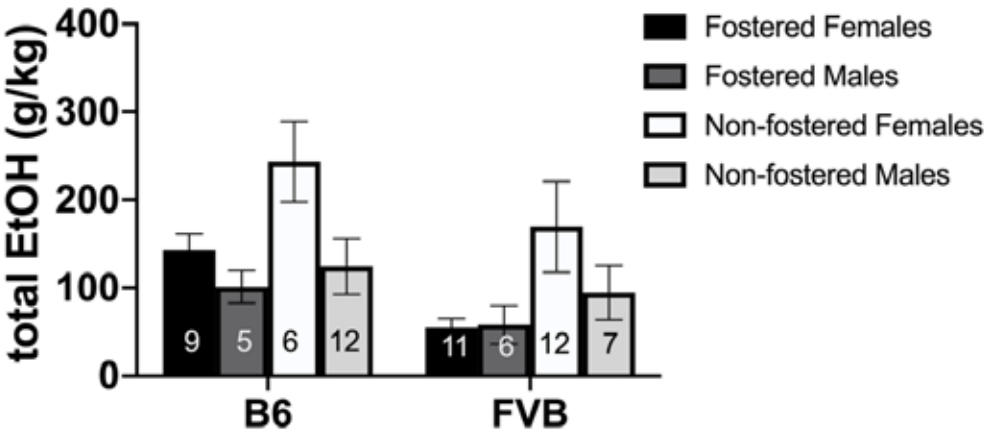

Figure 4: Total Alcohol Consumption in Control and Fostered Mice. Shows the total amount of EtOH (g/kg) consumed across sessions. B6 mice drank more than FVB mice (Strain: $F(1, 60) = 4.92$, $p = 0.03$). Non-Fostered mice drank more than fostered mice (Fostered: $F(1, 60) = 6.71$, $p = 0.012$). Females drank more than males (Sex: $F(1, 60) = 4.84$, $p = 0.032$). No interactions were significant.

Drinking in the Dark

There were multiple significant effects that resulted from the intermittent drinking in the dark. Firstly, it was found that B6 mice consumed more alcohol than FVB mice across control and experimental groups (see *Figure 4*). Secondly, there were sex effects as females drank more than males in both the B6 and FVB strains. Lastly, non-fostered mice consumed more alcohol than fostered mice; this was a profound finding as it is consistent with results from the LDB where cross-fostered mice may be less stressed and therefore less prone to drinking than control mice. This introduces the notion of anxiety and its role, in combination with epigenetics, on the effects of alcohol consumption. Overall, B6 and FVB non-fostered females consumed the most alcohol. These findings support prior research and confirm that female mice and B6 mice are prone to consume alcohol more than male and FVB mice. However, these findings also implicate that cross-fostering in early life may have an opposite effect on alcohol consumption, making non-fostered mice at higher risk to drink than fostered mice. There were no significant interactions found.

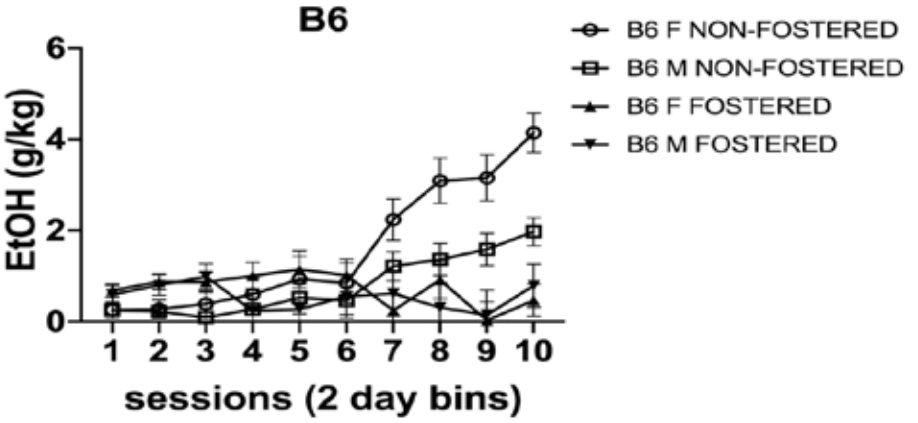

Figure 5: Alcohol Consumption Over Time in Control and Fostered B6 Mice. Shows the amount of alcohol consumed across sessions in female and male fostered and non-fostered B6 mice. Females consumed more alcohol than males, while non-fostered mice drank more than fostered mice.

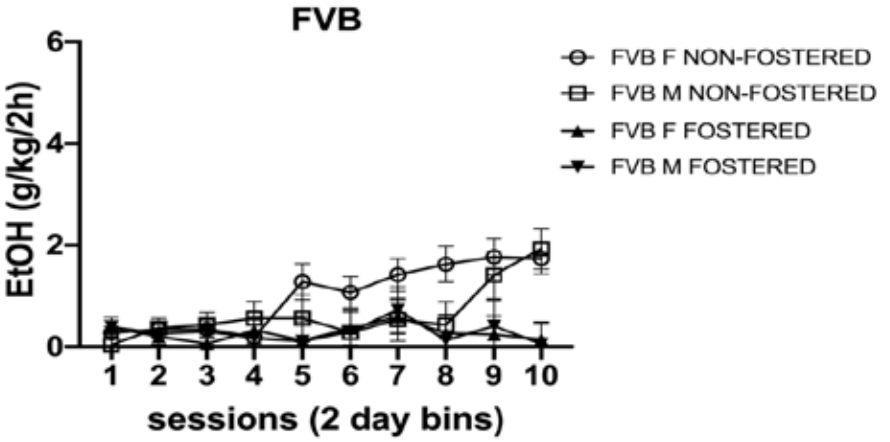

Figure 6: Alcohol Consumption Over Time in Control and Fostered FVB Mice. Shows the amount of alcohol consumed across sessions in female and male fostered and non-fostered FVB mice. Females consumed more alcohol than males, while non-fostered mice drank more than fostered mice.

Discussion

This research aimed to answer the question if rearing mice with different mothers who are either predisposed or not predisposed to drinking alcohol would have any effect on the pup's own predisposition to drink or not drink alcohol via maternal care and epigenetics. Of the two hypotheses that were established, only one was supported. The first hypothesis predicted that B6 pups predisposed to drink alcohol reared with FVB mothers would drink less than B6 pups reared with their own B6 mothers. This hypothesis was supported (see *Figure 5*). The second hypothesis predicted that FVB pups not

predisposed to drink alcohol reared with B6 mothers would drink slightly more alcohol than FVB pups reared with FVB mothers. However, this was not supported; the opposite occurred. FVB pups that were cross-fostered drank less than FVB pups who were not cross-fostered (see *Figure 6*). This raises many interesting questions.

This difference in alcohol consumption could possibly be from differences in mothering styles between FVB and B6 mothers. However, since maternal observations are not available at this time, no reliable conclusions can be made. Given the results of this study, another possible explanation may be that cross-fostering early in life may have served as a protective agent against anxiety and alcohol predisposition later in life. Future research should focus on examining the effects of early versus late trauma on anxiety and alcohol consumption in mice. It has been hypothesized that early trauma may actually act as a protective agent while late trauma may act as a risk factor for mice. This may explain why fostered mice were less anxious and drank less overall than non-fostered mice. Future research may want to examine if cross-fostering in early life will act as a protecting agent and lead to less anxiety and drinking, while cross-fostering later in life will act as a risk factor and lead to increased anxiety and drinking.

One limitation of this study is that maternal observations could not be completed. This is currently being corrected and data will hopefully be available soon. In order to prevent future errors, maternal observations should be live-scored and also recorded. With these two scores supplemented, researchers can ensure the accuracy of maternal observations and may also make observations remotely from watching recordings of the mice. Another limitation is that this research did not have an in-strain cross-fostering control comparison. This may lead to a confound in the results. Currently, strict conclusions cannot be made about the reason for these results and if these findings are due to differences in rearing or simply from the act of cross-fostering. There is a current project that is looking to rectify this. This future research is looking to cross-foster B6 pups with a different B6 mother as well as cross-fostering FVB pups with a different FVB mother and test these pups in the LDB and measure their alcohol consumption. This will then control for the act of cross-fostering on anxiety and drinking behaviors. By having a non-fostered group, a cross-fostered group between strains, and a cross-fostered group within strains, the act of cross-fostering on alcohol consumption will not be a confound.

Alcohol abuse is a serious issue, and these findings are significant to understand the underlying mechanisms behind it. As research continues, some potential causes and solutions may be discovered to better understand alcohol abuse and how it may be placated.

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Application of the SEIRD Epidemic Model and Optimal Control to Study the Effect of Quarantine and Isolation on the Spread of COVID-19

Luz Melo

sponsored by Sedar Ngoma, PhD

Abstract

Mathematical models serve as a powerful tool for visualizing and describing the dynamics of infectious diseases. In this article, the *SEIRD* (Susceptible-Exposed-Infected-Recovered- Deceased) epidemic model consisting of a system of five non-linear differential equations is considered. By using COVID-19 data pertinent to the United States and the world situation, the use of existence and uniqueness of the disease-free equilibrium is established, the value of the basic reproductive number is determined, a stability analysis is carried out, and the parameters that fit the model to the data are estimated. An optimal control approach is performed to study the effect of quarantine and isolation on the spread of COVID-19. The goal is to explore the effectiveness of quarantine and isolation at controlling the spread of COVID-19.

Acknowledgments

First and foremost I would like to express my immense gratitude towards my research supervisor and academic advisor, Dr. Sedar Ngoma. It has been a great privilege and honor to have the opportunity to work on such a captivating research while receiving guidance from a wonderful Mathematician and person. I would like to also give special thanks to professors Dr. Aaron Heap, Dr. Ahmad Almomani for believing in me. The completion of this thesis would not have been possible without the help of the great professors in charge of the Mathematics Honors Committee. This work was partially supported by funds made available under a SUNY Expanded Investment and Performance Award to SUNY Geneseo.

1 Introduction

The Coronavirus (COVID-19) is a novel disease that emerged in Wuhan, China, in December of 2019. COVID-19 is primarily transmitted from person-to-person through exposure to respiratory droplets carrying the infectious virus (Centers for Disease Control and Prevention, n.d.). The symptoms can range from fever, cough, loss of taste or smell, fatigue, and muscle ache to trouble breathing, chest pain, and confusion (Centers for Disease Control and Prevention, n.d.). While most individuals infected with the virus experience mild to moderate symptoms similar to the common cold, older age groups and individuals with underlying medical conditions are at risk of developing more serious, life-threatening complications. Thus, as the highly contagious virus rapidly spread in a population with absolutely no immunity, containing the virus became a global priority. On March 11 of 2020, the World Health Organization (WHO) declared COVID-19 a pandemic and, two days later, President Donald Trump declared COVID-19 a National Emergency for the United States (Centers for Disease Control and Prevention, 2021). As of April of 2021, there has been over 140 million confirmed cases and 3 million deaths across nearly 200 countries. In this study, we hope to contribute to the ongoing research on this topic and, more specifically, provide insights into the importance of quarantine and isolation as non-pharmaceutical intervention strategies for mitigating the spread of COVID-19.

1.1 Properties of the Model

In this section, the *SEIRD* compartmental mathematical model for prediction of COVID-19 epidemic dynamics is introduced. The model is a modified version of the basic Susceptible Infected-Removed (SIR) model proposed by W.O. Kermack and A.G. MacKendrick. The *SEIRD* system consists of five nonlinear differential equations, in this case represented by compartments, namely *S, E, I, R,* and *D*. In this study, the data gathered represents the spread of the disease prior major intervention strategies were applied. The variables used in our model represent the number of people in each compartment at a particular time *t* and are described as follows:

Table 1: Variables used and their meaning.

Variable	Meaning
$S = S(t)$	The susceptible population at time t.
$E = E(t)$	The exposed population at time t.
$I = I(t)$	The infectious population at time t.
$R = R(t)$	The recovered population at time t.
$D = D(t)$	The dead population at time t.

More specifically, the susceptible population are those individuals that are capable of contracting the disease once in contact with an infectious individual, the exposed population are infected individuals that remain latent for some time before becoming in-

fectious, the infectious population are the individuals in the population that spread the disease, the recovered population are the individuals who have survived through the infectious period and become immune to the disease, and the dead population are the individuals that died due to the disease.

Table 2: Parameters used and their meaning.

Parameter	Meaning
β	Disease transmitting rate.
γ	Incubation rate.
μ	Recovery rate.
ρ	Death rate due to the disease.

The disease transmitting rate is the rate at which individuals contract the disease, the incubation rate is the rate at which the exposed individuals display symptoms of the disease, the recovery rate is the rate at which infectious individuals recover from the disease, and the death rate is the rate at which infected individuals die due to the disease. The total number of fixed people in the population at time t is given by $N = S(t) + E(t) + I(t) + R(t) + D(t)$ and S_0, E_0, I_0 R_0, and D_0 are the given initial conditions. In this study, the *SEIRD* model is defined as follows:

1.2 The SEIRD Model without Optimal Control

$$\frac{dS}{dt} = -\beta SI, \qquad S(0) = S_0 > 0, \tag{1.1}$$

$$\frac{dE}{dt} = \beta SI - \gamma E, \qquad E(0) = E_0 > 0, \tag{1.2}$$

$$\frac{dI}{dt} = \gamma E - \rho I - \mu I, \qquad I(0) = I_0 > 0, \tag{1.3}$$

$$\frac{dR}{dt} = \mu I, \qquad R(0) = R_0 > 0 \tag{1.4}$$

$$\frac{dD}{dt} = \rho I \qquad D(0) = D_0 > 0 \tag{1.5}$$

The interactions between our given variables and parameters are pivotal in order to understand the model. Studies have shown that the virus is mainly transmitted through human to human contact when infected respiratory droplets are inhaled. Thus, a major interaction occurs in the first two differential equations where the susceptible population and the infected population come in contact with each other. The term βSI indicates the portion of susceptible people who were in contact with an infectious individual. Hence, the individuals who are in direct contact with an infectious individual become exposed to the virus (this is particularly true in the early stages of the COVID-19 outbreak before hygiene protocols, face masks, and quarantine are implemented), and so this portion now moves from the susceptible group to the exposed group.

As a result, in the process of disease spread for the *SEIRD* model, the susceptible individuals S will first move to the exposed population E instead of directly moving to the

infected population *I*. Now, βSI is the amount of individuals in the exposed population *E*. However, out of this population a portion of individuals will catch the virus and will undergo an incubation period before becoming infectious. That is, γE individuals will move from the exposed population *E* to the infected population *I*. Consequently, the total number of individuals in the infected compartment will fluctuate depending on 1) how many μI individuals recover from the disease and move to the recovered class, or 2) how many ρI individuals end up dying from the disease and move to the dead class.

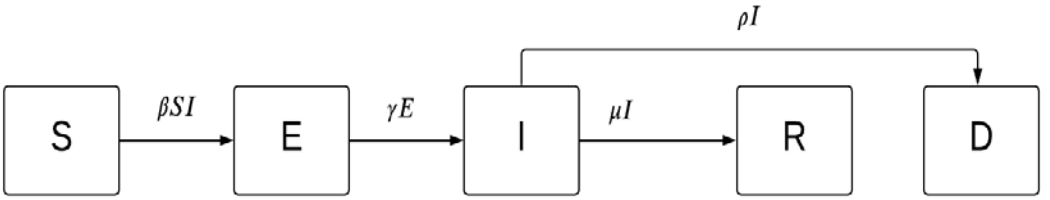


Figure 1: Flowchart diagram for the SEIRD model. The five compartments represent the five distinct groups of individuals in a given population. The arrows represent the portion of the individual that enters or leaves a group.

1.3 Model Assumptions

Before we proceed to use the *SEIRD* model to represent the dynamics of COVID-19 using real data, it is important to notice that this is an idealized model. As nonlinear systems of equations are difficult to solve due to the high dependency of the system variables on each other, the *SEIRD* model has been deliberately constructed as a simplified version of COVID-19 transmission dynamics. Thus, the model relies on a few but important assumptions:

1. The *SEIRD* model is here used to model COVID-19 in a human population; hence, it is reasonable to assume that all the variables and parameters are non-negative.

2. It is assumed that every individual in our population is susceptible to COVID-19.

3. The infected and susceptible populations are assumed to mix homogeneously. That is, each infectious individual (regardless of age, geographic location, etc.) has the same probability of coming in contact with any susceptible individual in the population.

4. The total population *N* remains constant over time as we ignore births, natural death, immigration, etc. Hence, no one joins the susceptible group and the only way an individual leaves the susceptible compartment is by becoming exposed to the virus. This results in the susceptible population decreasing monotonically towards zero over time as individuals become exposed to the virus.

5. All individuals in the population have the same probability to contract and die from the disease, regardless of their age or health status.

6. There is no treatment failure; a patient will either recover or die.

7. The model assumes that both Exposed-Recovered individuals and Infected-Recovered individuals become immune to the disease permanently. In other words, the individual gains immunity to the disease once recovered.

1.4 Existence and Uniqueness

In this section we find the equilibrium solution and briefly outline conditions under which system (5.1)–(5.5) has a solution. The result is stated in the following theorem:

Theorem 1.1 (Existence and Uniqueness). *Assume that the functions* $-\beta S(t)I(t)$, $\beta S(t)I(t) - \gamma E(t)$, $\gamma E(t) - \mu I(t) - \rho I(t)$, $\mu I(t)$, $\rho I(t)$ *appearing to the right sides of system* (5.1)– (5.5) *and their partial derivatives with respect to S, E, I, R, D are continuous in a rectangle* $a < t < b$, $c < S, E, I, R, D < d$. *Then for any* $t_0 \in (a, b)$ *and* $S_0, E_0, I_0, R_0, D_0 \in (c, d)$, *the initial value problem* (5.1)–(5.5) *has a unique solution valid on some open interval* $a < \alpha < t < \nu < b$ *containing* t_0.

Proof. Let $x(t) = (S(t), E(t), I(t), R(t), D(t))$, $t \in (a, b)$ and $S(t), E(t), I(t), R(t), D(t) \in (c, d)$. Then $x'(t) = (S^0, E^0, I^0, R^0, D^0)$. Define a function g as

$$g(x(t)) = (-\beta SI, \beta SI - \gamma E, \gamma E - \rho I - \mu I, \mu I, \rho I).$$

Let $t_0 \in (a, b)$ and $x(t_0) = (S(t_0), E(t_0), I(t_0), R(t_0), D(t_0)) = (S_0, E_0, I_0, R_0, D_0) = x_0 \in (c, d)$. By assumption we know that $g(x(t))$ and its partial derivative $g_x(x(t))$ are continuous in the rectangle $a < t < b$, $c < x < d$. By (Logan, 2015, p. 74), the initial value problem

$$\begin{cases} x'(t) = g(x(t)) \\ x(t_0) = x_0 \end{cases}$$

has a unique solution valid on some open interval containing t_0.

Now consider

$$-\beta SI = 0 \tag{1.6}$$

$$\beta SI - \gamma E = 0 \tag{1.7}$$

$$\gamma E - \rho I - \mu I = 0 \tag{1.8}$$

$$\mu I = 0 \tag{1.9}$$

$$\rho I = 0 \tag{1.10}$$

First, recall the vector $x'(t) = g(t, x(t))$ made from the right hand side of our system of differential equations (1.1)-(1.5). To find the equilibrium solution, we set $x'(t) = 0$. From (1.9)-(1.10), since μ and ρ are positive parameters, we must have that $I = 0$. Consequently, from (1.8) it follows that $E = 0$. Now, the term $\beta SI = 0$ since $I = 0$. This means that S could potentially be any other constant other than zero. Also, recall that, by assumption, our model does not consider births, natural death, immigration, etc. Thus, it follows that $x^* = (S_0, 0, 0, 0, 0)$ is the only equilibrium solution. This corresponds to the disease-free

equilibrium where the disease is not present in the population. For further explanation on the topic and a general proof of existence and uniqueness for the *SI* model refer to (Adnaoui, el Berrai, & Bouyaghroumni, 2017).

2 Basic Reproductive Number

Definition 2.1. *The basic reproduction number, R_0, is the average number of secondary infections produced by one infectious individual in an entirely susceptible population.*

In this section, the basic reproduction number is used as a threshold quantity to measure the transmission potential of COVID-19. To find the reproductive number, we use the approach of Next-Generation matrix given by Van den Driessche and Watmough. This method consists in a technique for the derivation of the next-generation matrix from ordinary differential equation compartmental models for disease transmission (Martcheva, 2015).

2.1 Next-Generation Matrix Approach

First, we begin by dividing the compartments into two sections: the infected compartments and the non infected compartments. The infected compartments consists of two type of individuals:

1. The individuals that have been exposed to the virus but are not yet infectious.
2. The infectious individuals that spread the virus.

The non-infected compartments are made of the remaining individuals who are not infected, that is, the susceptible population, recovered population, and dead population. Let $a = (E, I)$ be the vector of dependent variables in the infected compartments and $b = (S, R, D)$ be the vector of variables in the non infected compartments. Hence, $a \in \mathrm{R}^2$ and $b \in \mathrm{R}^3$. Now, we arrange the *SEIRD* model such that the first 2 compartments of the system correspond to the infected compartments as follows:

$$\begin{aligned} a_i &= f(a,b) \qquad \text{for } i = 1,2. \\ b_j &= g(a,b) \qquad \text{for } j = 1,2,3. \end{aligned}$$

That is,

$$\begin{aligned} a_1' &= E' = \beta SI - \gamma E \\ a_2' &= I' = \gamma E - \mu I - \rho I) \end{aligned}$$

and

$$\begin{aligned} b_1' &= S' = -\beta SI \\ b_2' &= R' = \mu I \\ b_3' &= D' = \rho I. \end{aligned}$$

In addition, we divide the right-hand side of the infected compartments such that

$$a_i' = \mathcal{F}_i(a,b) - V_i(a,b) \qquad \text{for } i = 1,2.$$
$$b_j' = g_j(a,b) \qquad \text{for } j = 1,2,3.$$

In the above equations, $F_i(a, b)$ represents the rate of appearance of new infections in the i^{th} compartment and $V_i(a, b)$ represents the remaining transfer of individuals into and out of the compartment i. In our case, we get that

$$\mathcal{F}_1(a,b) = \beta SI$$
$$\mathcal{F}_2(a,b) = \gamma E$$

and

$$\mathcal{V}_1(a,b) = \gamma E$$
$$\mathcal{V}_2(a,b) = \mu I + \rho I,$$

where this decomposition satisfies the properties outlined in Martcheva (2015, p. 105). }. Now, recall that our *SEIRD* model has a unique disease-free equilibrium, namely $x^*=(S_0, 0, 0, 0, 0)$. Thus, we determine the matrices F and V with components $F = \frac{\partial \mathcal{F}_i(a,b)}{\partial x_j}$ and $V = \frac{\partial \mathcal{V}_i(a,b)}{\partial x_j}$, for $i, j = 1, 2$, to be defined as

$$F = \begin{bmatrix} 0 & \beta S_0 \\ \gamma & 0 \end{bmatrix}$$

and

$$V = \begin{bmatrix} \gamma & 0 \\ 0 & \rho + \mu \end{bmatrix},$$

respectively. The next-generation matrix is defined to be $K = F V^{-1}$. Thus, basic matrix multiplication yields that

$$K = \begin{bmatrix} 0 & \frac{\beta S_0}{\rho+\mu} \\ 1 & 0 \end{bmatrix}.$$

The basic reproduction number, R_0, is known to be the largest eigenvalue of K. Therefore, for the control-free SEIRD system it follows that the basic reproductive number of our model is given by

$$\mathcal{R}_0^2 = \frac{\beta S_0}{(\rho + \mu)}. \tag{2.1}$$

In order to see that formula (2.1) for R_0 satisfies definition 2.1, notice that the number of new cases per unit of time produced by the infectious population is given by $\beta S_0 I$. When the first case of COVID-19 originated, there was only one infectious individual and so $I_0 = 1$. Thus, the number of secondary cases one infectious individual produces per unit of time will be βS_0. Since $\mu + \rho$ is the rate at which individuals leave the infected class, this means that the average time spent as an infected individual is $\frac{1}{\mu+\rho}$. Therefore, the number of secondary cases an individual will produce during the infectious period is indeed $\mathcal{R}_0^2 = \frac{\beta S_0}{(\rho+\mu)}$.

Next, the reproduction number R_0 is calculated using data pertinent to the USA and world situation. The corresponding values of R_0 are shown in *Table 3*. Since $R_0 > 1$, we can estimate that COVID-19 will continue to spread for both the USA and the world.

Table 3: Basic reproductive number for the USA and world data.

Region	Basic reproductive number
USA	1.82
World	1.43

3 Local Stability of Disease-Free Equilibrium

In this section we determine the stability of the disease-free equilibrium. To determine the stability of the *SEIRD* system, will perform linearization to obtain quantitative features of the solution in the close neighborhood of the disease-free equilibrium. Recall the Hartman-Grobman Theorem which says that the stability type of an equilibrium of a non-linear system is the same as that of the linearized system.

Theorem 3.1 (Hartman–Grobman Theorem). *The solutions of an $n \times n$ autonomous system of ordinary nonlinear differential equations in a neighborhood of a steady state look "qualitatively" just like the solutions of the linearized system near the origin (Martcheva, 2015).*

Theorem 3.2 (Local Stability). *An isolated equilibrium state $x*$ is locally stable if there in an open interval I containing $x*$ such that $\lim_{t \to +\infty} x(t) = x*$ for any solution $x = x(t)$ with $x(0)$ in I (Logan, 2015).*

Definition 3.1 (Jacobian Matrix). *The Jacobian matrix is defined as the matrix of all first order partial derivatives of a vector-valued function.*

The general form of the Jacobian matrix for the *SEIRD* system is denoted as

$$J = \begin{bmatrix} -\beta I & 0 & -\beta S_0 & 0 & 0 \\ \beta I & -\gamma & \beta S_0 & 0 & 0 \\ 0 & \gamma & -\rho - \mu & 0 & 0 \\ 0 & 0 & \mu & 0 & 0 \\ 0 & 0 & \rho & 0 & 0 \end{bmatrix}.$$

Subsequently, the Jacobian matrix evaluated at the disease-free equilibrium $x* = (S_0, 0, 0, 0, 0)$, in particular where $I = 0$, is given by

$$J(x^*) = \begin{bmatrix} 0 & 0 & -\beta S_0 & 0 & 0 \\ 0 & -\gamma & \beta S_0 & 0 & 0 \\ 0 & \gamma & -\rho - \mu & 0 & 0 \\ 0 & 0 & \mu & 0 & 0 \\ 0 & 0 & \rho & 0 & 0 \end{bmatrix}.$$

Theorem 3.3 (Unstable equilibrium). *The disease-free equilibrium, x∗, is unstable if and only if the basic reproductive number* $R_0 > 1$.

Now, we wish to further expand on the stability of the *SEIRD* model. To do this, we will prove that the disease-free equilibrium is locally unstable by looking at the eigenvalues of the Jacobian matrix and the basic reproductive number. Recall that the basic reproductive number of the *SEIRD* system is computed to be $\mathcal{R}_0^2 = \frac{\beta S_0}{(\mu+\rho)}$. Since the basic reproductive number yield to be $R_0 > 1$ for both the USA and world data, by Theorem 3.3 it follows that the *SEIRD* system is locally unstable at the disease-free equilibrium. The following proof of Theorem 3.3 is meant to further validate our conclusion.

Proof. The disease-free equilibrium, x^*, is unstable if and only if $\lambda_1 < 0$ and $\lambda_2 > 0$. Assume that the disease-free equilibrium, x^*, is unstable. The characteristic equation of the Jacobian $|J - \lambda I| = 0$ is a quadratic polynomial in λ given by

$$A\lambda 2 + B\lambda + C = 0$$

where

$$A = 1$$
$$B = (\gamma + \rho + \mu)$$
$$C = \gamma(\rho + \mu - \beta S_0).$$

Thus, using the quadratic equation, we obtain that

$$\lambda_1 = \frac{-(\gamma + \rho + \mu) - \sqrt{(\gamma + \rho + \mu)^2 - 4\gamma(\rho + \mu - \beta S_0)}}{2}. \tag{3.1}$$

$$\lambda_2 = \frac{-(\gamma + \rho + \mu) + \sqrt{(\gamma + \rho + \mu)^2 - 4\gamma(\rho + \mu - \beta S_0)}}{2}. \tag{3.2}$$

Notice that $\lambda_1 < 0$ and $\lambda_2 > 0$ can only happen when $\rho + \mu - \beta S_0 < 0$ so that the discriminant $(\gamma + \rho + \mu)^2 - 4\gamma(\rho + \mu - \beta S_0) > 0$. If $\rho + \mu - \beta S_0 < 0$, then $\rho + \mu < \beta S_0$, $\frac{\rho+\mu}{\rho+\mu} < \frac{\beta S_0}{\rho+\mu}$, $\mathcal{R}_0^2 > 1$, and so $R_0 > 1$, as desired.

Conversely, assume that $R_0 > 1$. Then, $\mathcal{R}_0^2 > 1$, $\frac{\beta S_0}{\rho+\mu} > 1$, $\beta S_0 > \rho + \mu$, $\beta S_0 - (\rho + \mu) > 0$, or $(\rho + \mu) - \beta S_0 < 0$. This implies that the discriminant in (3.1)-(3.2) is positive and consequently $\lambda_1 < 0$ and $\lambda_2 > 0$. Hence, since $\lambda_1 < 0$ and $\lambda_2 > 0$, the disease-free equilibrium, x^*, is unstable. Therefore, the disease-free equilibrium, x^*, is unstable if and only if the basic reproductive number is $R_0 > 1$.

Theorem 3.4 (Stable equilibrium). *The disease-free equilibrium, $x*$, is locally asymptotically stable if and only if the basic reproductive number $R_0 < 1$.*

Proof. For the sake of curiosity, assume that the disease-free equilibrium, x^*, is stable. Then we must have $\rho+\mu-\beta S_0 > 0$ so that the discriminant is negative. This results in two complex eigen values with negative real parts. Thus, the disease-free equilibrium, x^*, would be asymptotically stable (Logan, 2015, p. 251). The converse would hold in a similar argument.

4 Fitting the Model to the Data

In this model, we want to verify that the *SEIRD* model accurately depicts the transmission dynamics of COVID-19. To do this, we use real world data provided by the World Health Organization (WHO) (n.d) and fit the model to the data using the least squares approach. We fit the model to incidence weekly data of the United States and the world situation within a fifteen-week time span. The goal is to determine from the fitting curve the parameters β, ρ, and μ that best represent the observed data.

Notice that different time spans are used for the USA data and the world data. Distinct time intervals are used to correspond to the periods where the region experienced a constant weekly increase of COVID-19 cases. For the purpose of our study, it is crucial to collect data prior to major intervention strategies being implemented. Thus, the data has been deliberately selected prior to the peak of the infectious period.

Table 4: Weekly COVID-19 Cases in the United States

Weeks	Cases
09/07/20	242694
09/14/20	275171
09/21/20	298149
09/28/20	296082
10/05/20	327514
10/12/20	382981
10/19/20	436292
10/26/20	548965
11/02/20	684493
11/09/20	1004852
11/16/20	1147581
11/23/20	1150654
11/30/20	1251632
12/07/20	1456800
12/14/20	1666736

Table 5: Weekly COVID-19 Cases Globally

Weeks	Cases
04/13/20	533134
04/20/20	553798
04/27/20	547077
05/04/20	582996
05/11/20	597373
05/18/20	679659
05/25/20	719524
06/01/20	842755
06/08/20	888759
06/15/20	1019230
06/22/20	1139197
06/29/20	1305436
07/06/20	1431541
07/13/20	1560279
07/20/20	1743320

Definition 4.1 (Curve-fitting). *The process of identifying the parameters of the model so that the solution best fits a given set of data (Martcheva, 2015).*

4.1 The Least Squares Approach

Definition 4.2 (The Method of Least Squares). *The least squares method is a statistical procedure to find the best fit for a set of data points by minimizing the sum of the squared residuals of data points from the fitted curve.*

Our objective consists of applying the least squares approach to estimate the parameters of the *SEIRD* model that best fit the collected real data. The parameters to be estimated are β, ρ, μ, where γ is excluded from the fitting procedure. We assume that the x-coordinates (time in weeks) of the data are exact and represent the time independent variable, while the y-coordinates (number of infected individuals taken from WHO data) may be noisy or distorted and represent the time dependent variable. Particularly, our data is given in the form $\{(t_0, Y_0), \ldots, (t_{14}, Y_{14})\}$.

Definition 4.3 (Residual). *The difference between the actual value of the time dependent variable and the value estimated by the model.*

Thus, since we are fitting the number of COVID-19 cases for the infected variable $I(t)$ in the *SEIRD* model (as shown in *Table 4-5*), we have that the residual is given by

$$r_i = Y_i - I(t_i) \text{ for } i = 0, 2, \ldots, 14.$$

and the sum-of-squares error is given by

$$SSE = \sum_{i=0}^{15} r_i^2.$$

The sum-of-squares error (SSE) is a function of the parameters of the model (Martcheva, 2015). Hence, in order to determine the best fit for the data, the values of β, ρ, μ that yield the fitted curve with the smallest SSE is desired. This becomes an optimization problem where we seek to minimize the SSE as much as possible. To do this, we use MATLAB's built-in function, *fminsearch*, to perform a minimization routine. The fitted curve for the USA data and world situation is shown below in *Figure 2* and *3*.

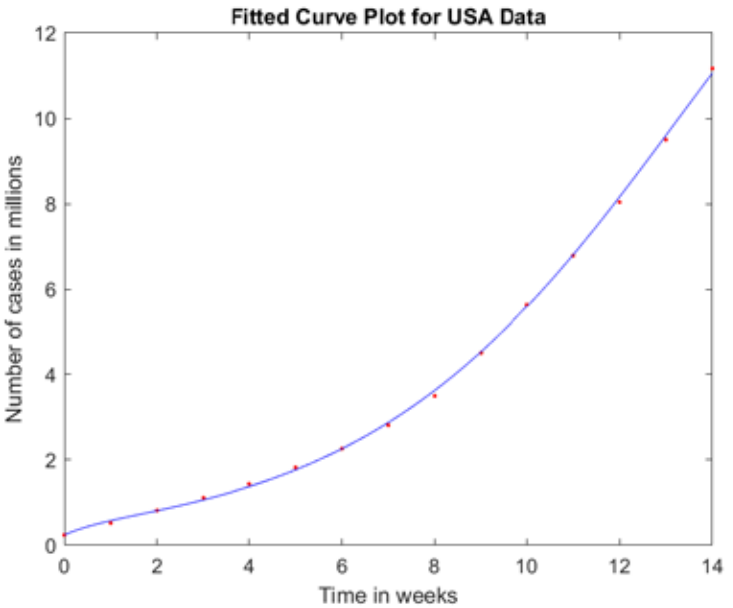


Figure 2: The graph displays time in weeks versus the incidence number of cases in a weekly basis in the United States between September 7, 2020 and December 14, 2020. The red dots represent weekly amounts of cases obtained by the WHO. The initial conditions are as follows: N = 330660000, S_0 = 325595940, E_0 = 4497300, I_0 = 242694, R_0 = 318920, and D_0 = 5146. Convergence was reached after 52 iterations with an error of 0.070624.

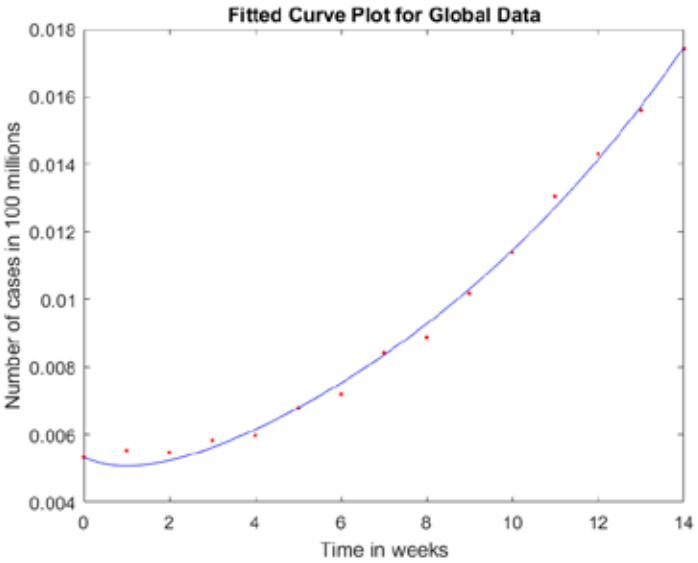


Figure 3: The graph displays time in weeks versus the incidence number of cases on a weekly basis of the global situation between April 13, 2020 and July 20, 2020. The red dots represent weekly amounts of cases obtained by the WHO. The initial conditions are as follows: $N = 7800000000$, $S_0 = 7791272494$, $E_0 = 1171224$, $I_0 = 533134$, $R_0 = 7023148$, and $D_0 = 51585$. Convergence was reached after 131 iterations with an error of 0.000001.

4.2 Estimation of Parameters

The specified value for the initial conditions and initial guesses for the parameters have a pivotal role on the fit. In this fitting, we do not fit the initial conditions. Instead, we determine their value based on the corresponding collected data. The total number of fixed people in the population at time t_0, $N = S_0+E_0+I_0+R_0+D_0$, is taken to be the total population of the United States on September 7, 2020 and the total global population on April 13, 2020, respectively. We let I_0 denote the number of infectious individuals at time t_0 and D_0 to be the number of dead individuals at time t_0. Based on I_0 and D_0, we adjust the values of E_0 and R_0 as necessarily. Thus, with N, E_0, I_0, and R_0 known, the susceptible population at t_0 follows to be $S_0 = N -(E_0+I_0+R_0+D_0)$.

A classical approach to the estimation of parameters is to identify features of the set of data and then choose parameters of our model to match those features. Based on existing research, the incubation period of COVID-19 and other coronaviruses ranges from 2–14 days (World Health Organization, n.d.). Thus, we fix the incubation rate to be $\gamma = 0.16$, which is 6.25 days. Early estimates predict that the overall COVID-19 recovery rate to be between 97% and 99% and death rate to be between 1–2%, so we pre-estimate ρ and γ to be $\rho = 0.01818$ and $\mu = 0.9818$. Lastly, we fix the obtained estimated parameters, γ, ρ and μ, to manipulate the value of β until a good agreement with the data is attained. Ultimately, the desirable value yields to be $\beta = 0.01$.

Table 6: Fitted parameters for the USA and world data.

Region	USA	Global
β	0.0101	0.0119.
μ	0.9780	0.4311.
ρ	0.0185	0.0223.

Next, we examine the residual graphs of the USA data and the world data in order to verify that the fitting curve is appropriate for the data. Notice that positive values for the residual mean the prediction was too low and negative values mean the prediction was too high. If the residual is equal to zero, this means that our fitted value was exactly correct. Consequently, in order for the fit to be good, the residuals should be randomly distributed, tending to cluster towards the middle of the plot.

By examining the residuals in *Figure 4*, we notice that for both the USA data and the world data, three out of the fifteen red dots almost perfectly fall on the blue line. This is a great indication of a good fit since it implies that at those fitted values the error is negligible. Also, the residual plots display a fairly random pattern, with approximately one half of the residuals positive and the other half negative. Therefore, since the fitting curve effectively reflects the data, it is safe to conclude that the *SEIRD* model accurately depicts the transmission dynamics of COVID-19.

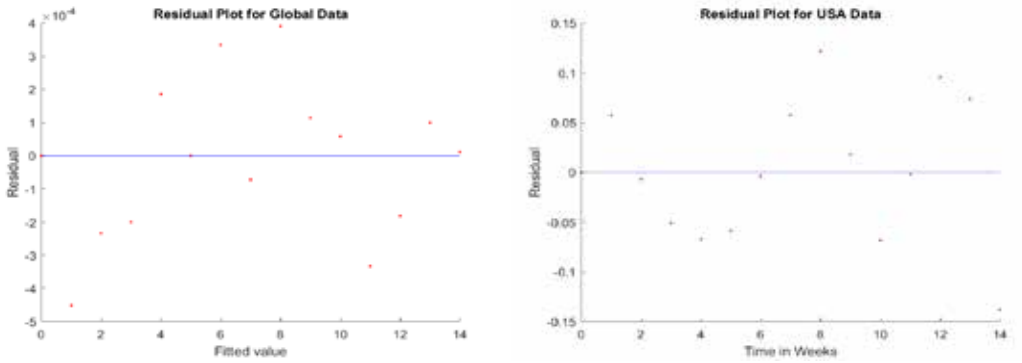


Figure 4: The graphs display the least squares residuals of the USA (left) and global situation (right). The distance from the red dots to the blue line at residual = 0 illustrates how far the fitted value is from the actual value.

5 Optimal Control

Now, we introduce the finite-dimensional optimal control problem to determine how effective quarantine and isolation are at minimizing the number of infected individuals over time. Hence, we consider two controls which serve as prevention methods for COVID-19: quarantine, $q(t)$, and isolation, $z(t)$. In general, these two controls are widely used by health officials to combat the spread of an epidemic.

Definition 5.1 (Quarantine). *Separates and restricts the movement of people who were exposed to a contagious disease to see if they become sick.*

Definition 5.2 (Isolation). *Separates sick people with a contagious disease from people who are not sick* (*Quarantine and Isolation*, 2017).

The goal of this study is to determine the effectiveness of implementing quarantine and isolation together to control the spread of COVID-19 over time. In our study, we consider the previous studies for COVID-19 dynamics that have explored the topic of quarantine and isolation as optimal controls (Huang et al., 2021; Mitarai & Yanagi, 2020; Nenchev, 2020; Xu, Wu, & Topcu, 2021). For instance, we see that previous research considers an optimal control approach for the *SEIR* system for vaccination and quarantine, but excludes isolation as a possible preventive strategy (Xu, Wu, & Topcu, 2021). In fact, various research in the topic explores quarantine as its own compartment but considers the patients in the infectious period to be partially isolated so that they can not participate in the transmission of the virus (Huang, Zhu, Gao, Zeng, Zhang, Liu, & Liu, 2021). On the other hand, some studies have found that isolation of the infected is not actively controlled in the *SIR* model, and therefore isolation is prioritized over quarantine (Mitarai & Yanagi, 2020). Despite the fact that the study of optimal control for both quarantine and isolation has been also considered (Nenchev, 2020), the model could contain major constraints such as having the assumption that only limited quarantine control is available. In our study, we wish to study the impact on the transmission of COVID-19 dynamics when quarantine and isolation are applied both separately and simultaneously and contribute to the extensive archive of research on the topic.

5.1 The SEIRD Model with Optimal Control

In this section, we modify the SEIRD model by introducing the controls $q(t)$ and $z(t)$ as follows

$$\frac{dS}{dt} = -\beta SI \qquad S(0) = S_0 > 0, \tag{5.1}$$

$$\frac{dE}{dt} = \beta SI - \gamma E - q(t)E, \qquad E(0) = E_0 > 0, \tag{5.2}$$

$$\frac{dI}{dt} = \gamma E - z(t)I - \rho I - \mu I, \qquad I(0) = I_0 > 0, \tag{5.3}$$

$$\frac{dR}{dt} = q(t)E + z(t)I + \mu I, \qquad R(0) = R_0 > 0 \tag{5.4}$$

$$\frac{dD}{dt} = \rho I \qquad D(0) = D_0 > 0 \tag{5.5}$$

In this case, a portion of the exposed population to the virus will be quarantined for a certain amount of time t. The expression $q(t)E$ represents the portion of exposed individuals who went into quarantine. Similarly, $z(t)I$ is the portion of infectious individuals who went into isolation. It is assumed that after being in quarantine or isolation for t amount of time the person recovers from the virus. Thus, $q(t)E$ and $z(t)I$ individuals will automatically move to the recovered group once the period of quarantine/isolation is over.

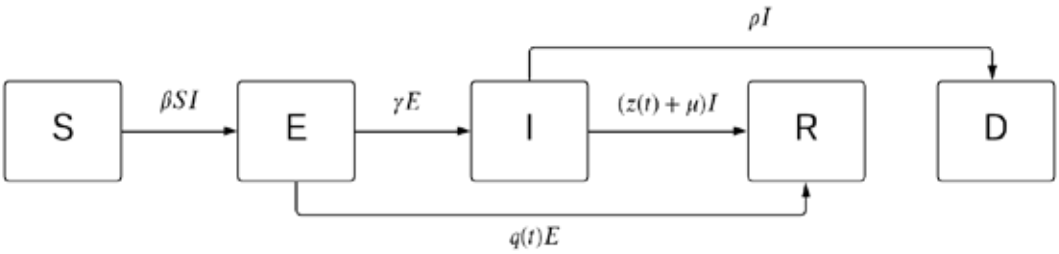


Figure 5: Flowchart diagram for the SEIRD model with controls q(t) and z(t).

In our optimal control problem for ordinary differential equations, the functions $q(t)$ and $z(t)$ represent the controls and $x(t)$ represents the state variable. The state variable satisfies a differential equation which depends on the control variables:

$$x'(t) = g(t, x(t), q(t), z(t)).$$

The principal technique for such an optimal control problem is to solve a set of necessary conditions that an optimal control and corresponding state must satisfy. In particular, we seek for piecewise continuous controls $q^*(t)$ and $z^*(t)$ and the associated state $x(t)$ to minimize the given objective functional:

$$\min_{q,z} J(q,z) = \min_{q,z} \int_{t_0}^{t_1} f(t, x(t), q(t), z(t))dt$$

subject to

$$x'(t) = g(t, x(t), q(t), z(t))$$
$$x(t_0) = x_0 \text{ and } x(t_1) \text{ free}$$

where f is a continuously differentiable function defined as

$$f(t, x(t), q(t), z(t)) = I(t) + \frac{A}{2}q^2(t) + \frac{B}{2}z^2(t)$$

with A and B as positive constants. In order to find an optimal solution, we define the Hamiltonian and use Pontryangin's Maximum Principle to derive the adjoint equations and optimality conditions.

Theorem 5.1 (Pontryangin's Maximum Principle). Suppose that $\bar{q}(t)$ and $\bar{z}(t)$ are optimal for the given objective functional and state equation x. Then, there exists a piecewise differential adjoint variable $\lambda(t) = (\lambda_S, \lambda_E, \lambda_I, \lambda_R, \lambda_D)$ such that

$$H(t, \bar{x}(t), q(t), z(t), \lambda(t)) \leq H(t, \bar{x}(t), \bar{q}(t), \bar{z}(t), \lambda(t))$$

for all controls $q(t)$ and $z(t)$ at each time t, where the Hamiltonian H is defined as

$$H = f(t, x(t), q(t), z(t)) + \lambda(t) \cdot g(t, x(t), q(t), z(t))$$

and the adjoint system is given by

$$\lambda'(t) = -\frac{\partial H(t, x^*(t), q^*(t), z^*(t), \lambda(t))}{\partial x},$$
$$\lambda(t_1) = 0.$$

In our case, the Hamiltonian is equivalent to the addition of the integrand of the objective function and the dot product of the vectors $\lambda(t)$ and $x'(t)$. Thus, the Hamiltonian is defined as

$$\begin{aligned} H = &\left(I(t) + \frac{A}{2}q^2(t) + \frac{B}{2}z^2(t)\right) + \lambda_S\left(-\beta SI\right) \\ &+ \lambda_E\left(\beta SI - (\gamma + q(t))E\right) + \lambda_I\left(\gamma E - (z(t) + \rho + \mu)I\right) \\ &+ \lambda_R\left(q(t)E + (z(t) + \mu)I\right) + \lambda_D(\rho I)\,. \end{aligned}$$

Next, we use the Hamiltonian to derive the adjoint equations. Notice that, since our model consists of five differential equations, there will be an adjoint equation corresponding to each of the *S, E, I, R* and *D* compartments. Hence, the adjoint equations are defined as

$$\begin{aligned} \lambda_S' &= \lambda_S\beta I - \lambda_E\beta I \\ \lambda_E' &= \lambda_E(\gamma + q(t)) - \lambda_I\gamma - \lambda_R q(t). \\ \lambda_I' &= -1 + \lambda_S\beta S - \lambda_E\beta S + \lambda_I(z(t) + \rho + \mu) - \lambda_R(z(t) + \mu) - \lambda_D\rho. \\ \lambda_R' &= 0. \\ \lambda_D' &= 0. \end{aligned}$$

Lastly, posing the necessary conditions from Pontryagin's principle, we have that the Hamiltonian must have a critical point in the variable $q(t)$ and $z(t)$ at $\bar{q}(t)$ and $\bar{z}(t)$, respectively. Thus, the optimal conditions are obtained by setting the partial derivative of the Hamiltonian with respect to $q(t)$ and $z(t)$ to zero. Solving for $q(t)$ yields

$$\bar{q}(t) = \frac{\lambda_E E - \lambda_R E}{A}.$$

Similarly,

$$\bar{z}(t) = \frac{\lambda_I I - \lambda_R I}{B}.$$

To provide numerical simulations of the control problem, we use a numerical approach known as the Forward-backward sweep method. This method will be used to solve the state $x(t)$ forward in time from t_0 to t_1 and solve the adjoint equations $\lambda(t)$ backward in time from t_1 to t_0. To do this, we will use a modified version of the MATLAB's code provided in (Lenhart & Workman, 2007, p. 50).

The basic algorithm of the Forward-Backward Sweep Method is shown below:

5.2 Forward-Backward Sweep Method

1. Step 1. Make an initial guess for q and z over the interval.

2. Step 2. Using the initial condition $x(t_0) = x_0$ and the values for q and z, solve for x forward in time according to its differential equation in the optimality system.

3. Step 3. Use the transversality condition $\lambda_{N+1} = \lambda(t_1) = 0$ and the values for q, z and x to solve λ backward in time.

4. Step 4. Update q and z in each iteration by entering the new x and λ values into the characterization of the optimal control.

5. Step 5. Check for convergence. If values of the variables in the current iteration and the last iteration are negligibly close, output the current values as solutions. If values are not close, return to Step 2.

Even though there exists many methods for solving initial value problems, the Runge-Kutta 4th order (RK4) method is used in our study. The procedure used to implement RK4 to the *SEIRD* model is shown below:

5.3 Runge-Kutta 4th Order Method

For the step size h and the state $x'(t) = g(t, x(t))$, the approximation of $x(t + h)$ is defined as

$$x(t+h) \approx x(t) + \frac{h}{6}(k_1 + 2k_2 + 2k_3 + k_4)$$

where

$$\begin{aligned} k_1 &= g(t, x(t)) \\ k_2 &= g(t + \frac{h}{2}, x(t) + \frac{h}{2}k_1) \\ k_3 &= g(t + \frac{h}{2}, x(t) + \frac{h}{2}k_2) \\ k_4 &= g(t + \frac{h}{2}, x(t) + \frac{h}{2}k_3). \end{aligned}$$

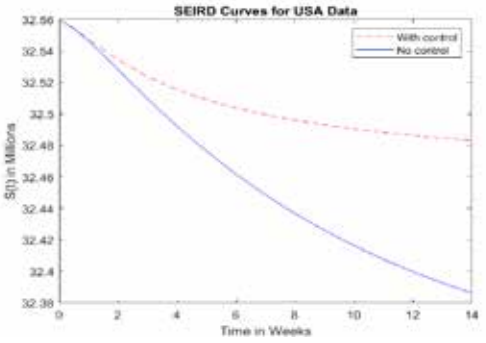
The initial conditions are the same as those used for our curve fitting and the initial guesses for the optimal controls are $q = 0$ and $z = 0$. The error for Runge-Kutta 4th is, as the name suggests, is $O(h^4)$. Additional information on the accuracy of this method can be found in numerous texts (Butcher, 1967; Butcher, 1966). In the numerical experiment we use $h = \frac{T - t_0}{M}$ where T is the final time, t_0 is the initial time, and $M = 1000$ is the total number of subintervals.

6 Discussion

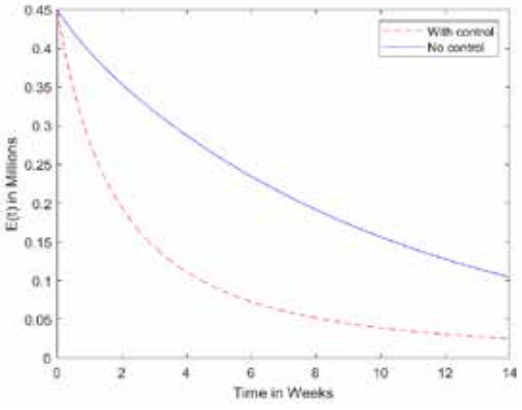
The *SEIRD* model constructed considers the model with and without quarantine and isolation as optimal controls. We use MATLAB to execute the forward-backward sweep on the optimal *SEIRD* model. The simulation results for the *SEIRD* curves given by [a]-[e] in *Figure 6* compares the trajectory of the disease as time progresses when a weight of $A = B = 0.5$ is applied on the optimal conditions $\bar{q}(t)$ and $\bar{z}(t)$. The solid and dashed lines represent the model without and with control, respectively. More specifically, the solid lines represent the model where no intervention method is applied to stop the

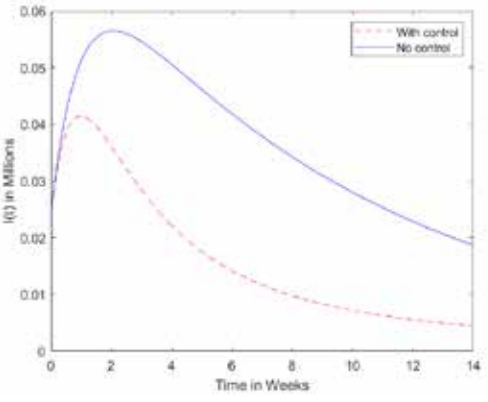
spread of the disease whereas the dashed lines represent the model with the condition that each of the compartments must consider $q(t)$ and $z(t)$ as intervention strategies. The behavior of the curves adheres to the same intuitive pattern we would expect in the real world. First, notice that the dashed curve for the susceptible class (*Figure 6 [a]*) decreases monotonically at a slower rate than its solid counterpart. This is due to the fact that more individuals become exposed to the virus in the *SEIRD* model without control than with control, so the solid curve will decrease faster as individuals are contracting the virus and becoming part of the exposed compartment at a faster pace. Also, notice that within the first week of exposure to the virus, there is no significant distinction between the curves of susceptible individuals with control and without control. This implies that the time spent in quarantine by the majority of susceptible individuals is approximately a week. Thus, it is expected for the susceptible population to begin to decrease after the first week as individuals are assumed to move automatically to the recovered compartment after being in quarantine, isolation, or both.

The remaining of the curves also coincide with the data. First, notice that from our system of equations, the portion of individuals being quarantined are extracted from the exposed compartment. Thus, the curve for the exposed population (*Figure 6, [b]*) decreases abruptly as it is directly linked to the portion of quarantined individuals in the subject. The infected curve (*Figure 6 [c]*) shows that between weeks 0 to 1.5 the rate at which individuals contract the disease increased. This correlates with what is expected since in the early stages there is a greater portion of susceptible individuals that are not immune to the disease. Similarly, the curve for the recovered population (*Figure 6, [d]*) and death population (*Figure 6, [e]*) is consistent with what is predicted since the use of quarantine and isolation results in fewer fatalities since less individuals are becoming infected in the first place.

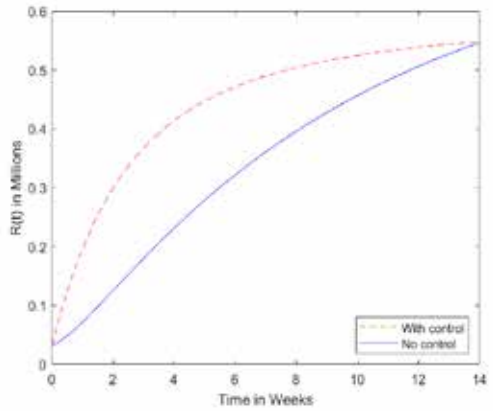


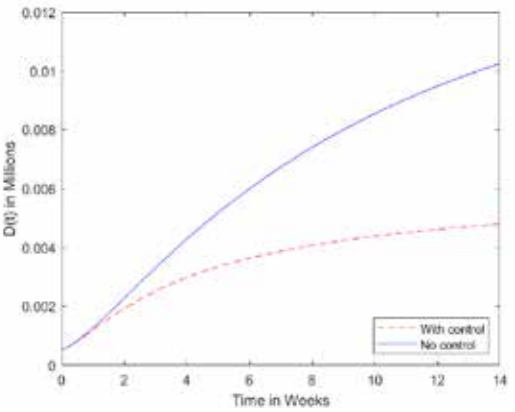
[a]





[b][c]

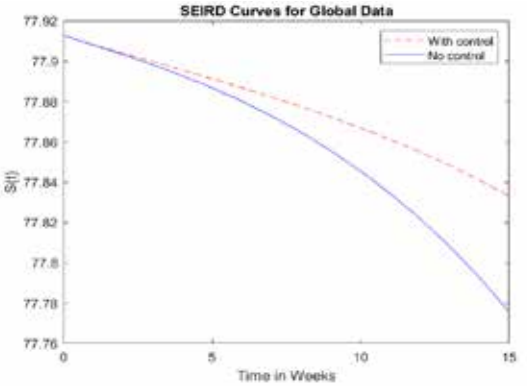




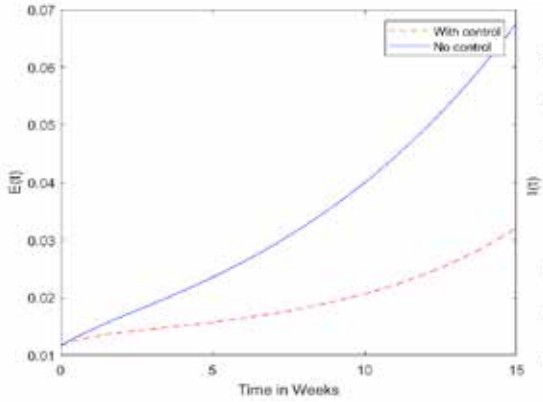
[d][e]

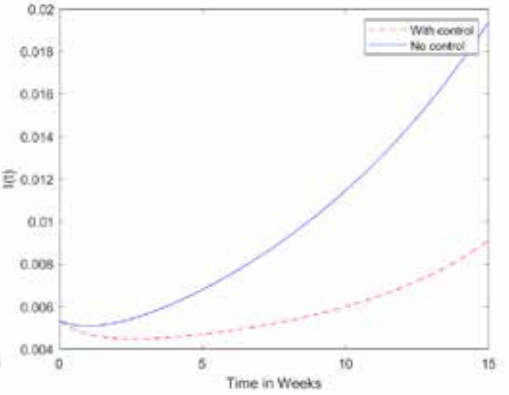
Figure 6: The five plots display each of the curves for the SEIRD model in millions for the USA data. The solid curves are the disease running its course through the population. The dashed curves display the effects of quarantine and isolation on containing the spread of the disease. The initial conditions are as follow: N = 330660000, S_0 = 325595940, E_0 = 4497300, I_0 = 242694, R_0 = 318920, D_0 = 5146, with A = 0.5, and B = 0.5

The following curves for the optimal *SEIRD* model using world data (*Figure 7*) yield a similar result.

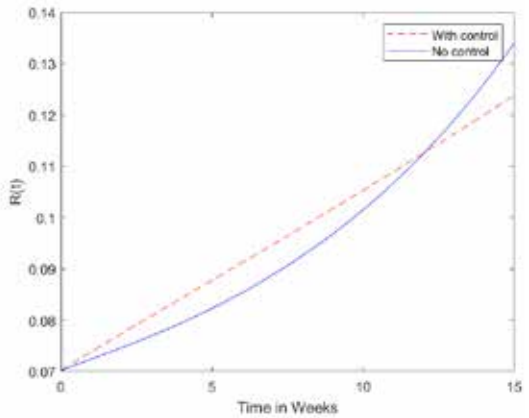


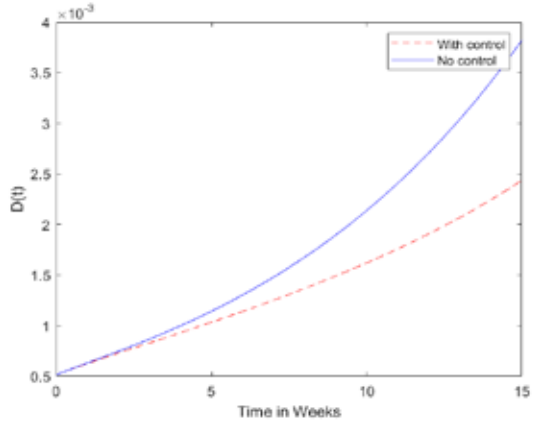
[a]





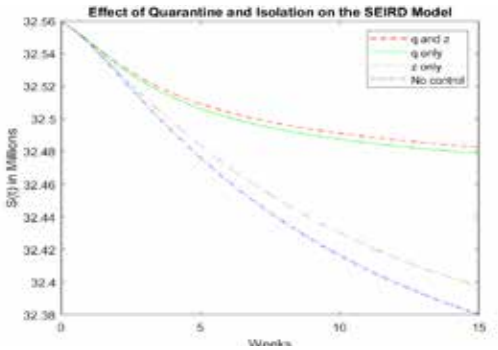
[b][c]



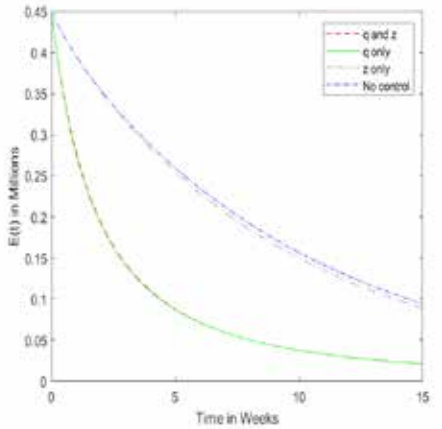


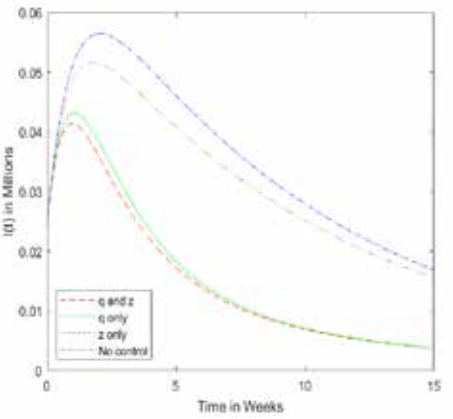
[d][e]

Figure 7: The five plots display each of the curves for the SEIRD model in 100 million. The solid curves are the disease running its course through the population. The dashed curves display the effects of quarantine and isolation on containing the spread of the disease. The initial conditions are as follow:N = 7800000000, S_0 = 7791272494, E_0 = 1171224, I_0 = 533134, R_0 = 7023148, and D_0 = 51585, with A = 0.5, and B = 0.5

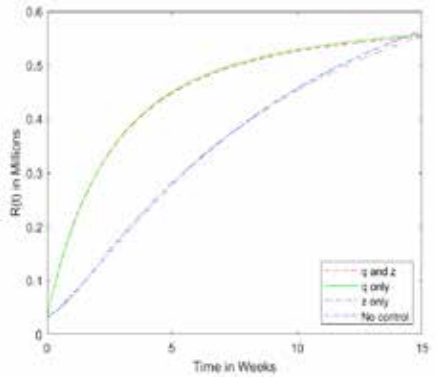


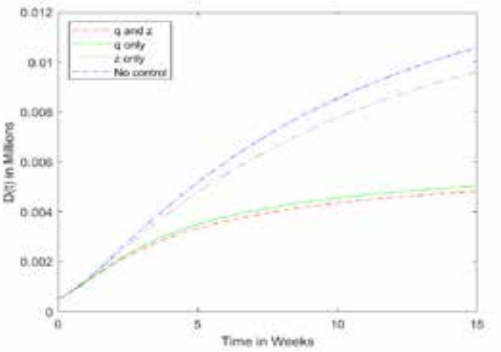
[a]





[b][c]





[d][e]

Figure 8: The five plots display each of the curves for the SEIRD model in millions for the USA data with no control, with q and z independently, and both q and z simultaneously. The initial conditions are as follow: N = 330660000, S_0 = 325595940, E_0 = 4497300, I_0 = 242694, R_0 = 318920, D_0 = 5146, A = 0.5, and B = 0.5

Next, we examine the effect of quarantine and isolation separately using USA data. The plot of *Figure 8* considers the curves for each of the compartments when quarantine and isolation are examined separately as control strategies. First, from *Figure 8 [a]-[b]* we notice an eye-catching pattern. Notice that the curve for the model with both control (red dashed curve) and the curve with only quarantine as a control (green solid curve) have very similar trajectories. This phenomenon is also present between the curve without control (blue dotted-dashed curve) and the curve with only isolation as a control (black dotted curve). This could be because quarantine has a greater impact than isolation on stopping the spread of the disease. This is pivotal because it shows that quarantine must be prioritized when it comes to implementing early intervention strategies to control the disease. Also, notice that as the value of A and B grow in size, the curves will get closer to each other. As a result, based on the curves we determined that preventive methods such as quarantine and isolation, in particular quarantine, are key in order to stop the spread of COVID-19.

As previously mentioned, one of the main goals of this study was to determine how effective quarantine and isolation are at controlling the spread of COVID-19. To archive this, the optimal conditions for quarantine and isolation were determined through an optimal control approach using real data. However, the *SEIRD* system is extremely sensitive to the initial conditions and initial guesses of the parameters; slight deviations can lead to completely different outcomes. Thus, we take a closer look at the parameters and variables to validate our model. The goal is to decide qualitatively how much influence the quarantine rate and isolation rate have in the model's output (Martcheva, 2015). From *Figures 6* and *7*, it is evident that introducing an optimal control is an effective preventive measure in the population. However, when fitting the model to our data, the estimated fitted parameters vary drastically depending on the scaling of the initial guesses for our parameters, the initial conditions, and the data set. Recall that the fitted value for μ is $\mu = 0.97796$ for the USA data and $\mu = 0.43108$ for the world data. The difference in recovery rates relies on the idea that COVID-19 was more fatal globally than locally in the USA. Also, we focus on the rates of the optimal controls, $\bar{q}(t)$ and $\bar{z}(t)$ when the value of A and B ranges from 0.1 to 0.5 (*Figure 9*). Notice that as the weight of A and B increase, the weight of $\bar{q}$and $\bar{z}$decrease. From this, we can conclude that when the value of A and B becomes sufficiently large, the values of $\bar{q}$and $\bar{z}$become ineligible. Hence, it is safe to conclude that the values of A and B are sensitive constants since the rate at which exposed individuals are being quarantined and the rate at which infected individuals are being isolated are directly related to the values of A and B.

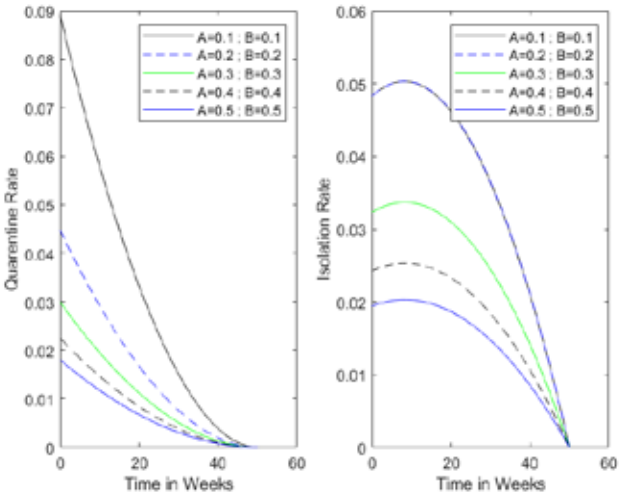


Figure 9: The graph displays the time in weeks vs the quarantine rate (left) and isolation rate (right) for the USA. The values for A and B range between 0.1 and 0.5 with a 0.1 increase.

In addition, notice that over a time interval of sixty weeks, the quarantine rate decreases in an exponential decay. More importantly, observe that approximately, during the first fifty weeks, the quarantine rate decreases entirely. This could imply that as more individuals are being quarantined over time, the more people will recover and gain immunity in the long run. Furthermore, notice an interesting pattern present in the curves given by the isolation rate. We observe that the isolation rate increases for approximately the first ten weeks and then decreases. Thus, we see that the isolation rate behaves similar to the curves of the infected population given in *Figure 6 [c]*. This could be because as the infected population increases, the isolation rate also increases to fight the disease. In general, the fact that the quarantine and isolation rate is zero after fifty weeks of being introduced as controls implies that after fifty weeks (or about a year) we can expect quarantine and isolation to no longer be necessary. This is critical information because it provides insight on the portion of individuals that should be quarantined and isolated in order to stop the spread of the disease in the desired time interval.

7 Conclusion

In this paper we implement the proposed control approach in the COVID-19 *SEIRD* model with real data collected from WHO (World Health Organization, n.d.). The region from which the data was collected was for the United States and the world. The use of numerical and analytical methods was used to quantify and interpret the dynamics by which COVID-19 spreads. To measure the transmission potential of COVID-19, the basic reproductive number was calculated and determined to be $R_0 > 1$ for both the USA and world data. We conclude that the *SEIRD* system is locally unstable at the disease-free equilibrium. The curves for the control provide critical and useful information

that indicates that COVID-19 will continue to spread if no further action is taken by health officials.

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