

reach

Inspiring Creativity, Discovery,
and Innovation

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**Areyzaga
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**The Emotional Experiences of Latino Men That Motivate
Academic Goal Pursuit**

Abstract

The focus of this study is to investigate the emotional experiences of Latino men that motivate academic goal pursuit. This research is to better understand the cultural and emotional factors that have aided Latino men in their academic pursuit to assist others in similar situations. There are 3 research questions: 1) How does Latino culture impact how Latino men deal with emotional experiences? 2) How do Latino men use these emotional experiences as academic motivation? 3) What are the most prevalent emotional experiences that academically motivate Latino men? Participants will be recruited through the university by using SONA, club discord, and snowballing. 10 participants will be recruited who self-identify as Latino men and university students. Semi-structured interviews will be conducted in person and on Zoom. The interviews will be transcribed and analyzed by a research team. Participants will also be given the opportunity to approve the transcripts. The transcripts will be analyzed using interpretive phenomenological analysis (IPA) to identify themes. IPA is used to analyze qualitative methods with an interest in the psychological aspect of how people make sense of experience (Larkin & Thompson, 2012). These questions are geared toward understanding a specific group of people and their circumstances. Awareness to this study can bring Latino men the opportunities and resources to thrive and succeed in an educational environment. Clinical implications can use this research to further investigate emotional experiences within the Latino male community. This qualitative study uses interpretive phenomenological analysis to investigate the emotional experiences of Latino men that motivate academic goal pursuit. Participants who self-identify as Latino men and are currently university students were recruited and given semi-structured interviews. Results will bring awareness to this study that can bring Latino men the opportunities and resources to thrive and succeed in an educational environment.

Intro

The main goal is to understand what emotional experiences motivate Latino men in academic goal pursuit so that we can bring awareness to how Latino men succeed in academics. Clinical implications can be done for understanding how Latino men deal with their emotions. The importance is to discover how Latino men use their emotional experiences so that more resources can be given to encourage these behaviors. In most articles, it seems inclusion and finding some sense of belonging within a college campus do increase motivation in academic goal pursuit. Aided by faculty and staff who are also Latino or are within a Latino club led to increases in academic achievement (Cerezo, 2013). Other factors included succeeding in college for their parents. Being motivated by the sacrifices their parents gave for them is a motivator for Latino men in academia (Ballysingh, 2021). Thoughts along the lines of I will succeed in college to buy my parents a car or a house are common answers for intrinsic motivation for Latinos. Other motivational aspects are wanting to be supportive of others after being mistreated or having low expectations set on them since they are Latino men. Countering the narrative as well serves as a motivation for those Latinos who were told they would not succeed in their field or are one of the first in

their demographics to try (Burmicky, 2022). Financial security and responsibilities are major barriers for most Latino men in academia.

Furthermore, there are other barriers that impact Latino men in the mental health field. One of these barriers is the stigma of mental health being for the weak or not real. Latinas are more likely to be open to receiving mental health support than Latinos (Ishikawa, 2010). Growing up in a Latino culture encourages working hard and making no excuses (Rodriguez, 2021). Most Latino males grow up providing for their families and putting them before their own wants and needs. Combining this with growing up as a male where masculine norms encourage being independent, strong, and stoic leads to a mix that does not align with current thoughts on mental health. Looking into alternative methods of mental health support that align with the perspective of Latino males in hopes of incorporating a means to give them support (Ponjuan, 2012). Methods such as looking at how understanding family members and being able to connect with them can line up with the motivations of Latino men (Trevino, 2014). Latino culture has a major emphasis on family and using that as a sort of motivator could potentially get results in the mental health field. The two hypotheses are that Latino men will be motivated by their experiences of love for their family or spite for those who doubted them.

Methods and Design

Participants will be recruited through the university by using SONA, club discord, and snowballing. 10 participants will be recruited who self-identify as Latino men and university students. Semi-structured interviews will be conducted in person or on Zoom. The interviews will be transcribed and analyzed by a research team. Participants will also be given the opportunity to approve the transcripts. There will be about 6 questions alongside some probing and demographic questions. Notes created during the interview will be collected and displayed.

Results (Lit Review/Research Question Thesis since no interview results)

Previous research further supports that Latino men are heavily motivated by their love for their families. Furthermore, research also shows that community support in higher education helps Latino men feel a sense of family on campus and can lead to a higher chance of academic success. Meanwhile, on the other hand, the second hypothesis is that Latino males would be motivated toward academic goal pursuit because they have been doubted to have the ability to do so. There has been an intrinsic motivation for the want to have Latinos in higher paying jobs and spots in academia because of stereotypes of that not being the case. Academia still has lower levels of Latinos in higher education and succeeding in of spite that fact is a motivator for some.

Discussion

Motivation comes from all sorts of different emotions while anger and love can be strong emotions to promote either. Looking into the research shows connections between community and family being motivators academically so resources could be put into more clubs or communities. Having a more inclusive and helpful campus could help promote

academic goal pursuit based on previous experiences of Latino Males. Furthermore, gearing these programs to focus on connections rather than a particular subject or career in order to build bonds that are similar to families. Creating these sorts of connections with the campus could have a significant impact on Latino Males in academia as a whole. Furthermore, this could have clinical implications for Latino Males as well since it could look into how to build a plan that gears mental health toward Latino men. Perhaps having a group conversation among multiple Latino Males and health professionals can lead to more openness to mental health support while simultaneously destigmatizing mental health in Latino culture. This could also be a place to look into the feeling of succeeding out of spite and gaining an understanding to bring awareness that Latino males are not alone in this feeling. Using spite as fuel could be helpful, but it is important in how it used as motivation in academic goal pursuit that is important. For future research using interviews to get more in-depth answers on these motivations and emotions could help promote a better understanding. Surveys based on the interview questions could then reach a much larger population to see if the answers properly represent the community.

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**Bates
Addison***

**Project Title: The Effects of Texting, Tweeting, and Internet Slang
on Academic Literacy**

**Dr. Anita
Jain**

Abstract

This study aims to explore the intersection between leftist ideology and parenting styles, with a focus on feminist parenting. Drawing from feminist theory and personal narratives, this research seeks to identify methods for resisting harmful societal norms and imparting healing to children. The literature review consists of four key texts: *Living a Feminist Life* by Sarah Ahmed, *Heartberries* by Terese Marie Mailhot, and *Feminisms in Motion* edited by Jessica Hoffman and Daria Yudacufski. These texts provide a foundation for the study's approach, offering insights into how societal oppression is produced by the family, personal experiences of integrating leftist ideology into parenting, diverse perspectives on intersectional feminism, and a big-picture perspective on democracy and liberation. The study employs a qualitative research design, utilizing semi-structured interviews with participants who self-identify as feminist parents. The analysis will be guided by Ahmed's concept of "sweaty concepts," which emphasizes the importance of incorporating personal experiences and emotions in academic research. The study's findings will contribute to the emerging field of feminist parenting, offering practical methods for parents to integrate broad ideologies into their parenting style. Additionally, this research aims to expand on the intentions of *Feminisms in Motion*, providing a more comprehensive archive of perspectives on the topic of intersectional feminism with specific regard to parenting. Overall, this study hopes to provide a better understanding of how parenting styles are deeply connected to our society's political landscape and offer guidance to parents seeking to resist harmful societal norms and impart healing to their children.

Introduction

My first immersive experience with a child was with my nibling, Teagan. I lived with Teagan, my sister, and brother-in-law from when Teagan was one month to four months old. During this time, I was surprised by how much this baby was teaching me. Teagan taught me how to bounce her, sing to her, and love her. Contrary to the idea that adults are powerful, Teagan highlighted where I was powerless.

Now, as an aunt of six children, Keene, Holland, Jora, Silas, Harper and of course, Teagan, I continue to be challenged and humbled by the unique insights and perspectives that children offer. My five years of professional experience with children have humbled me and inspired me to recognize and address my limitations with humility. Given that humility has been a major theme in my learning to be an aunty and a mentor, I question the common approach of asserting authority onto children. I suspect this approach may prevent us from truly understanding and connecting with the children in our lives. By prioritizing control and discipline, we risk overlooking the unique insights and perspectives that children can offer, and miss out on the opportunity to build meaningful, trusting relationships with them.

Understanding effective ways of healing our relationships with children is my top priority, as I believe it is crucial to societal healing. I intend to participate in societal healing from this angle by becoming a part of an in-patient healing retreat center for black youth impacted by intersecting forms of oppression. As a member of this organization, I will need to have a deep understanding of theoretical and practical approaches to working with children in a way that promotes human regeneration.

As such, the topic of my research is the parenting strategies and philosophies used by feminists. Using feminist standpoint theory, critical race theory, and disability justice as my theoretical frameworks, I gathered a collection of ways that feminist social and political analysis can be applied to parenting. By documenting these explorations with my participants, I hope their contributions and my analysis can act as a guide for understanding some of the practices of and beliefs that inform feminist parenting.

This collection of interviews addresses two key questions that are important to building this understanding. Firstly, for my primary research question, I will explore how feminist parents apply their political values to their beliefs around raising children, detailing how their experiences offer insights into clear alternatives. Then, my secondary research question will be what values and experiences inform the perspectives of these feminist parents? By exploring the context from which these participants are situated, I hope to build more entry points for a wider variety of readers.

I hope that my findings inspire healing in our society's relationship with children and childhood. For folks who feel dissonance between their wider social values and their relationship with children, I hope that my research helps guide them in discovering more integration. And on the children's side, I hope that this work has the potential to impact children's lives by helping them recognize and claim their human rights. By highlighting successful alternatives to traditional parenting practices, I hope to help guide folks in healing their relationship with childhood, and in doing so, contribute to the promotion of human regeneration.

In conclusion, my research on feminist parenting seeks to contribute to a broader archive of feminist thought, specifically that of Sarah Ahmed, Terese Marie Mailhot, Audre Lorde, Bell Hooks and Maya Angelou. I share the goal of challenging oppressive systems and creating spaces for individuals to exist and thrive authentically.

Literature Review

Sarah Ahmed's *Living a Feminist Life* provided an intersectional feminist investigation into how societal oppression is produced by the family and offers a means of breaking away from oppressive norms. This text helps to give background to my study's approach. My study operates on the understanding that parenting styles are deeply connected to our society's political landscape, and *Living a Feminist Life* vividly describes how this can happen, as well as a recourse for shifting away from toxic norms. My study builds from this and illustrates explicit methods for feminist parenting. Furthermore, an idea that informed my research intentions, content, and framework is this idea of "Sweaty Concepts" coined by Sara Ahmed in this text, Sweaty Concepts are concepts that come out of the effort to

transform (Ahmed 13). Our society encourages us to cover up sweat, to hide sweat, it is gross, it is shameful, nothing should be that hard, but Sara Ahmed says that there is certain wisdom that comes out of the messy, grimey, gritty urge to transform. This wisdom is central in my research. My participants' accounts detail their raw determination to center their values in their actions. These "sweaty" accounts are academic contributions.

Terese Marie Mailhot's *Heartberries* is a memoir that covers her experience as a First Nations woman within academia, her family, and society overall. Her story is filled with pain, chaos, and shattering. She quite literally shattered her whole kitchen. In particular, the second section of the book speaks to the violence that Mailhot has brought forth, as she shares intimate details of how she has hurt her child, Casey, and herself. The story is self-reflective and raw. She is honest about the shame she carries, the fears she carries, and toxic beliefs she reflexively carries. When read in the context of feminist theory, her story and reflection provides a personal expression of intimately applied feminist theory.

This memoir offers a detailed account of integrating leftist ideology into parenting. In *Heartberries*, the reader sees Mailhot attempting to unlearn oppressive and harmful beliefs that were given to her by society and her parents. She offers "sweaty concepts" that arise out of her fierce work to completely embody herself. My study took her memoir and used it as a reference point for how one may take on the work of integrating liberation-oriented ideology into parenting. In a way, through her memoir, Mailhot acted as my first participant. It is important to remember that *Heartberries* only shares the process of one individual, and there are many ways of approaching resisting harm and imparting healing as a parent.

Feminisms in Motion edited by Jessica Hoffman and Daria Yudacufski, offers a comprehensive archive of perspectives on the topic of intersectional feminism, as well as feminist critiques of feminist efforts. It provides a range of short texts such as interview transcripts, poems, short stories, and essays that have to do with intersectional feminism. Some pieces are directional and focused on expressing ideas related to how to apply or understand feminism, while others are narratives that embody feminist theory. Overall, the project of "Feminisms in Motion" is to give a comprehensive archive of perspectives on the topic of intersectional feminism. This text brought me inspiration for the form and purpose of my research. However, where *Feminisms in Motion* offers the reader an archive of feminist thoughts and interventions, my research expands this archive with specific attention to the perspective of the parent.

Additionally, my study used *Feminisms In Motion* as a sort of encyclopedia when exploring the diverse contributions of participants. This text includes an incredible variety of life experiences as both the sources of perspectives and the playgrounds for these perspectives.

Theoretical Frameworks

The theoretical framework I used were feminist standpoint theory, critical race theory, and disability justice.

First, feminist standpoint theory affirmed the form and intentions of my research. Feminist standpoint theory recognizes that representing divergent social realities is essential for creating a more accurate and thorough social portrait, "Rejecting the notion of a single, objective truth, standpoint theorists instead posit that a multiplicity of divergent social realities create a more thorough and accurate portrait of social reality than that which is endorsed by dominant cultural narratives" (Harding, 1986). In this way, my research seeks to archive divergent social realities, reject the idea of a single truth and acts in hope for a more accurate portrait of social reality.

Additionally, this theoretical framework acted as a sort of library that I understood my research as expanding on. The perspectives I gathered through interviews of folks who practiced some kind of self-defined feminist parenting were meant to help represent more divergent parenting styles and thus, help create a more realistic representation of parenting styles used in this country in this time.

As such, my approach was non-comparative, and prioritized understanding each collaborator's perspective, rather than analyzing its efficacy, merit or lack thereof. The in-depth representation of each collaborator was the pinnacle value of this research. By centering clear representation, rather than attempting to situate these experiences within a broader network of perspectives, this research can ultimately contribute to a more nuanced and thorough understanding of feminist parenting.

The second theoretical framework I used was critical race theory. In the article, "Images and Words that Wound: Critical Race Theory, Racial Stereotyping and Teacher Education," Daniel G. Solorzano explains that Critical race theory has five themes that inform it as a framework, "1. The Centrality and Intersectionality of Race and Racism...2. The Challenge to Dominant Ideology...3. The Commitment to Social Justice...4. The Centrality of Experiential Knowledge...5. The Interdisciplinary Perspective"(Solorzano 6-7). Critical Race Theory informed my research in that my research aims to challenge dominant ideology, embodies a commitment to social justice, and centers experiential knowledge. My research implicitly challenges dominant ideology by detailing a divergent social reality, it embodies a commitment to social justice in that it focuses on the application of a social justice ideology, and it centers experiential knowledge in that my participants' contributions are the academic backbone of my project.

Finally, the last theoretical framework I used was Disability Justice. Disability Justice uplifts the inherent ways in which we live in relation to one another. Our society inherently relies on one another, and our intentional coordination with one another was central in my personal beliefs that informed my desire to do this research. In specific, as Lydia X. Z. Brown explains in the panel "Intersectionality for Beginners" at Women of the World Festival 2017, "Disability Justice calls us not just to acknowledge somebody's existence, but to work to create activist communities and movements that fight isolation, that recognize isolation as a form of abuse and violence, that recognize that honoring the whole humanity of everyone is indispensable and is vital." Holding space for parents to describe their experiences in an effort to weave broader connection and healing inherently disrupts the implied isolation of parenting and the nuclear family, and instead thrusts this experience into a network of care. Furthermore, I hold this space in belief that the children of these parents also deserve their

whole humanity to be recognized as indispensable and vital. Interdependence underscores that our authentic and intentional relationships with one another are vital to our safety and healing as a society. With interdependence as a goal, my research attempts to build more bridges to the more private spheres of our society and our lives.

Methods

A semi-structured interview approach was used to gather first-person accounts of feminist parenting. Feminist standpoint theory and "sweaty concepts," both emphasized the importance of personal knowledge, and as such, the research operated with the same emphasis.

Interviews were held with 10 collaborators to explore their values, parenting styles, stories, advice, struggles, hopes, inspirations, and pride. For each interview, a set list of questions was asked, but depending on their answers, follow-up questions were asked in the moment to optimize clarity and accuracy of representation.

To provide context and authenticity to the findings, pre-existing literature within the Gender, Ethnicity, and Multicultural Studies discipline was explored. This literature informed the perspective, questions used in the interviews, and the collaborators' perspectives. As the responses were analyzed, the relationship between the responses and other literature within the discipline was explored, which helped to elevate the kind of social divergence represented and the norms from which they diverge.

The questions that were asked during the interviews fell within four sections and were as follows;

Values and Political Leaning

1. What movements, politics and/or values do you align yourself with?
2. How did your values, political beliefs and involvement develop to what they are today?
3. How do your politics relate to children? Are there problems children face that your political beliefs relate to?

Personal Parenting Experience

1. What has been hard about being a parent? Rewarding?
2. What do you think helps keep you grounded as a parent? What helps you grow as a parent?
3. How and when do you expose children to the painful realities of societal oppressions?

4. Can you tell me a story of a moment that makes you proud of the relationship you have with your kids? You could also tell me a story that makes you proud of your kid or of yourself?

5. Can you tell me a story of when your child taught you something?

6. What surprised you most about being a parent?

7. What is your parenting philosophy?

Understanding Kids

1. What do you think is hardest about being a kid? What do you think is the best part of being a kid?

2. What does abolition or liberation mean in the context of building relationships with kids?

Parenting Tips

1. If you could give advice to other parents, what advice might you give them?

2. What do you consider to be a healing way of interacting with parents who are or who have chronically harmed their children?

After each interview, I wrote reflections of my initial response to the interviews and the themes that I saw arise in the collaborators' responses. I kept a recording of each interview as well as a transcription created by online software.

Findings

Theme #1: Respecting Children's Autonomy

"Poisonous pedagogy has its roots in the ruling of people, as well as the domination of children. We know after all that the enslaved and the colonized were positioned as children, as those for whom discipline was moral instruction, who were not supposed to have a will of their own; who must be willing to obey." - Sarah Ahmed, *Living a Feminist Life*

The first way in which we are taught to accept the oppression of an entire class of people, simply because they are in that class of people, is during our time as children. One of the first lessons many of us learn is that our perspective will be understood as inferior. What is superior is the perspective of the adult. And because of that, we must do what we are told, we must take what we are given, and we must conform to what is expected of us. If we do not adhere to these standards, punishment often follows. This system that many of us are held hostage in is taught to us to be acceptable because dominant ideology says that the adult has ownership over the child. One of the child's first lessons is that it is normal for an entire class of people to be dehumanized.

Challenging dominant ideology, in the spirit of Critical Race Theory, my research collaborators saw respecting the autonomy of children as a priority in their parenting, especially within the context of how respecting their child's autonomy would impact their child within broader societal norms of oppression. One of my participants, Crystal Byrd Farmer, a black engineer turned educator, organizer, and consultant from Gastonia, NC, explained this priority saying, "My idea of supporting the marginalized and anti-oppression extends to children in a way that a lot of other people don't think about it... It is important to me that children are able to make choices and speak for themselves". To facilitate this for her child, Farmer affirms that her child has the right to say no to her, that her child does not have to pretend to be happy, and that she will do her best to honor her child's preferences.

All the other collaborators echoed similar sentiments, Collaborator 1 explained that children have wisdom and that it is not our responsibility to tame them but to understand them. Feminist Standpoint Theory would agree in that the divergent social reality is necessary for a more accurate portrayal of social reality. Furthermore, by holding space for their children to be authentic, my collaborators teach their children that their most authentic selves can be loved, cared for, and respected. Later on in our interview, Collaborator 1 went on to explain how this parenting strategy supports children throughout their lives, "Children need to learn what freedom is so they can notice when it's being taken away from them".

Theme #2: Interdependence

"I no longer buy into the autonomous self... Individualism is a myth, no less dangerous than manifest destiny; we are unfinished beings who shape-shift and change with new relationships and experiences. And I, for one, feel more powerful in partiality; I am broken, laid bare, by the intensity of feelings I have for my children, and yet I have never felt so capable, so connected." - Andrea Richards, *Feminisms in Motion*

Similar to the philosophies central to Octavia Butler's *Parable of the Sewer*, we are inherently constantly impacted by and impacting the world around us. Again, pulling from Feminist Standpoint Theory, remembering this relationship constant, remembering our interdependence offers us more opportunity to more effectively engage with our reality.

My collaborators all shared a practice of seeing the inherent interdependence of people, but also decidedly engaged with this reality in ways that valued Critical Race Theory's theme of commitment to social justice. They all felt commitment to those around them, in the personal and the political, and all deeply considered the broader impacts of their personal choices.

One of the ways, Collaborator 3 explained that their political values relate to children is in considering the question "How can you be a good person for the people in your life, especially your children". An important value of this collaborator is considering how to be a good person, with specific attention to what being a good person means to the people in your life. This same collaborator offered specifics on how their relationship with their children embodies this interdependence-based intentionality.

“I think the more responsible or caring people that my kids are exposed to the healthier they are. I can't provide everything for them. It's not healthy for me either.” And then, “My children guide me a lot, and my children need structure too, which I give them.” This collaborator described their experiences of parenting in such a way that situated them as just one point on a constellation of experiences. They reject the notion that the parent isolated unidirectionally provides everything to the child, and instead offer that their children provide too, and so do other people that their kids may be exposed to.

These contributions from Collaborator 3, and the others contribute to Disability Justice and Critical Race Theory in that they challenge isolation and describe it as unhealthy, they center interdependence, challenge dominant ideology and embody a commitment to social justice.

Theme #3: Embracing Challenge

“It only took four weeks for the symptoms to appear. I yelled at my son in a way I never had, for no reason. I had the sense to apologize...“You know that nobody, not even me, has the right to speak to you that way, no matter what you do?’ I started to cry. ‘I know, Mom,’ he said. He got himself a soda and sat with me on the couch in silence.” - Terese Marie Mailhot, Heart Berries

In reflecting on Heartberries, Inertia Wilder, a friend of mine said to me, “Mailhot challenges the idea of parental exceptionalism, this idea that the parent has a right to treat their kid however they want.”

In challenging this idea, Mailhot confronts her own mistakes. Embracing challenge in this way, Mailhot expands on Critical Race Theory by offering a personal intervention strategy for embodying a commitment to social justice in the personal sphere of parenting. She does this through storytelling which operates within the frameworks of Critical Race Theory and Feminist Standpoint Theory. While portraying this personal intervention, she also honors the rights of her child in the spirit of Disability Justice, despite her child being just that, a child.

In accordance with Mailhot, my collaborators reflected perspectives that they are intent on self-reflection, self-growth, and accountability to those around them, especially their children. This group of people shared a value in facing the realities of the world, even if doing so was challenging. Collaborator 3 explained her process saying, “[I try] to see things as they are even if they are not ideal. Like seeing that truth or dealing with the discomfort of a non-ideal relationship or scenario”. And Amy Tam, a first generation Chinese Ecuadorian Queer Non Binary wounded healer of color said, “I think parenting is the biggest accountability. You know you can't talk shit. You know you are either really about some shit or you're just talking shit...So you know it challenges you to show up and keep showing up. And for me, that's exciting”. Likewise, Collaborator 1 reflected on their limitations as a parent and their grounding practices such as self-care rituals, meditation and writing, and Crystal Byrd Farmer emphasized the importance of stepping back and considering how to change unhealthy patterns.

Returning to the notion of interdependence, Feminist Standpoint Theory and Critical Race Theory, this research finding of the ways in which feminist parents embrace challenge contributes to these frameworks in that it offers an embodiment of centering the experiential knowledge of the self while simultaneously being deeply engaged with how the self is in conversation with the other, especially the marginalized other.

Conclusion

I came to this research from a very personal desire to broaden my understanding of how to be my best self to the kids around me. I care so much for children, but simultaneously, there seems to be very few models in our society of engaging with children in restorative or even transformative ways that acknowledge the complex and important reality of the child's perspective. This research offered me the opportunity to meditate on intimate liberation through learning from radical healers in my community. These healers offered me wisdom that can only manifest from the messy, grimey, gritty urge to transform. They are committed trailblazers who have decided to hack away at paths less trodden in a belief of intimate and societal liberation. I am deeply grateful that my collaborators, all of which I did not know before this project, shared with me so many intimate and delicate truths of their experiences. Their vulnerability gave me a tremendous amount to meditate on, and I hope that I can honor their offerings by embodying all that I learned through this project and sharing their teachings with others.

I would love to spend more time on this research. I would love to share my findings with my collaborators and then do another round of interviews with them. It would be amazing to have the opportunity to expand my collaborator pool as well, and integrate more perspectives. Also, getting my collaborators together in a sort of round table would be especially exciting, as I am sure incredible teachings would arise from the convergence of all these mindful, passionate and dedicated folks. Finally, having the opportunity to interview the children of these folks, or other feminist parents would be a critical perspective to include in this research.

In conclusion, I am honored to have had the opportunity to learn from these folks and share some of the wisdom that I gathered. I recognize that my research is limited by the size of my pool, the time that I spent on my research, and finally the lack of perspective from the child. Still, the perspectives that I did gather are precious, and I hope to further honor them by making these findings even more accessible.

One way in which I hope to do that is by transforming some of the stories of my participants into a children's book that can be read and shared among kids themselves.

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Appendix

1.Quotes from collaborators regarding autonomy:

- a."My idea of supporting the marginalized and anti-oppression extends to children in a way that a lot of other people don't think about it. So it is important to me that children are able to make choices and speak for themselves. And sometimes defining ways to give them choices. Even when they may not know they have a choice. Or the traditional systems may not be set up to give them that choice."- Crystal Byrd Farmer
- b."We should appreciate the wisdom of children, not like children that we have to tame. But rather people that we have to understand."-1
- c."Children need to learn what freedom is so they can notice when it's being taken away from them" -1
- d."They're so present. They live in the moment. That's why their so joyous. That's what they teach us. " -1
- e."[My parenting philosophy] is very child guided while also having firm boundaries."-3
- f."Children aren't valued well in our culture."-3
- g."Kids aren't always respected, or seen as holding wisdom, or medicine, or that they equally contribute."-Amy Tam
- h."My children call me out all the time, "Are you being curious or are you making an assumption right now?"-Amy Tam

2.Quotes from collaborators regarding interdependence:

- a."What's hard is generational trauma. Even if you want to break cycles...it is not fair for me to tell you to stop doing something if we are not replacing that with something else. It is a fucking job to imagine everything you're going to be replacing. So that's why community is really important. Cause it's like, "Alright girl, how are we going to address this? You need

space to imagine."- Amy Tam

- b."How can you be a good person for the people in your life, especially your children"-3
- c."I think the more responsible or like caring people that my kids are exposed to the healthier they are. I can't provide everything for them. Its not healthy for me either."-3
- d."So for example, one of them says, "Share joy and vulnerability. Build meaningful connections." The other one I have says, "Noone is disposable." -Amy Tam
- e."I rarely have to sit down and say these are all the terrible things happening in this world. Cause we know these things happen because we're connected to what's going on in the world. "-Crystal Byrd Farmer
- f."A lot of parents don't know how to facilitate intimacy with their kids. "-Amy Tam
- g."Forgiveness is important. If we shame people, they're just going to shame themselves. Shame their children."-1

3.Quotes from collaborators regarding embracing challenge:

- a."[I try] to see things as they are even if they are not ideal. Like seeing that truth or dealing with the discomfort of a non-ideal relationship or scenario. We all struggle and are all trying our best. It is important for parents to be able to get the resources and support they need. See a friend, talk to a friend, and take care of your body. Go to therapy. So much of parenting is about modeling...Giving yourself permission to heal your inner child translates to kids feeling comfortable in themselves. They feel safe taking risks with you, so they feel safe taking risks by themselves. So, make sure to take care of yourself. It's very hard." -3
- b."I think it is a good time to not turn away from what's hard. You need to keep exploring what's hard for you and why. Be open. Be curious. There's a lot of meditation philosophy that's very helpful. Like turn into it, not away from it. That in itself is very brave."-3
- c."I think parenting is the biggest accountability. You know you can't talk shit. You know you are either really about some shit or you're just talking shit. You know it's all air. So you know it challenges you to show up and keep showing up. And for me, that's exciting. "-Amy Tam
- d."I think that the biggest thing is just stepping back and thinking what would you have wanted as a child. What are those things that you didn't get? Can you give those things to your child? Not in the sense of buying them all the toys that they want. But what about that love? And the attention? And the quality time that they needed? You know a gentle voice instead of being yelled at. You know those things, give them to your kid. You have to do that work in therapy. Figure out how I'm going to change patterns" -Crystal Byrd Farmer

Carrillo Sara **Effects of Omega-3 Fatty Acid Supplements and Probiotic Supplements on Selective Attention of Adults**

Abstract

The ability to pay attention is crucial for learning and social interactions. Omega-3 fatty acids (n3 FA) and probiotics play a role in neurodevelopment, neurofunction, and participate in the relationship between the brain and gut microbiome. Past studies measuring attention have not considered how stress experienced by a subject in a research setting may affect results. Therefore, this pilot study differed by having subjects meditate prior to measuring selective attention. The aim of this study was to use the Stroop effect to investigate the following relationships: 1) the relationship between probiotic supplements and selective attention; and 2) the relationship between omega-3 fatty acid supplements and selective attention in a sample of neurodiverse adult human subjects, ages 22 to 34 years old, at Cal Poly Pomona. This study was a randomized crossover design, utilizing two 5-week treatment periods (n-3 FA and probiotics supplements) with a 5-week wash-out period. At baseline and at the end of each treatment period, subjects completed the Scale of Positive and Negative Experience (SPANE) and a 10minute meditation, while wearing an ear sensor to measure emotional well-being and relaxation status (heart rate variability). Selective attention was measured using Stroop Color and Word test. General linear models were used to analyze the effect of both treatments on participants' Stroop effect and to compare the change in Stroop effect between Group 1 and Group 2 during each of the treatment periods. The Related Samples Wilcoxon Signed Rank test was used to analyze the change in Stroop effect from baseline to end of treatment for each treatment period. 17 participants were enrolled, but only 12 completed the study. Neither treatment showed a significant improvement in selective attention. However, we found that the change in average heart coherence may have had a significant effect on the change in Stroop effect outcomes for participants who received the probiotic treatment during the second treatment period. It may be likely that the probiotic treatment and slight increase in heart coherence may have worked together to impact Stroop effect outcomes. Therefore, it is important that future nutritional studies continue to embrace a more holistic lens or approach when designing a study. Research on how supplements affect cognitive functions like selective attention is lacking. If evidence is found to support that n-3 FA and probiotics may improve selective attention, it would further support the relationship between one's diet and cognitive function. This could also result in potentially benefitting those with learning disabilities in which selective attention is affected.

Introduction

Omega-3 fatty acids (n-3 FAs) and probiotics play a role in neurodevelopment and neurofunction. In recent literature, strong evidence has been found on probiotics' participation in the relationship between the brain and gut microbiome, referred to as the gut-brain axis.¹ Through this relationship, probiotics may have an influence on the synthesis of neurotransmitters (chemical messengers used by neurons to communicate with each other) and even on myelin formation in the prefrontal cortex of the brain, the region responsible for executive functioning and cognitive skills such as focus and attention.² N-3 FAs are used by the body to form the phospholipid bi-layer in cellular membranes,

resulting in a more fluid cell membrane for various types of cells, including neurons, the fundamental units in the brain and nervous system.³ Cell membrane fluidity is important because it affects many cellular functions, a cell's receptor binding sites, and how well the cell interacts with its surrounding cells.³ Neurons communicate with other neurons through electrical impulses and neurotransmitters, which is why the receptor binding sites of neurons are key in neurotransmission. Our brain activity is dependent on how well neurons communicate with each other. Therefore, cell membrane fluidity is important in neurons.⁴ Since attention and focus are cognitive functions that mainly take place in the brain's prefrontal cortex, n-3 FAs supplements or probiotic supplements might be able to influence an individual's attention span and focus.

Omega-3 Fatty Acids

Because our bodies do not contain the delta-12 and delta-15 desaturase enzymes to produce n3 FAs, n-3 FAs are considered an essential lipid that must be obtained from one's diet. There are 11 types of n-3 FAs, but the three most important are alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). Alpha-linolenic acid (ALA) is the most common type of n-3 FA. Plant-based foods like chia seeds, flaxseeds, hempseeds, walnuts, soybeans, kale, spinach, and canola oil contain high amounts of ALA. ALA does not have the same health benefits as DHA and EPA. DHA plays a functioning role in synaptic membranes, vision, neuroprotection, memory, and has anti-inflammatory properties as well.⁵ DHA and EPA are two types of n-3 FAs that are found in oily fish and seafood. Examples of foods containing high levels of EPA and DHA are salmon, herring, oysters, tuna (canned, white), sardines, and algae. Currently, there is only an Adequate Intake (AI) for ALA, which is 1.6 g/day for male adults, ages 19 years and older, and 1.1 g/day for female adults, ages 19 years and older. No AI or Recommended Dietary Allowance (RDA) has been set for EPA or DHA. However, based on the possible health benefits concluded by researchers, health professionals recommend that people consume two 4-ounce servings of seafood high in EPA and DHA every week.⁵ Depending on the seafood consumed, two 4-ounce servings of seafood every week contains approximately 0.5-2.8g EPA and 1.4-2.5g DHA.³ Studies have found that the American population is not consuming these recommended levels of EPA and DHA.⁵ In a 2019, researchers used data collected from 2003 to 2014 by the National Health and Nutrition Examination Survey (NHANES) to assess the dietary intake of n-3 FAs from both children and adults in the United States.⁵ This study found that most of the population consumes the omega-3 fatty recommendation as ALA, but consume very little of DHA and EPA.⁵ The researchers concluded that all subgroups in the United States population, based on age, gender, and pregnancy status, do not meet the recommended intakes of EPA and DHA.⁵ This is extremely concerning because we know how important and crucial EPA and DHA are in neurodevelopment, neurofunction, and neuroprotection. Individuals not meeting the recommended EPA and DHA intakes are at a high risk of adverse physical, mental, and emotional health outcomes. DHA supplementation has shown to cause an improvement in behaviors and cognitive function in neurodivergent individuals with attention deficit hyperactivity disorder (ADHD), Autism Spectrum Disorder (ASD), bipolar disorder, and schizophrenia.⁶ Several studies have been conducted to determine the effect of omega-3 fatty acids on populations with ADHD and ASD. In 2016, a study was conducted to compare the serum levels of n-3 FAs in neurodivergent children with ADHD and ASD to the serum levels of n-3 FAs in neurotypical

children.⁷ The results showed that neurodivergent children with ADHD and ASD had lower serum levels of n-3 FAs than the serum levels of n-3 FAs in neurotypical children.⁷ The researchers concluded that low serum levels of n-3 FAs may play a role in attention capacity, learning, and other cognitive functions in neurodivergent individuals.⁷ In 2019, a 12-week study showed that n-3 FA supplementation improved the attention span in youth diagnosed with ADHD.⁸ Other n-3 FA studies have been conducted in neurodivergent populations and have shown a positive effect in attention, behavior, and other symptoms.⁶ However, research on whether n-3 FA supplements improve an individual's attention span and focus is still lacking though and further research is required.

Probiotics

Probiotics are living microorganisms that are found in supplements or fermented foods such as kimchi, yogurt, kefir, sauerkraut, miso, tempeh, and kombucha. When consumed, these probiotics improve the health and diversity of the gut microbiome, also known as the gut flora or gut microbiota. The gut microbiota consists of all the living microorganisms, like bacteria and fungi, living in the intestinal tract. There currently is no RDA or AI for probiotics. However, several studies have shown that consuming probiotics may affect the brain. Research on the gut-brain axis and how it may influence an individual's neurofunction and neurodevelopment has been expanding over the last few decades. In a systematic review and meta-analysis of 18 studies (7 human studies and 11 animal studies), it was concluded that probiotic supplementation may have a positive effect on cognitive function.⁹ A randomized clinical trial study, published in November 2020, looked at the effect of probiotics on the cognitive health of a group of 145 older adults, ages 52-75.¹⁰ One group took a probiotic supplement containing *Lactobacillus rhamnosus*, while the other group took placebos.¹⁰ The cognitive test scores of both groups improved.¹⁰ While the group who took the probiotic supplement had a significantly higher increase of 23% in cognitive performance, the placebo group experienced only a 12.5% increase.¹⁰ Hence, this study concluded that probiotics may cause a significant improvement in cognitive health.¹⁰ Researchers speculate that there are three different ways that may explain the proposed mechanism of probiotics' influence on the brain: neurological, immune, and endocrine routes.¹ One of the possible mechanisms is the excitation of the vagus nerve caused by probiotics like the *Lactobacillus* species.¹ The vagus nerve, the longest cranial nerve, originates in the medulla oblongata of the brain and extends down the body to connect to the digestive system.¹¹ When the probiotics excite the vagal nerves, it results in positive effects and changes in depression, anxiety, learning, and memory.¹ Another possible effect of probiotics on neurofunction may be its role in increasing the synthesis of neurotransmitters—dopamine, norepinephrine, and acetylcholine—involved in attention span and focus. The myelin sheath formation of neurons may also be affected by probiotics. In a 2016 study, researchers found that mice exposed to environmental microbes had an upregulation in the activity of a specific gene related to myelin sheath formation in the prefrontal cortex region of the brain.¹² Myelin sheath is an insulating layer of tissue, surrounding the neuron's axon, composed of fat and proteins.¹² The myelin sheath acts as insulation, which helps electrical impulses travel more rapidly and efficiently through a neuron.¹² This results in a better transmission of electrical impulses and faster communication between neurons. Improvement in attention span and focus may result if neurotransmission is quicker and more efficient. Still, study findings remain inconsistent and

most studies on the effects of probiotics on cognitive function have been conducted on animal subjects.¹ Further research on the effects of probiotics on cognitive function like attention and focus in human subjects is needed.

Importance of this study

A study using n-3 FAs supplements and probiotic supplements as treatments, in a neurodiverse group of adults, to determine the effect on selective attention has not been conducted before. Additionally, past studies measuring selective attention have not considered how emotional wellbeing, negative emotions, and stress experienced by a subject in a research setting may affect the study results. Therefore, the present study's design takes this into consideration. This study differs from previous ones because the study design includes a relaxation technique: the practice of meditation. The study design also included measuring heart coherence and the SPANE questionnaire to assess negative emotions. Prior to subjects completing the tests to measure selective attention, participants completed a ten-minute meditation session. The goal of using meditation in this study is to ensure subjects will reach a relaxed status prior to testing and to maintain it during the testing. The purpose of this pilot study is to investigate if omega-3 fatty acid supplements or probiotic supplements improve adult selective attention in a neurodiverse adult population at California State Polytechnic University, Pomona (CPP). Investigating the effects of n-3 FAs and probiotic supplementation on selective attention may further support the relationship between an individual's diet and cognitive function.

Research Question

Do omega-3 fatty acid supplements and/or probiotic supplements improve an individual's selective attention?

Null hypothesis: The consumption of probiotic supplements and/or omega-3 fatty acid supplements have no significant effect on an individual's selective attention.

Alternative hypothesis: The consumption of probiotic supplements and/or omega-3 fatty acid supplements does have a significant effect on an individual's selective attention.

Major Objectives

- Compare Stroop Color & Word test results at end of first treatment period to baseline data #1 (conducted prior to start treatment 1) to determine if treatment 1 significantly improved selective attention
- Compare Stroop Color & Word test results at baseline data #2 (after washout period) to baseline data #1 to determine if washout period was effective.
- Compare Stroop Color & Word test results at end of second treatment period to baseline data #2 to determine if treatment 2 significantly improved selective attention
- Examine data of each individual subject to determine if an improvement in selective attention occurred during either or both treatment period(s)
- Compare results (individual and group) between the two supplements
- Evaluate data of sub-analysis groups by comparing and contrasting the following categories:

Gender	Age	Race/ethnicity	Average heart coherence and negative feelings	Diet
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Methods

On July 19, 2021, the study was approved by the Institutional Review Board (IRB) at California State Polytechnic University, Pomona under IRB Protocol Number: IRB-21-78 (see Appendix A). On September 3, 2021, an amendment to protocol was submitted to IRB to request approval for the virtual testing option for this study. This amendment was approved on September 16, 2021. On November 4, 2021, a second amendment to protocol was submitted to IRB to request approval for adding research assistants, requesting participant contact information, updating length of study from 18 weeks to 15 weeks, and narrowing dependent variable to a specific type of attention (selective attention). On November 22, 2021, the second amendment was approved. On January 11, 2022, a third amendment to protocol was submitted to IRB to request approval for financially compensating participants with a \$20 Amazon gift card at the end of study. On January 25, 2022, the third and final amendment to IRB protocol was approved.

Participants

Recruitment

This study recruited students, faculty, and staff at Cal Poly Pomona ages 18 years or older. Researchers expected to have about 50 students participating, depending on the response. In allowing for a 20% dropout rate, this would provide about 40 students total in our study, providing a power of about 80%. Recruitment was conducted via email through all the Colleges' research sites at Cal Poly Pomona. A recruitment email with an attached flyer and link to initial screening questionnaire was sent out to Cal Poly Pomona students, staff, and faculty to ask for their participation in the study. Individuals interested in participating in the study completed the initial screening questionnaire and emailed confirmation to the researchers. The consent form was then be sent to those interested to be completed, signed, and emailed back to the researchers. After receipt of the signed consent form and completed initial screening questionnaire, researchers determined if participant was eligible for study. If eligible, participant was invited to join the study. If participant did not meet the requirements, a thank you letter encouraging them to continue volunteering for studies was sent.

This is a convenience study and recruitment was not based on race, ethnicity, gender, or health status. Researchers expected the study to have a balanced sample, based on the diversity in Cal Poly Pomona.

Inclusion and Exclusion Criteria

Participants must be 18 years or older and a student, faculty, or staff at Cal Poly Pomona. The recruitment flyer and email sent to potential participants listed the following participation exclusion criteria:

- Have not been diagnosed with a gastrointestinal disorder
- No allergies to iodine, fish, seafood, and/or fish oil
- Not be colorblind
- Cannot be taking any anticoagulant or antiplatelet drugs (blood-thinning medications)
- Cannot be pregnant or breastfeeding

The initial screening questionnaire contained questions asking if the participant met any of the above exclusion criteria. If participant did meet any of the above exclusion criteria, they were instructed to not complete the initial screening questionnaire and were excluded from participating in this study.

Materials

Two supplements were used in this study for participants to consume.

- Treatment A was a probiotic supplement: HUM Gut Instinct. The treatment consisted of the subject consuming 1 vegan capsule containing 10 strains of probiotic bacteria [Lactobacillus acidophilus (UALa-01), Bifidobacterium lactis (UABla-12), Lactobacillus plantarum (UALp-05), Bifidobacterium longum (BL03 AF), Lactobacillus rhamnosus (Lr32), Streptococcus thermophilus (St-21), Lactobacillus paracasei (Lpc-37), Bifidobacterium breve (BR03 AF), Lactobacillus salivarius (Ls-33), Lactobacillus casei (Lc-11)] every day.
- Treatment B was a n-3 FA supplement: Nordic Naturals Ultimate Omega 2X, Lemon flavor. The treatment consisted of the subject consuming two soft gels, which contain 2150 mg of n-3 FAs (875 mg DHA, 1125 mg EPA, and 150 mg other n-3 FAs), per day.

Measures

The following tests and equipment were used or completed by the participants.

Ear pulse sensor

The product name is Inner Balance Coherence Sensor. This sensor weighs 25.5 grams and its dimensions are 82.55 x 53.9 x 15.87 mm. The ear sensor detects participant's pulse rate or heart rate through the ear lobe. The sensor uses Inner Balance technology to measure heart rate variability (HRV) and heart coherence to assess the status of the individual's emotional state. To help minimize stress and negative emotions as potential hidden influences on selective attention, these measurements were important so that we could check that participants reached a calm, emotionally stable, and mentally clear state, prior to being tested for selective attention. Subjects wore the Inner Balance sensor twice during each of the testing sessions: during the 10-minute meditation and then while they took the Stroop Color & Word test.

Scale of Positive and Negative Experience (SPANE)

SPANE is a questionnaire that was used to assess the subject's emotional wellbeing and negative emotions they may have felt during testing.¹³ The standard questionnaire consists of a list of 12 items (6 items are positive feelings and 6 items are negative feelings),

but for this study the questionnaire was modified to only ask participants the questions on the negative feelings.¹³ The subject was asked to report, from a scale of 1 to 5 (1 = Very slightly, 5 = Extremely), how much they were experiencing, at the moment, any of the following six feelings: negative, bad, unpleasant, sad, afraid, and angry. Each participant completed SPANE three times during each testing session: before starting the meditation, after completing the meditation, and after completing the Stroop Color & Word test. The total score was calculated by adding all the responses from each of the six items. The total score may range from 6 to 30 (6 = lowest negative feeling score, 30 = highest negative feeling score). The subject's emotional wellbeing, intensity of negative emotions, and level of relaxation were assessed using this total score.

Stroop Color and Word Test (SCWT)

Selective attention was measured by the SCWT, a neuropsychological test used to measure several executive functions including one's selective attention. SWCT was created in the 1930's by John Ridley Stroop, based on the Stroop effect, described as the increase in reaction time when doing a task that requires the simultaneous processing of information that is automatic and controlled.¹⁴ The test assesses an individual's ability to reduce cognitive interference from occurring when a specific stimulus conflicts with a simultaneous processing of another stimulus during a cognitive task.¹⁴ That is what selective attention is: when the brain selects a specific item or piece of information to focus on while it suppresses all other information that may be distracting in the environment. A computerized version of the test was obtained from an online toolkit called PsyToolkit.^{15,16} The test consisted of 40 trials or tasks that in total take about 2-5 mins for each participant to complete. For each trial, the name of a color appears on the screen (red, green, blue, yellow), but in different font colors. The participant must respond to the font color, and not the name of the color. Participants respond by pressing the "r," "g," "b," or "y" button on their keyboard (r = font color is red, g = font color is green, b = font color is blue, and y = font color is yellow). The trial or task is considered congruent when the font color and the name of the color displayed are the same. For example, the word "green" has a green font color. The trial or task is considered incongruent when the font color differs from the name of the color displayed. For example, the word "green" has a yellow font color. When completing an incongruent task, the participant must use selective attention processing which results in a delay in reaction time (known as the Stroop effect). By comparing the Stroop effect between each baseline and post-treatment from each treatment period, the Stroop test will show if an individual's selective attention has improved due to effect of the treatment that the participant consumed.

Procedures

Study Design



Figure 1. Proposed Study Design for the Probiotic and Omega-3 Fatty Acid Supplement Study for Participants Completing Testing Virtually*

Ear sensor = ■ Meditation = ■ SPANE = ■ SCWT = ■ A= Probiotic supplement = ■
 B= n-3 FA supplement = ■

**Virtual testing via Zoom

Each treatment period had (3) 24-hour dietary recalls for treatment compliance.

This study was a randomized crossover design, with two 5-week treatment periods that were separated by a 5-week washout period with no treatment (Figure 1). The experimental diets were consumed during two treatment periods and consisted of the subject's free-living diet, with the addition of a 2150 mg omega-3 fatty acid (875 mg DHA and 1125 mg EPA) supplement per day during one treatment period and the addition of a probiotic supplement per day during another treatment period. Initially, we had planned for participants to self-select whether they would like to complete testing in-person or virtually. However, due to the COVID-19 pandemic, many working remotely from home, and to ensure safety for all, we decided to only conduct virtual testing. A proposed study design was created in the event that testing was changed to an in-person setting (see Appendix B). Participants were randomly assigned to two groups: Group #1 who would be starting with Treatment A (probiotic) and Group #2 who would be starting with Treatment B (n-3 FA). Subjects were instructed to not make any changes to current physical activity level, neither increasing it nor decreasing it. Each treatment period included three 24hour dietary recalls for each participant to ensure compliance of study. Participant were not notified in advance when dietary recalls would be conducted. Dietary recalls were completed over the phone or Zoom video call. A unique Zoom meeting link was sent to each participant via email.

Before baseline testing occurred, all participants received the Inner Balance ear sensor, instructions to download the Inner Balance app, a 2.5-week supply of treatment, and a written reminder of the scheduled date and time for their baseline testing session via U.S. mail. Participants needed to download the Inner Balance app on to their phones before their baseline testing date. This free app stored heart coherence data and heart variability results from the ear pulse sensor. When the participant logged on to Zoom meeting on their baseline testing appointment date, they began the session by completing the SPANE questionnaire. Then, they were instructed to clip the ear sensor to their ear lobe and connect the sensor to the Inner Balance app via Bluetooth. Next, the participant listened to a 10 min meditation audio recording, created and guided by Dr. Alane Daugherty, while wearing the ear sensor. When the meditation was completed, they removed the ear sensor. Next, the participant completed the SPANE questionnaire again. After completing SPANE for the second time, the participant clipped the ear sensor to their ear lobe and connected the sensor to the Inner Balance app. While wearing the ear sensor, the participant took the Stroop Color & Word test. This test measured their reaction time in responding to incongruent and congruent tasks, which then calculated their Stroop effect. The Stroop Effect value would be used to assess the participant's selective attention. The ear sensor was removed once the Stroop test was completed. Lastly, the participant completed the SPANE for the third and final time. This concluded the baseline testing session. Since the treatment supply was mailed to participants a few days prior to baseline testing, they were instructed to take their treatment immediately after their baseline testing session ended.

Participants began the first 5-week treatment period. During the second week of the treatment period, another 2.5-week supply of the treatment was delivered to them. When the treatment period ended, participants met virtually via Zoom with a research team member for their end of treatment testing session. During this testing session, the same order of procedures described in the baseline testing were completed. After testing was completed, there was a 5-week washout period. Neither of the treatments were consumed by the participants during the washout. Once the washout period ended, subjects met virtually with one of our research team members for the second baseline testing period, before starting the second 5-week treatment period. Group #1 received Treatment B and Group #2 received Treatment A. At the end of the second treatment period, subjects met virtually via Zoom with one of our research team members for the final testing session, which consisted of the same procedures conducted in the previous testing sessions. The subjects completed the two treatment periods of the study randomly: experimental, washout, and experimental for a total of 15 weeks.

Statistical Analysis

The program that was utilized for data analysis is IBM SPSS Statistics 28.

Tables were created by compiling all data collected, mean, p-values, and +/- standard deviation. The data collected include:

- Results from SPANE questionnaires
 - Total SPANE scores for negative affect
- Results from Stroop Color and Word Test
 - Scores for incongruent, congruent, and Stroop effect (difference between incongruent and congruent)
- Results from Inner Balance app from using ear sensor
 - Average heart coherence
- Information on participant characteristics, diet, and lifestyle from screening questionnaire for sub analysis

A general linear model was used for analyzing the effect of the probiotic and n-3 FA supplements on Stroop effect. The covariants included in this general model linear were the change in average heart coherence for the first 5-week treatment period, the change in average heart coherence for the second 5-week treatment period, the change in total SPANE scores in the first 5-week treatment period, and the change in total SPANE scores in the second 5-week treatment period. Covariants were calculated as follows:

- Change in average heart coherence = (average heart coherence during Stroop test end of treatment) - (average heart coherence during Stroop test at baseline)
- Change in total SPANE score = (final total SPANE score after Stroop test at end of treatment) – (final total SPANE score after Stroop test at baseline)

A general linear model was used to also compare the change in Stroop effect between Group 1 (AB) and Group 2 (BA) during each of the 5-week treatment periods.

A non-parametrical statistical test, called the Related Samples Wilcoxon Signed Rank test, was used to analyze the change in Stroop effect from baseline to end of treatment for each 5-week treatment period.

Potential Risks

Possible Adverse Effects

Subjects may have possibly experienced the following adverse effects from taking the omega-3 supplements: fish-like aftertaste belching, stomach upset, diarrhea, heartburn, abdominal pain, and/or nausea. Subjects may have possibly experienced the following adverse effects from taking the probiotic supplements: digestive symptoms like gas, bloating, and/or diarrhea. Every Monday, the researchers checked in on the subjects on a weekly basis via email or text message

(depending on subject’s preference). The email or text message asked the subject how they were feeling and if they were experiencing any side effects. Subjects were instructed to contact their primary care physician or the Cal Poly Pomona Student and Wellness Services immediately if they did not feel sick and/or did not feel well. Subjects were then instructed to notify the researchers as soon as possible. Subjects were asked if they wish to continue participating in this study. If any subject experienced any adverse effects to the treatments in this study, an adverse effect form would be completed by the researchers and submitted to the IRB Compliance Office.

Anonymity and Confidentiality

Personal information was collected from subjects. Any information that was obtained in connection with this study—and that can be identified with the subject—will remain private and will be disclosed only with the subject’s permission or as required by law. The identity of a subject will be kept strictly confidential by removing their name and all identifiers. All information will be de-identified and provided a subject number/code before data is analyzed. Once study is completed, all interview materials will be destroyed. The de-identified data collected during this study will not be shared with other researchers in the future without further consent obtained from the subject.

Results

Recruitment and Flow of Participants throughout Study

A total of 92 individuals expressed interest in being study participants by completing the screening questionnaire. Of these 92 individuals, 51 were excluded due to being outside the age range for this study. To be included in this study, participants had to be between the ages of 22 and 34 years. 41 individuals were eligible for the study, but 24 of these individuals were no longer interested and withdrew. A total of 75 screened individuals were excluded which led to 17 enrolled participants (see Figure 2).

Participants were then randomized into two groups: Group 1 (AB) and Group 2 (BA). 9 participants were randomly selected for the AB treatment group and 8 were randomly selected for the BA group. The AB treatment group received the probiotic treatment during the first 5-week treatment period and then the n-3 FA treatment during the second treatment period. The BA treatment group received the n-3 FA treatment during the first treatment period and then the probiotic treatment during the second treatment period. Two participants dropped out from Group 1 during the 1st week of the first treatment period due to little time available to commit to study and experiencing too much stress from outside factors. One participant from Group 2 did not respond to our communications and was dropped from study. Two more participants decided to withdraw from Group 2 during the washout period due to little time available to commit to study (see Figure 2).

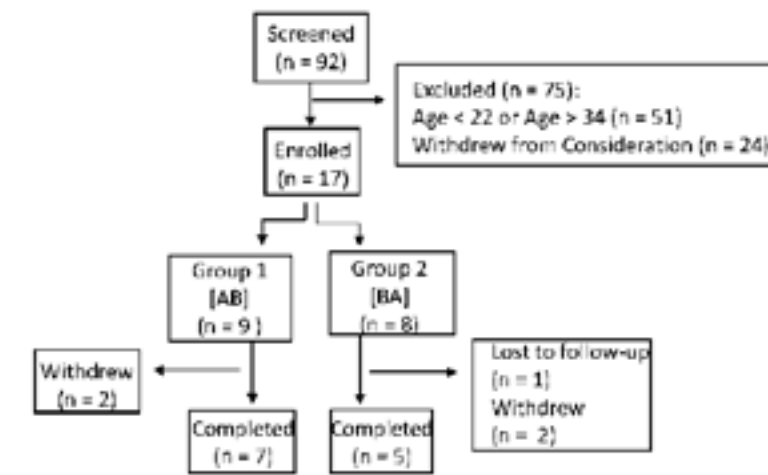


Figure 2. Recruitment and flow of study participants.

Participants completed both 5-week treatment periods, a 5-week washout period, and attended baseline testing and end of treatment testing for both treatment periods.

Participant Baseline Characteristics

Participants were between the ages of 22 and 34 years (see Table 1). The mean ± SD for age is 26.5 ± 3.7 years. 53% of the participants were female. Other categorical data included in Table 1: race/ethnicity, diet followed, CPP college attended, units enrolled for Spring 2022, and whether participants consumed probiotic foods or foods high in n-3 FA.

Table 1. Baseline characteristics

Characteristic	Group 1 [AB]** (n = 9)	Group 2 [BA]*** (n = 8)	Total (n = 17)
Female – no. (%)	7 (78%)	2 (25%)	9 (53%)
Age – years Mean (SD)	27.8 (3.8)	25(3.1)	26.5(3.7)
Race/ethnicity – no. (%)			
Asian	4 (44%)	1 (12.5%)	5 (29%)
Hispanic, Latino or Spanish Origin	4 (44%)	1 (12.5%)	5 (29%)
Middle Eastern or Northern African	1 (11%)	1 (12.5%)	2 (12%)
White	0	4 (50%)	4 (24%)
Other*	0	1 (12.5%)	1 (6%)
Diet – no. (%)			
Western or carnivore	3 (33%)	2 (25%)	5 (29%)
Plant-based, vegetarian, or Mediterranean	2 (22%)	1 (12.5%)	3 (18%)
Low carb or intermittent fasting	2 (22%)	4 (50%)	6 (35%)
No specific diet			
CPP college			

Characteristic	Group 1 [AB]** (n = 9)	Group 2 [BA]***(n = 8)	Total (n = 17)
College of Agriculture	4 (44%)	1 (12.5%)	5 (29%)
College of Business	1 (11%)	0	1 (6%)
College of Engineering	3 (33%)	3 (37.5%)	6 (35%)
College of Environmental Design	1 (11%)	4 (50%)	5 (29%)
Units enrolled			
None	0	1 (12.5%)	1 (6%)
Part-time (1-11 units)	4 (44%)	1 (12.5%)	5 (29%)
Full-time (12+ units)	5 (56%)	6 (75%)	11 (65%)
Consume probiotic foods daily (Yes:No)	2:7	3:5	5:12
Consume n-3 FA foods weekly (Yes:No)	6:3	5:3	11:6

*White and Asian

**[AB] = A is probiotic and B is n-3 FA

***[BA] = B is n-3 FA and A is probiotic

Research hypotheses

The aim of this study is to use Stroop effect to investigate the following relationships: 1) the relationship between probiotic supplements and selective attention; and 2) the relationship between omega-3 fatty acid supplements and selective attention.

Null hypothesis: The consumption of probiotic supplements and/or omega-3 fatty acid supplements have no significant effect on an individual’s selective attention.

Alternative hypothesis: The consumption of probiotic supplements and/or omega-3 fatty acid supplements does have a significant effect on an individual's selective attention.

Determining if Data is Normally Distributed

A histogram was created for the Stroop effect data values collected to determine if the data values were normally distributed. Figure 3 shows that the data values for the change in Stroop effect for the n-3 FA treatment were close to a bell-shaped curve but do not exactly fit the shape of bell curve. Figure 4 shows that the data values for the change in Stroop effect for the probiotic treatment do not follow a bell-shaped curve. Therefore, the data is not normally distributed and does not satisfy one of the assumptions to use a parametric t-test for statistical data analysis.

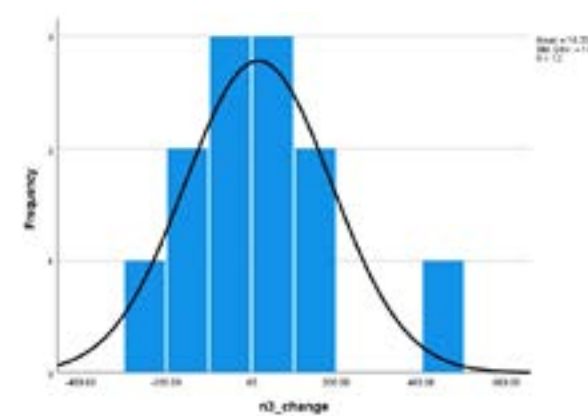


Figure 3. Frequency of Stroop effect for n-3 FA treatment

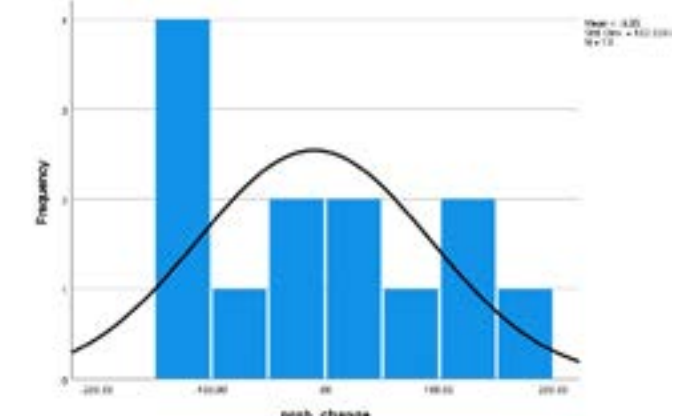


Figure 4. Frequency of Stroop effect for probiotic treatment

Comparing Baselines—Checking for Carryover Effect

Participants completed a 5-week washout period in between treatment periods. To determine whether a carryover effect may have occurred, the Baseline 1 Stroop effect results were compared to the Baseline 2 Stroop effect results. The related-samples Wilcoxon Signed Rank Test was used for this analysis (see Table 2). The p-value of 0.530 confirms there was no statistical difference between Baseline 1 and Baseline 2. Therefore, no carryover effect occurred. Although no carryover effect was confirmed by the p-value, a scatter plot was created to visually compare both baselines (see Appendix C). The scatter plot shows a positive linear trend: the higher the Stroop effect during baseline 1, the higher the Stroop effect was during baseline 2.

Table 2. Hypothesis Test Summary for Differences between Baseline 1 Stroop effect and Baseline 2 Stroop effect

	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between (Baseline 1 stroop effect (ms) and (Baseline 2 stroop effect (ms) equals 0.	Related-Samples Wilcoxon Signed Rank Test	.530	Retain the null hypothesis.

a. The significance level is .050.
b. Asymptotic significance is displayed.

Statistical Tests Used

Due to the data not being normally distributed and the study having a small sample size, a general linear model (GLM) was used. The GLM helped to answer our research question by computing the mean and standard deviation of our dependent variables (see Table 3) and analyzing the effect of both treatments on participants’ Stroop effect (see Tables 4 and 5). Next, a table was created to compare the change in Stroop effect for each participant during the first and second treatment periods (Appendix D). Another GLM was then used to compare the change in Stroop effect between Group 1 (AB) and Group 2 (BA) during each of the 5-week treatment periods (see Appendix E). This was done to compare if Treatment A or Treatment B had more of an effect on Stroop effect. Lastly, a non-parametrical statistical test, specifically the Related Samples

Wilcoxon Signed Rank test, was used to analyze the change in Stroop effect from baseline to end of treatment for each 5-week treatment period. [see Appendix F and Appendix G].

Effect of Treatment A and B Not Statistically Significant on Change in Stroop Effect

To determine whether Treatment A and B had an effect on the Change in Stroop Effect, we performed a multivariate general linear model. The mean ± SD for change in Stroop effect for Treatment A (probiotic) is -9.85 ± 102.03 ms (see Table 3). The mean ± SD for change in Stroop effect for Treatment B (n-3 FA) is 16.33 ± 172.08. The standard deviation is greater than the mean which means that there is high variation between data values and data is abnormally distributed. This is further supported by the histograms created to check normal distribution in Figures 3 and 4. A *p*-value of 0.178 and *F*-value of 2.104 confirms that Treatment A and/or Treatment B had no statistically significant effect on the change in Stroop effect. Therefore, the null hypothesis is confirmed: The consumption of probiotic supplements and/or omega-3 fatty acid supplements have no significant effect on adult selective attention (see Table 4).

Table 3. Descriptive Statistics for Effect of Treatment A and B on Change in Stroop Effect

	N	Minimum	Maximum	Mean	Std. Deviation
prob_change	13	-150.00	151.00	-9.8462	102.02601
n3_change	12	-211.00	423.00	16.3333	172.00155
Valid N (listwise)	12				

Table 4. Multivariate Tests for Effect of both Treatment A and B on Stroop effect change

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.058	.276 ^b	2.000	9.000	.765
	Wilks' Lambda	.942	.276 ^b	2.000	9.000	.765
	Hotelling's Trace	.061	.276 ^b	2.000	9.000	.765
	Roy's Largest Root	.061	.276 ^b	2.000	9.000	.765
T#1 Supplement	Pillai's Trace	.319	2.104 ^b	2.000	9.000	.178
	Wilks' Lambda	.681	2.104 ^b	2.000	9.000	.178
	Hotelling's Trace	.468	2.104 ^b	2.000	9.000	.178
	Roy's Largest Root	.468	2.104 ^b	2.000	9.000	.178

a. Design: Intercept + T#1 Supplement
 b. Exact statistic

Table 5. Tests of Between Subjects Effects Table for Effect of both Treatment A and B on Stroop effect change, Change in Average Heart Coherence, and Change in SPANE total scores

Tests of Between-Subjects Effects									
Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power ^a
Corrected Model	prob_change	74753.284 ^a	5	14950.657	2.474	.171	.712	12.369	.357
	n3_change	176002.193 ^b	5	35200.439	1.304	.389	.566	6.520	.203
Intercept	prob_change	4660.601	1	4660.601	.771	.420	.134	.771	.111
	n3_change	73.770	1	73.770	.003	.960	.001	.003	.050
T1hc_change	prob_change	694.853	1	694.853	.115	.748	.022	.115	.059
	n3_change	777.323	1	777.323	.029	.872	.006	.029	.052
T2hc_change	prob_change	40969.269	1	40969.269	6.779	.048	.576	6.779	.555
	n3_change	12944.753	1	12944.753	.480	.519	.088	.480	.088
T1SPANE_change	prob_change	10752.009	1	10752.009	1.779	.240	.262	1.779	.193
	n3_change	116601.403	1	116601.403	4.320	.092	.463	4.320	.392
T2SPANE_change	prob_change	1918.593	1	1918.593	.317	.597	.060	.317	.075
	n3_change	.008	1	.008	.000	1.000	.000	.000	.050
T#1 Supplement	prob_change	121.740	1	121.740	.020	.893	.004	.020	.052
	n3_change	15682.622	1	15682.622	.581	.480	.104	.581	.096
Error	prob_change	30218.352	5	6043.670					
	n3_change	134966.716	5	26993.343					
Total	prob_change	105483.000	11						
	n3_change	318934.000	11						
Corrected Total	prob_change	104971.636	10						
	n3_change	310968.909	10						

a. R Squared = .712 (Adjusted R Squared = .424)
 b. R Squared = .566 (Adjusted R Squared = .132)
 c. Computed using alpha = .05

Although the null hypothesis was confirmed, a GLM test was performed to determine if the change in average heart coherence and the change in SPANE total scores influenced either of the treatments during both treatment periods (see Table 5). The change in average heart coherence during the second 5-week treatment period may have had a significant effect on the change in Stroop effect for participants who received the probiotic treatment ($F_1 = 6.779$, *p*-value = 0.048, observed power = 0.555). The mean ± SD for the change in average heart coherence for probiotic treatment recipients during the second treatment period is 0.5714 ± 0.9928 (see Table 6). In Table 5, we also see that the effect of the change in SPANE total scores during the first treatment period on the change of Stroop effect for participants who received the n-3 FA treatment is approaching statistical significance ($F_1 = 4.320$, *p*-value = 0.092, observed power = 0.392). The mean ± SD for the change in SPANE total scores for n-3 FA treatment recipients during the first treatment period is 1.400 ± 5.639 (see Table 6).

Table 6. Descriptive Statistics for Change in Heart Coherence During 2nd Treatment Period and Change in SPANE Total Score During 1st Treatment Period

	T#1 Supplement		Statistic	Std. Error			
T2hc_change	1	Mean	.5714	.37526			
		95% Confidence Interval for Mean	Lower Bound	-.3468			
			Upper Bound	1.4896			
		5% Trimmed Mean	.5405				
		Median	.8000				
		Variance	.986				
		Std. Deviation	.99283				
		Minimum	-.60				
		Maximum	2.30				
		Range	2.90				
		Interquartile Range	1.60				
		Skewness	.588	.794			
		Kurtosis	.467	1.587			
		T2hc_change	2	Mean	-.2600	.31559	
				95% Confidence Interval for Mean	Lower Bound	-1.1362	
					Upper Bound	.6162	
				5% Trimmed Mean	-.2732		
Median	-.4000						
Variance	.498						
Std. Deviation	.70569						
Minimum	-1.00						
Maximum	.70						
Range	1.70						
Interquartile Range	1.35						
Skewness	.494			.913			
Kurtosis	-1.552			2.000			
T1SPANE_change	1			Mean	-.1429	1.01015	
				95% Confidence Interval for Mean	Lower Bound	-2.6146	
					Upper Bound	2.3289	
				5% Trimmed Mean	-.2143		
		Median	.0000				
		Variance	7.143				
		Std. Deviation	2.67261				
		Minimum	-4.00				
		Maximum	5.00				
		Range	9.00				
		Interquartile Range	1.00				
		Skewness	.946	.794			
		Kurtosis	3.033	1.587			
		T1SPANE_change	2	Mean	1.4000	2.52190	
				95% Confidence Interval for Mean	Lower Bound	-5.6019	
					Upper Bound	8.4019	
				5% Trimmed Mean	1.1667		
Median	.0000						
Variance	31.800						
Std. Deviation	5.63915						
Minimum	-4.00						
Maximum	11.00						
Range	15.00						
Interquartile Range	7.50						
Skewness	1.671			.913			
Kurtosis	3.564			2.000			

a. There are no valid cases for T2hc_change when T#1 Supplement = .000. Statistics cannot be computed for this level.

b. There are no valid cases for T1SPANE_change when T#1 Supplement = .000. Statistics cannot be computed for this level.

Comparing the Change in Stroop Effect Between Groups 1 and 2 During Each Treatment Period

A table was compiled to display the order of treatment receipt, the change in Stroop effect for each treatment period, and whether selective attention improved or decreased (See Appendix D). The change in Stroop effect was calculated by subtracting the baseline Stroop effect from the post-treatment Stroop effect. During the first treatment period, 2 of the 5 participants from Group 2(BA) showed a decreased change in Stroop effect (improved selective attention), while 4 of the 8 participants from Group 1 (AB) showed a decreased change in Stroop effect (improved selective attention). During the second treatment period, 3 of the 5 participants from Group 2(BA) showed a decreased change in Stroop effect (improved selective attention), while 4 of the 7 participants from Group 1 (AB) showed a decreased change in Stroop effect (improved selective attention).

To determine if there was a difference in Stroop effect change between the treatment groups during each of the treatment periods, we ran a GLM test for each treatment period (see Appendix E). For the first 5-week period, Table E1 shows the calculated p-value is 0.420 (see Appendix E). The average change in Stroop effect for the probiotic treatment group was 9.375, while the average change in Stroop effect for the omega-3 FA treatment group was 82 (see Table E2 in Appendix E). A p-value of 0.420 confirms that there was no statistical difference in the change of Stroop effect between Group 1 (AB) and Group 2 (BA). In Table E3, the p-value of 0.892 shows that there was also no statistical difference between Group 1(AB)'s change in Stroop effect and Group 2(BA)'s change in Stroop effect during the second treatment period (see Appendix E). In the second treatment period, the average change in Stroop effect of the probiotic treatment group (Group 2-BA) was -40.6, while the average Stroop effect of the n-3 FA treatment group (Group 1-AB) was -30.571 (see Table E4). Based on the p-values of 0.420 and 0.892, neither treatment had a greater effect on the change in Stroop effect than the other during each of the treatment periods.

Comparison of Baseline Stroop Effect and End of Treatment Stroop Effect During 1st Treatment period

Group 1 (AB) During 1st Treatment Period

During the first baseline testing, participants who received the probiotic treatment had a mean Stroop effect of 115.4 ms with a standard deviation of 88.4 ms (See Table F1 in Appendix F). By the end of the first treatment period, the average Stroop effect for these participants slightly increased to 124.75 ms with a decrease in standard deviation (67.4 ms). An increase in Stroop effect shows that there was a longer delay time to answer the Stroop Color & Word test questions. Therefore, this slight increase shows a slightly decreased or slower selective attention processing Group 1 during the first treatment period.

Group 2 (BA) During 1st Treatment Period

During the first baseline testing, participants who received the n-3 FA treatment had a mean Stroop effect of 0.4 ms with a standard deviation of 177.3 ms (See Appendix F). By the end of the

first treatment period, the average Stroop effect for these participants increased by 82 ms with a decrease in standard deviation (96.4 ms). As explained above, this shows that, on average, participants in Group 2 showed a decreased or slower selective attention during the first treatment period.

Graphing Baseline 1 and Post-treatment Stroop Effect During 1st Treatment Period

In Figure F1, each participant’s baseline Stroop effect result and post-treatment Stroop effect value during the first treatment period was plotted on a scatter plot. The change in Stroop Effect between baseline and post-treatment displays a positive linear relationship in the individuals who received the probiotic treatment during the first treatment period (see Appendix F). So, the higher a participant baseline Stroop effect was, the higher the post-treatment Stroop effect was. Participants who received the n-3 FA treatment shows mixed results with some participants experiencing an increase from their baseline Stroop effect to the post-treatment Stroop effect, while others experiencing a decrease. The R2 and power values for these linear regression models are low (0.170 and 0.082) which indicate very low reliability.

Determining P-values for Baseline Stroop effect vs. Post-Treatment Stroop Effect During 1st Treatment Period

To test whether there was a difference between the baseline Stroop effect values and the post-treatment Stroop effect values during the first treatment period, we calculated the p-value using the Related-Samples Wilcoxon Signed Rank Test (see Table F2 in Appendix F). A p-value of 0.422 indicates no statistical significance between baseline and post-treatment Stroop effect results during the first treatment period. No difference exists between baseline Stroop effect and post-treatment Stroop effect.

Comparison of Baseline Stroop Effect and End of Treatment Stroop Effect During 2nd Treatment period

Group 1 (AB) During 2nd Treatment Period

During the second baseline testing, Table G1 shows that participants who received the n-3 FA treatment had a mean Stroop effect of 97.7 ms with a standard deviation of 81.1 ms (See Appendix G. By the end of the second treatment period, the average Stroop effect for these participants decreased by 30.6 ms with a decrease in standard deviation (94.9 ms). A decrease in Stroop effect shows that there was a shorter delay time to answer the Stroop Color & Word test questions. Therefore, this shows an increased or faster selective attention processing.

Group 2 (BA) During 2nd Treatment Period

During the second baseline testing, Table G1 shows that participants who received the probiotic treatment had a mean Stroop effect of 79.4 ms with a standard deviation of 131.9 ms. The average Stroop effect decreased to 38.8 ms with an increase in standard deviation (53.7 ms) for

these same participants during post-treatment testing. Therefore, this shows an increased or faster selective attention processing.

Graphing Baseline 2 and Post-treatment Stroop Effect During 2nd Treatment Period

In Figure G1, each participant’s baseline and post-treatment Stroop effect during the second treatment period was plotted on a scatter plot (see Appendix G). The change in Stroop Effect between baseline and post-treatment in the individuals who received the probiotic treatment show no linear trend during the second treatment period. More than half of the Group 2 participants experienced a decrease in Stroop Effect from baseline to post-treatment. Group 1 showed mixed results with some participants experiencing an increase from their baseline Stroop effect to the post-treatment Stroop effect, while others experiencing a decrease. The R2 and power values for these linear regression models (0.080 and 0.005) are very low which indicate very low reliability.

Determining P-values for Baseline Stroop effect vs. Post-Treatment Stroop Effect During 2nd Treatment Period

To test whether there was a difference between the baseline Stroop effect values and the post-treatment Stroop effect values during the second treatment period, we calculated the p-value using the Related-Samples Wilcoxon Signed Rank Test (see Table G2 in Appendix G). The p-value of 0.433 indicates no statistical significance between baseline and post-treatment Stroop effect results during the second treatment period. No difference exists between the second baseline Stroop effect and post-treatment Stroop effect results.

Sub-Analysis Groups: Gender, Age, Race/ethnicity, Heart coherence, SPANE, and Diet

We performed a sub-analysis of the categories below by analyzing the data through graphs and tables. Since our study had a small sample size and our results were statistically insignificant, we did not run statistical analysis for these categories.

Gender	Age	Race/ethnicity	Average heart coherence and negative feelings	Diet
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Gender Identity vs. Mean Stroop Effect Change 1st Treatment Period

Figure H1 shows that the mean Stroop effect change for females and males differed during the first treatment period (see Appendix H). The mean change in Stroop effect for females in both treatment groups was a little less than 25 ms. However, females receiving the omega-3 FA treatment had a negative mean Stroop effect change which means that, on average, their selective attention slightly improved. Meanwhile, females receiving the probiotic treatment had a positive mean Stroop effect change. Males receiving the n-3 FA treatment had a positive mean Stroop effect change of 100 ms. Males receiving the probiotic treatment had a mean Stroop effect change of - 25 ms, so their selective attention, on average, improved slightly.

2nd Treatment Period

Figure H2 shows that the mean Stroop effect change for females in both treatment groups was negative (See Appendix H). This means that the change in Stroop effect, on average, decreased from baseline to post-treatment. Females experienced an improvement in selective attention during the second treatment period. Males receiving the probiotic treatment had a negative mean Stroop effect change, but a positive mean for the males who received the n-3 FA treatment.

Age vs. Mean Stroop Effect Change

In Figure I1, there appears to be no pattern or relationship between the age of participants and the change in Stroop effect from the first baseline to the post-treatment during the first treatment period (See Appendix I). The two oldest participants appear to have a lower Stroop effect change, between 10 and -200 ms, than the rest of the participants. All participants—except for one—have a change in Stroop effect no more than 200 ms.

In Figure I2, it shows that there may be a negative trend when comparing age to change in Stroop effect during the second treatment period (see Appendix I). The younger the participants, the higher the change in Stroop effect (decreased selective attention). The older participants at ages 29-34 years have a negative change in Stroop effect (improved selective attention).

Race/ethnicity during Treatment #1 period

In Figure J1, it shows that participants who identified as Asian—regardless of which treatment they received—were the only group to have a decrease in Stroop effect (improved selective attention) from the first baseline to post-treatment during the first treatment (See Appendix J).

In Figure J2, there were multiple groups that showed a decreased Stroop effect (improved selective attention) during the second treatment period: participants who identified as Asian and received the probiotic treatment, participants who identified as Hispanic, Latino, or Spanish origin and received the n-3 FA treatment, participants who identified as Middle Eastern or Northern African and received the omega-3 FA treatment, and participants who identified as white and received the probiotic treatment (See Appendix J).

Change in Average Heart Coherence

Heart coherence was measured for each participant at the beginning of the testing session (during a meditation) and towards the end of the testing session (during the Stroop Color & word test). In Table K1, the change in average heart coherence for each participant was calculated. Only two participants experienced an increase in heart coherence during the first baseline testing (See Appendix K).

In Table K2, it shows that five participants experienced an increase in heart coherence during the first post-treatment session.

Table K3 shows that only two participants experienced an increase in heart coherence during second baseline testing.

In Table K4, it shows that four participants experienced an increase in heart coherence during the second post-treatment session.

Change in SPANE Total Scores

Comparing the SPANE total score at the start of the first baseline testing session (before mediating) with the SPANE total score at the end of the first baseline testing session (after completing Stroop Color & Word Test), 7 participants indicated a decrease in the intensity of negative emotions they felt (see Table L1 in Appendix L). The remaining participants indicated no change in the intensity of the negative emotions they were feeling.

During the first post-treatment testing session, all the participants except for three showed a decrease in the intensity of negative emotions that they were feeling (see Table L2 in Appendix L). The remaining participants indicated no change in the intensity of the negative emotions they were feeling at the moment.

During the second baseline testing session, all the participants except for two showed a decrease in the intensity of negative emotions that they were feeling (see Table L3 in Appendix L). One of the remaining participants indicated no change in the intensity of the negative emotions, while the other participant indicated a slight increase in the intensity of the negative emotions they were feeling.

During the second post-treatment testing session, all the participants except for four showed a decrease in the intensity of negative emotions that they were feeling (see Table L4). Three participants indicated no change in the intensity of the negative emotions they were feeling. Only one participant indicated an increase in the intensity of the negative emotions they were feeling.

Diet vs. Mean Stroop Effect Change

We created a bar graph to compare the participants' diet with the mean Stroop effect change. Participants who received the probiotic treatment and followed a low carb or intermittent fasting diet or a plant based, vegetarian, or Mediterranean diet had a decrease in Stroop effect change (improved selective attention processing) during the first treatment period (See Figure M1 in Appendix M). Participants who received the omega-3 FA treatment and followed a low carb or intermittent fasting diet also showed a decrease in Stroop effect change (improved selective attention).

Participants who received the probiotic treatment and followed a low carb or intermittent fasting diet or no specific diet had a decrease in Stroop effect change (improved selective attention processing) during the second treatment period (see Figure M2 in Appendix M). Participants who received the omega-3 FA treatment and followed a Western or carnivore diet, plant based,

vegetarian, or Mediterranean, or no specific diet showed a decrease in Stroop effect change (improved selective attention).

Discussion

Our 15-week study to determine whether a high EPA and DHA omega-3 FA supplement or pure probiotic supplement improved adult selective attention showed that there was not a statistically significant relationship between these supplements and selective attention. This was the first study to look at the effects of both n-3 FA supplements and probiotic supplements on selective attention in adults. In addition, our study was the first n-3 FA and probiotic supplement study to incorporate meditation as part of the study design to help minimize the effect of subjects' negative emotional state on their selective attention outcome. To our knowledge, there have not been any studies conducted on the effect of probiotic supplements on selective attention. There has been only one other study conducted by Bauer et al. in 2014 that looked at how omega-3 FA supplements affect selective attention.¹⁷ This 2014 study found that subjects' Stroop effect decreased (faster reaction times/improved selective attention) after subjects consumed an EPA rich n-3 FA treatment for 30 days.¹⁷ Bauer's study used an EPA rich n-3 FA treatment that contained 590 mg of EPA,¹⁷ while our study's n-3 FA treatment contained 1125 mg. Bauer's study had a small sample size and consisted of 13 participants,¹⁷ similar to our study's sample size. However, Bauer's study had their subjects complete the Stroop test in-person, while subjects' brain activity was measured using functional magnetic resonance imaging (MRI).¹⁷ Our study did not use MRI, and we had subjects complete the Stroop effect remotely. If future studies would like to expand the research on whether n-3 FA supplements affect selective attention, we highly suggest that they use neurotechnology to observe and measure brain activity. This will produce selective attention findings that are more accurate. Besides Bauer's study, there was another study conducted in 2019 that looked at how n-3 FA supplements affected another form of attention: focused attention.⁸ Although this 2019 study found that a high dose of EPA may have caused an increase in focused attention, this study's sample consisted of youth under the age of 18 years and diagnosed with ADHD.⁸ Our study was not similar to Chang's study since we were not able to recruit a neurodivergent sample and our participants were adults. Further studies, with larger sample sizes, focusing on these supplements and their effect on adult selective attention need to be conducted.

One of the goals in our study was to measure participants' emotional wellbeing and stress by having them complete a meditation, complete the SPANE questionnaire during various points in each testing session, and measure their heart coherence. The SPANE results showed that almost all the participants indicated a decrease in the intensity of negative emotions after completing the meditation. These results support the current research on how meditation helps decrease negative emotions that an individual may feel.¹⁸ However, many participants experienced a decrease in heart coherence between meditating and completing the Stroop test. This may indicate that participants may have felt a decrease in emotional stability and mental clarity while taking the Stroop test. Although SPANE results showed a decrease in negative emotions, participants' cognitive function may still have been affected by stress during the Stroop test. This stress may possibly have been from the stress of taking the Stroop test or other factors outside of our control.

The effect of the change in SPANE total scores during the first treatment period on Stroop effect for participants who received the n-3 FA treatment showed approaching statistical significance. The positive mean of 1.40 of the SPANE total scores may have affected the Stroop effect outcomes for participants who received the n-3 FA treatment during the first treatment period. In 2011, Finucane conducted the first study that found that the negative emotions of fear and anger improved or enhanced selective attention.¹⁹ When subjects felt fear or angry, their brains were able to better suppress or inhibit distracting information so that they could focus on the selected information they needed to process at the moment.¹⁹ Therefore, Finucane's study supports the possibility that, in our study, there may have been a relationship between the SPANE total scores and Stroop effect outcomes in participants receiving the n-3 FA treatment. Still, due to our small sample size, the observed power was very low at 39.2%. To increase the observed power and determine if this was a true significant effect, our study would need to be repeated with a significantly larger sample size.

In addition, the change in average heart coherence during the second 5-week treatment period may have had a significant effect on the change in Stroop effect for participants who received the probiotic treatment. The positive mean change in average heart coherence is 0.5714 for participants who received the probiotic treatment during the second treatment period. This may mean that the heart coherence may have affected Stroop effect results for those who received the probiotic treatment during the second treatment period. The HeartMath Institute defines coherence as "the state when the heart, mind, and emotions are in energetic alignment and cooperation."²⁰ Recent research has shown how heart coherence influences cognitive function and emotional regulation in humans.^{18,20,21} Studies have shown that the heart sends communications via the vagus nerve to the brain, which result in the heart affecting brain activity including cognitive processes.²¹ Coincidentally, research has shown that one of the routes that the gut microbiome uses to communicate with the brain is through the vagus nerve.¹¹ According to Appleton, the gut-brain axis, a network for the gut microbiome to communicate with the brain, is composed of four major pathways: immune, neurologic, endocrine, and metabolic.²² This vagus nerve is part of the neurologic pathway that gut microbiome uses to communicate with the brain.²² Since the vagus nerve is a shared pathway for the heart and gut microbiome, it is interesting that the heart coherence affected the Stroop effect of participants who received the probiotic treatment. It may be likely that the probiotic treatment and slight increase in heart coherence may have worked together to affect the Stroop effect outcomes. However, it is important to note that the observed power of this statistical significance was moderate at 55%. As mentioned before, another study with a larger sample size should be conducted to increase the power and to determine if there really a relationship between probiotics, heart coherence, and Stroop effect.

In this study, we also looked at sub-analysis groups: diet, race/ethnicity categories, age, and gender identity. For diet, we noticed that a negative mean in Stroop effect change for the participants who received either treatment and followed a low carb, intermittent fasting, plant-based, vegetarian, or Mediterranean diets. Not many studies have been done on the relationship intermittent fasting and low carb diets on selective attention.²³ Few studies have shown any

benefits for cognitive function due to intermittent fasting.²³ This may be something that can be explored with future research. Past studies focusing on plant-based diets and Mediterranean diets have investigated the effect of certain nutrients, found in plant-based foods, may help lower inflammation in the body and affect cognitive function.²⁴ However, the findings from these types of studies are still inconclusive.²⁴ Another idea for a future study could be observing the effect of n-3 FA and probiotic supplements on selective attention in populations who follow plant-based, Mediterranean, vegetarian, or Mediterranean-DASH for Neurodegenerative Delay (MIND) diets. Participants who identified as Asian were the only race/ethnicity group that experienced an improved selective attention for both treatment groups throughout the entire study. We recommend that future studies examine this more to see if there are certain food staples or lifestyle habits in the Asian culture or in other cultural/ethnic groups that may help with selective attention. When comparing gender identity and Stroop effect, we noticed that females experienced a decrease in Stroop effect (improved selective attention) for both treatment groups in Treatment #2. However, the sample size of this study was too small to infer that gender identity may have influenced Stroop effect. A future study may be conducted to look more into gender identity and selective attention. Lastly, for age, we noticed that the two participants who were older than 30 years had lower Stroop effects (better selective attention) than the participants who were younger than 30 years. A future study may be conducted focusing on individuals who are all the same age or within a smaller age range than we chose for this study (22-34 years). The study's sample size began with 17 participants, but then decreased to 12 participants by the end of the study. Since our sample was very small, the significance of these study findings may change with a bigger sample size.

Our study had several limitations. First, the sample size was very small so we cannot know for certain if our findings were statistically insignificant due to the effect of treatment or not having enough study subjects. Second, our study recruited and was conducted while many individuals were working remotely due to the COVID-19 pandemic. Therefore, we decided to conduct testing virtually. Since the testing environment was conducted virtually via Zoom, participants completed their testing in different environments such as their home, work, outdoors, or on campus. Each of these environments may have had different distractions that affected our study findings. Third, participants may have reacted quicker each time they took the Stroop Color & Word test due to learning repetition. This may have affected the Stroop effect results. Lastly, our study was limited by time since it was conducted to fit within the length of a semester (15 weeks). The washout period and both treatment periods were each 5 weeks long. A statistically significant effect may possibly be seen with a longer treatment period and washout period.

To improve this study for the future, we recommend that there be a third treatment period for participants to receive a placebo or no treatment arm. They would not receive either supplement. This would help to see how Stroop effect changes when participants receive no treatment and compare data to other treatment periods. An additional treatment arm consisting of participants receiving both probiotic and omega-3 FA supplements at the same time could also be included in future study designs. We also suggest that the testing location be in-person so all participants can be in the same environment when completing the meditation and selective attention testing. Other recommendations for future studies are to increase the length of the study to at least 12 weeks for each treatment period and increase the sample size to more than

a hundred participants to meet a power of at least 75%. This would require more researchers, funding, and time, but a more realistic sample of population and an increase in power of statistical significance would be obtained.

Ethical Considerations

Conflict of Interest

Researchers have no conflict of interest in this study.

Informed Consent

Once a potential subject was screened and confirmed eligible to participate in this study, an invitation to enroll as a subject for study was sent out along with an informed consent form. The informed consent form was reviewed by the potential subject, and the researchers answered any questions participants had. The informed consent form included the researchers' names and contact information, what the study was about, the possible risks and benefits in this study, and what the subject would have to do in this study. If subject decided to enroll as a subject for this study, they were asked to sign the informed consent form.

Conclusion

We have concluded that neither the n-3 FA treatment nor the probiotic treatment improved adult selective attention. However, a severe study limitation was that our sample size was not large enough. Research on how supplements affect cognitive functions like selective attention is lacking. So, we believe it is important that future studies be conducted to investigate the effects of n-3 FA and probiotics on selective attention. If evidence is found to support that n-3 FA and probiotic supplementation may improve selective attention, it would further support the relationship between one's diet and cognitive function. This could also result in potentially benefiting those with learning disabilities in which selective attention is affected. Our study also found that other factors, such as one's emotional state, gender, diet and lifestyle may be influential when looking at cognitive function. The change in total SPANE score of participants during the first treatment period may have affected the Stroop effect outcomes in those who received the n-3 FA treatment. Additionally, the participants' average heart coherence may have influenced the Stroop effect outcomes of participants who received a probiotic treatment during the second treatment period. Therefore, it is important that future nutritional studies continue to embrace a more holistic lens or approach when designing a study.

Acknowledgements

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Appendix A: IRB approval dated 07-19-2021



Memorandum
 California State Polytechnic University, Pomona
 Institutional Review Board -- Office of Research Compliance
 Federalwide Assurance 00001759 -- IRB principles: respect for persons, beneficence, and justice

Date: July 19, 2021
 PI Name: Sara Garcia; Department/College: Human Nutrition & Food Science
 Co-PI(s): Bonny Burns-Whitmore
 IRB Protocol Number: IRB-21-78
 Protocol Title: Effect of Omega-3 Fatty Acid supplements and Probiotic Supplements on Attention Span and Focus
 Protocol Submission Type: Initial; Review Board Type: CPP IRB members
 Review Type: Expedited
 Decision: Approved

Dear Investigator(s),

The protocol as described above has been reviewed by the Cal Poly Pomona Institutional Review Board (IRB) by the expedited review method. It was found to be in compliance with applicable federal and state regulations and Cal Poly Pomona policies regarding the protection of human subjects used in research. Thus, the Cal Poly Pomona IRB grants you approval to conduct the research. On its behalf, I thank you for your adherence to established policies meant to ensure the safety and privacy of your study participants. You may wish to keep a copy of this memo with you while conducting your research project.

You may initiate the project as of July 13, 2021, and it must be completed by --. Federal regulations limit the IRB approval of studies for up to one year. If you find the need to renew your protocol, please remember to submit a request to the IRB at least six (6) weeks before this end date to ensure continuous human subjects' protection and IRB approval. The Cayuse system will remind you, however the responsibility lies with the study investigators.

It would be appreciated that you advise the IRB upon the completion of your project involving the interaction with human subjects. Please use the "Closure or termination of the protocol" form in the Cayuse system.

Approval is conditional upon your willingness to carry out your responsibilities as the principal investigator under University policy. Your research project must be conducted according to the methods described in the final approved protocol. Should there be any changes to your research plan as described, please advise the IRB, because you may be required to submit an amendment (with re-certification). Additionally, should you as the investigator or any of your subjects experience any "problems which involve an undescribed element of risk" (adverse events in regulatory terms), please immediately inform the IRB of the circumstances. There are forms for both in the Cayuse system.

The committee wishes you success in your future research endeavors. If you need further assistance, you are encouraged to contact the IRB.

Sincerely,

Kristen Schiele

Kristen Schiele, Ph.D., MBA
 Chair, Institutional Review Board
 Assistant Marketing Professor
 College of Business Administration

This message has been automatically generated by the Cayuse system installed at Cal Poly Pomona. Please contact the IRB office (irb@cpp.edu or 909.869.4215 or .3713) if you have questions or you believe you have received this message in error. Thanks for your compliance with the regulations while conducting human subjects research. [2/13]

Appendix B: Proposed Study Design for In-Person Testing

	Baseline 1	1st Treatment Period (5 wk)	End	Washout (5 wk)	Baseline 2	2nd Treatment Period (5 wk)	End
Group 1 [AB]	Green	Brown	Green	Grey	Green	Yellow	Green
	Magenta		Magenta		Magenta		Magenta
	Cyan		Cyan		Cyan		Cyan
	Red		Red		Red		Red
	Light Green		Light Green		Light Green		Light Green
Group 2 [BA]	Green	Yellow	Green	Grey	Green	Brown	Green
	Magenta		Magenta		Magenta		Magenta
	Cyan		Cyan		Cyan		Cyan
	Red		Red		Red		Red
	Light Green		Light Green		Light Green		Light Green

Figure 1. Proposed Study Design for the Probiotic and Omega-3 Fatty Acid Supplement Study for Participants Completing Testing In-person*

Ear sensor = ■ Meditation = ■ SPANE = ■ SCWT = ■ A= Probiotic supplement = ■
 B = n-3 FA supplement = ■

**In-person testing at the Mind and Heart Lab

Each treatment period had (3) 24-hour dietary recalls for treatment compliance.

Appendix C: Comparison Between Baseline 1 Stroop Effect and Baseline 2 Stroop Effect

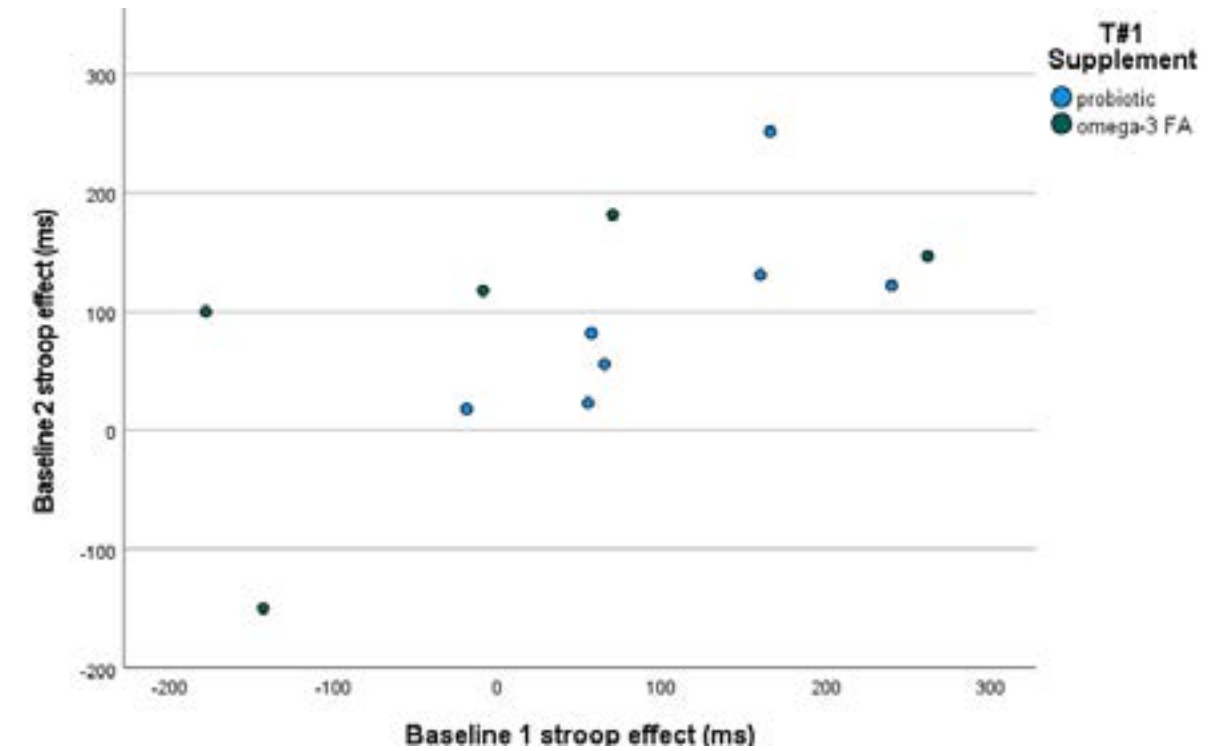


Figure 6. Scatter Plot Comparing Baseline 1 Stroop Effect and Baseline 2 Stroop Effect

Appendix D: Change in Stroop Effect per Participant During Each Treatment Period

Table D1. Change in Stroop Effect per Participant during 1st and 2nd Treatment Periods

Participant	Order of Receipt	T1_SE_change (ms)	Selective Attention (SA)	T2_SE_change (ms)	Selective Attention (SA)
1	BA	-12	↑	-150	↑
2	AB	-108	↑	-100	↑
3	BA	-176	↑	-110	↑
4	BA	159	↓	151	↓
5	AB	118	↓	142	↓
6	AB	52	↓	-22	↑
7	BA	423	↓	29	↓
8	AB	-23	↑	53	↓
9	AB	119	↓	-117	↑
10	BA	16	↓	-123	↑
11	AB	-13	↑	41	↓
12	A -	-95	↑	-	-
13	AB	25	↓	-211	↑
		During T#1, BA participants showing increased SA	2/5	During T#2, BA participants showing increased SA	3/5
		During T#1, AB participants showing increased SA	4/8	During T#2, AB participants showing increased SA	4/7

Appendix E: Statistical Analysis to Compare Change in Stroop Effect Between Groups 1 and 2

Table E1. Tests of Between-Subjects Effects Table for Change in Stroop Effect for Both Treatment Groups during 1st Treatment Period

Dependent Variable: T1_SE_change

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	16228.894 ^a	1	16228.894	.703	.420
Intercept	25690.433	1	25690.433	1.112	.314
T#1 Supplement	16228.894	1	16228.894	.703	.420
Error	254063.875	11	23096.716		
Total	288387.000	13			
Corrected Total	270292.769	12			

a. R Squared = .060 (Adjusted R Squared = -.025)

Table E2. Descriptive Statistics for Stroop Effect Change for Both Treatment Groups During 1st Treatment Period

Dependent Variable: T1_SE_change

T#1 Supplement	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
probiotic	9.375	53.732	-108.888	127.638
omega-3 FA	82.000	67.966	-67.592	231.592

Table E3. Tests of Between-Subjects Effects Table for Change in Stroop effect for Both Treatment Groups during 2nd Treatment Period

Dependent Variable: T2_SE_change

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	293.336 ^a	1	293.336	.019	.892
Intercept	14774.002	1	14774.002	.972	.347
T#2 Supplement	293.336	1	293.336	.019	.892
Error	151934.914	10	15193.491		
Total	166719.000	12			
Corrected Total	152228.250	11			

a. R Squared = .002 (Adjusted R Squared = -.098)

Table E4. Descriptive Statistics for Stroop Effect Change for Both Treatment Groups During 2nd Treatment Period

Dependent Variable: T2_SE_change

T#2 Supplement	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Probiotic	-40.600	55.124	-163.425	82.225
Omega-3 FA	-30.571	46.589	-134.377	73.234

Appendix F: Comparison of Baseline Stroop Effect and End of Treatment Stroop Effect During 1st Treatment period

Table F1. Comparison of Baseline Stroop Effect and End of Treatment Stroop Effect During 1st Treatment period

Participant	Treatment*	Baseline 1 SE (ms)	EOT 1 SE (ms)	T1_SE change (ms)	Selective Attention**
1	B	70	58	-12.00	↑
2	A	160	52	-108.00	↑
3	B	262	86	-176.00	↑
4	B	-143	16	159.00	↓
5	A	55	173	118.00	↓
6	A	65	117	52.00	↓
7	B	-178	245	423.00	↓
8	A	57	34	-23.00	↑
9	A	-19	100	119.00	↓
10	B	-9	7	16.00	↓
11	A	240	227	-13.00	↑
12	A	199	104	-95.00	↑
13	A	166	191	25.00	↓
Total	A; Group AB (n = 8)	Mean = 115.4 SD = 88.4	Mean = 124.75 SD = 67.4	Mean = 9.4 SD = 86.3	↓
Total	B; Group BA (n = 5)	Mean = 0.4 SD = 177.3	Mean = 82.4 SD = 96.4	Mean = 82 SD = 224.7	↓

*(A = probiotic, B = n-3 FA)

**↑ = improved selective attention (Decreased Change in Stroop effect = faster reaction time); ↓ = decreased selective attention (Increased change in Stroop effect = slower reaction time)

Appendix F (Continued)

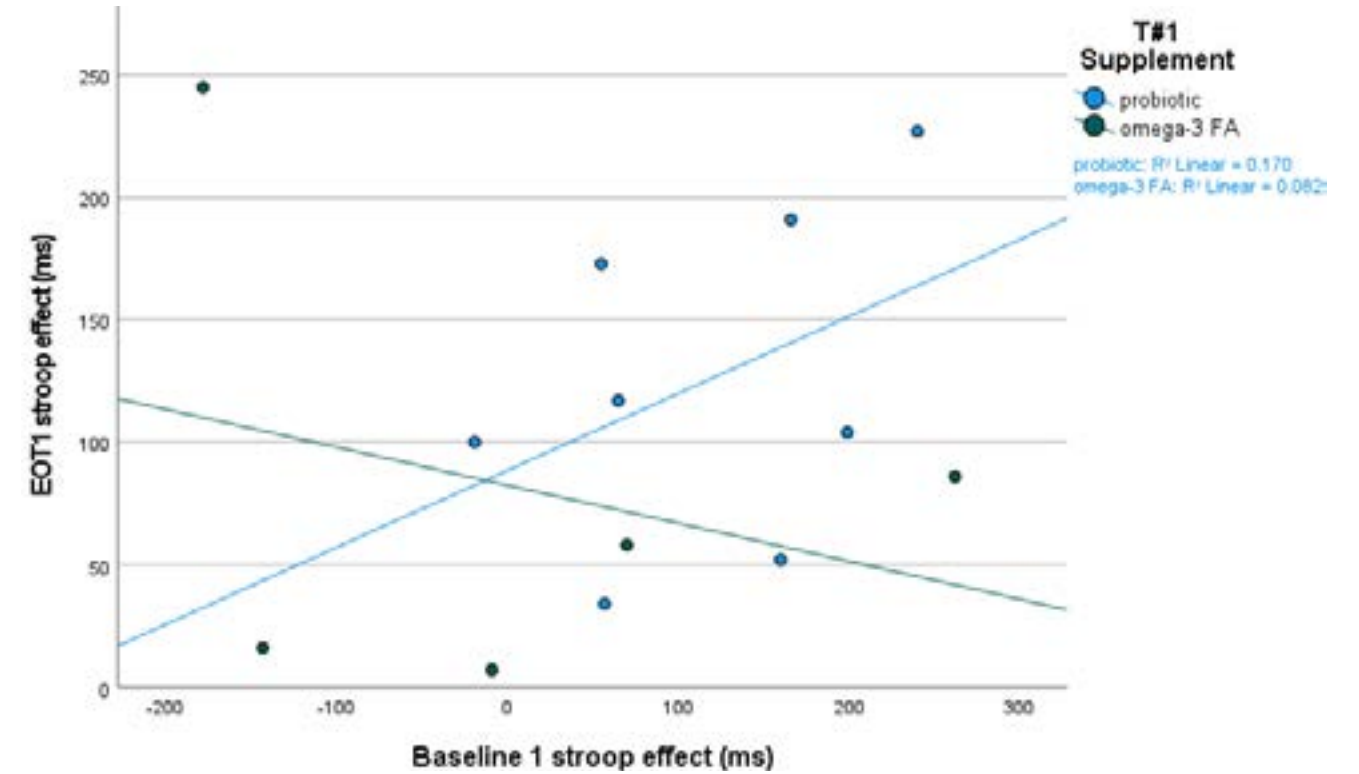


Figure F1. Scatter Plot Comparing Baseline 1 Stroop Effect and End of Treatment Stroop Effect During 1st Treatment Period

Table F2. Hypothesis Test Summary for Differences between Baseline 1 Stroop effect and EOT1 Stroop effect

	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between Baseline 1 stroop effect (ms) and EOT1 stroop effect (ms) equals 0.	Related-Samples Wilcoxon Signed Rank Test	.422	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Appendix G: Comparison of Baseline Stroop Effect and End of Treatment Stroop effect During 2nd Treatment Period

Table G1. Comparison of Baseline Stroop Effect and End of Treatment Stroop effect During 2nd Treatment Period

Participant	Treatment	Baseline 2 SE (ms)	EOT 2 SE (ms)	T2_SE change (ms)	Selective Attention*
1	A	182	32	-150.00	↑
2	B	131	31	-100.00	↑
3	A	147	37	-110.00	↑
4	A	-150	1	151.00	↓
5	B	23	165	142.00	↓
6	B	56	34	-22.00	↑
7	A	100	129	29.00	↓
8	B	82	135	53.00	↓
9	B	18	-99	-117.00	↑
10	A	118	-5	-123.00	↑
11	B	122	163	41.00	↓
12	B	252	41	-211.00	↑
Total	A = 5 Group BA	Mean = 79.4 SD = 131.9	Mean = 38.8 SD = 53.7	Mean = -40.6 SD = 127.6	↑
Total	B = 7 Group AB	Mean = 97.7 SD = 81.1	Mean = 67.1 SD = 94.9	Mean = -30.6 SD = 120.3	↑

*(A = probiotic, B = n-3 FA)

**↑ = improved selective attention (Decreased Change in Stroop effect = faster reaction time); ↓ = decreased selective attention (Increased change in Stroop effect = slower reaction time)

Appendix G (continued)

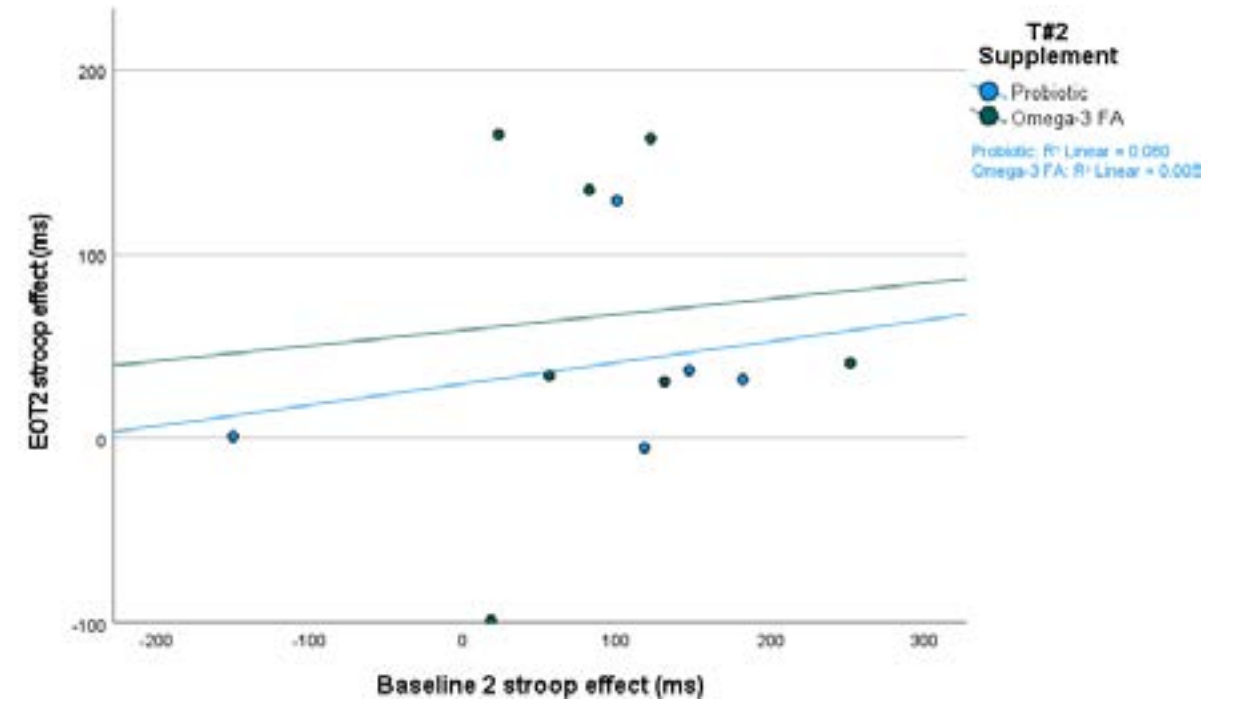


Figure G1. Scatter Plot Comparing Baseline 2 Stroop Effect and Post-Treatment Stroop Effect for all participants in Treatment #2 period

Table G2. Hypothesis Test Summary for Differences between Baseline 2 Stroop effect and EOT2 Stroop effect

	Null Hypothesis	Test	Sig. ^{a,b}	Decision
1	The median of differences between Baseline 2 stroop effect (ms) and EOT2 stroop effect (ms) equals 0.	Related-Samples Wilcoxon Signed Rank Test	.433	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Appendix H: Sub Analysis—Gender Identity and Mean Stroop Effect Change

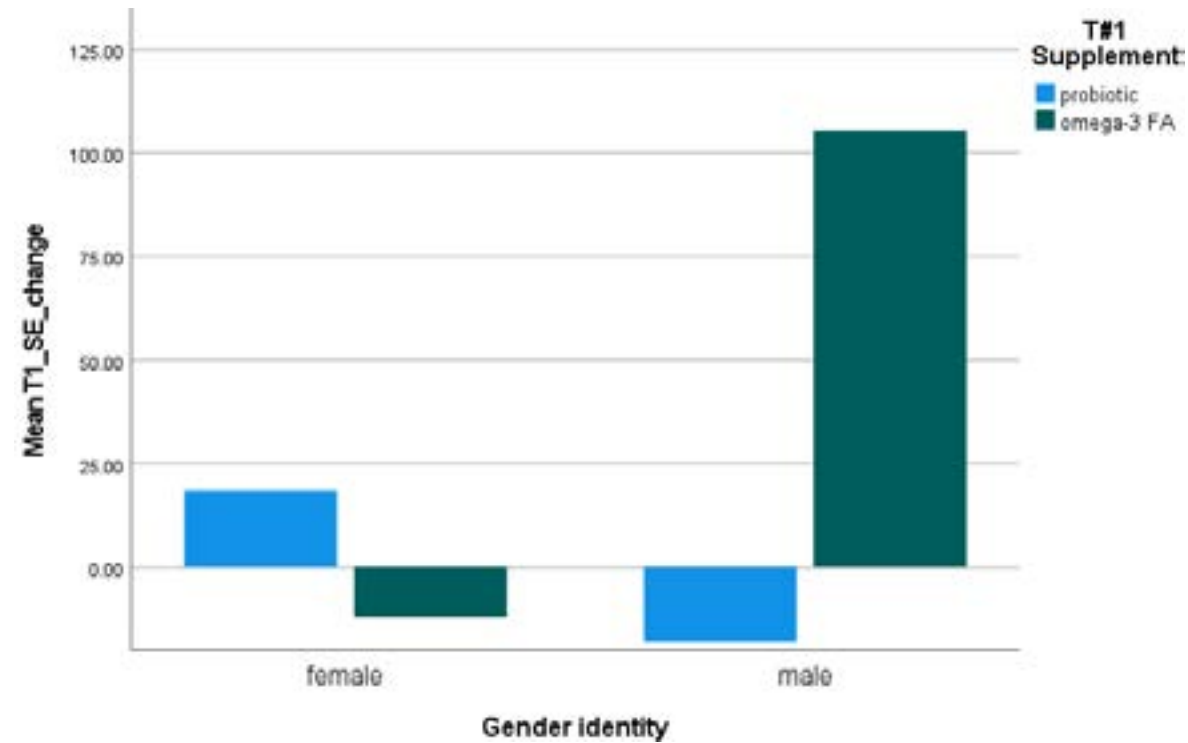


Figure H1. Gender identity vs. Mean Stroop Effect Change During 1st Treatment Period

Appendix I: Sub Analysis—Age and Stroop Effect Change During Both Treatment Periods

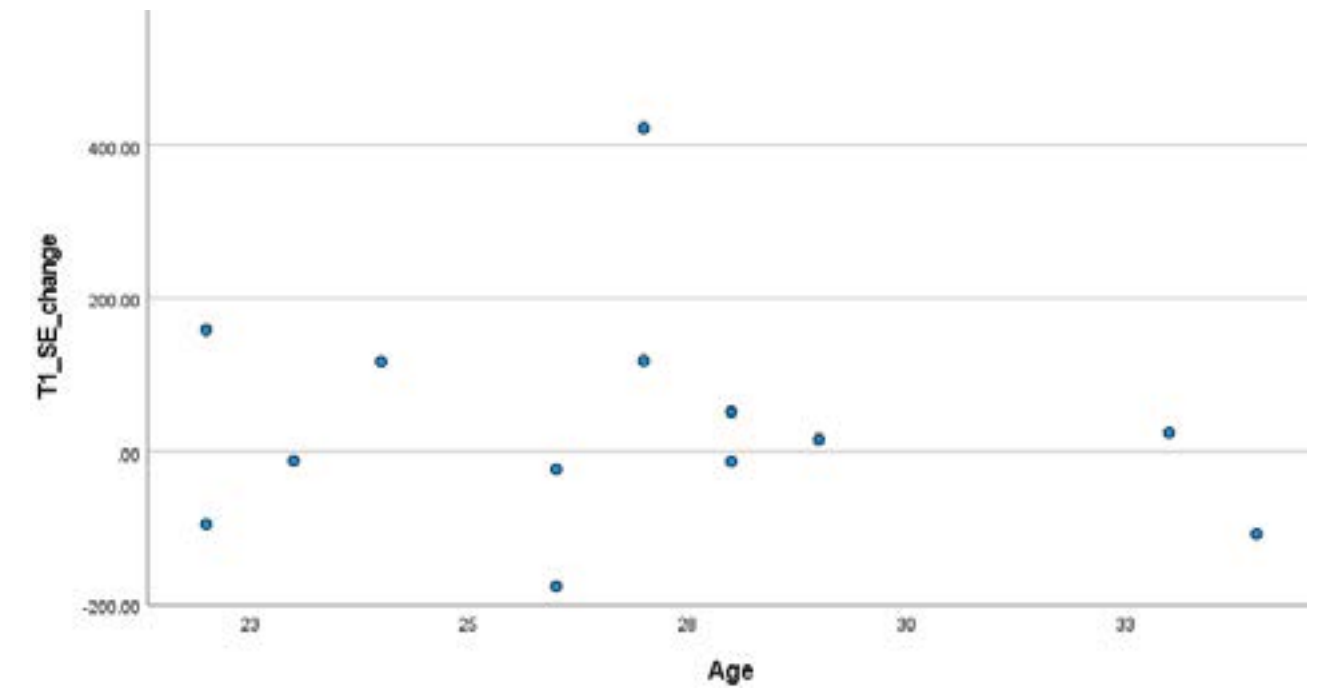


Figure I1. Participant Age and Stroop Effect Change During 1st Treatment Period

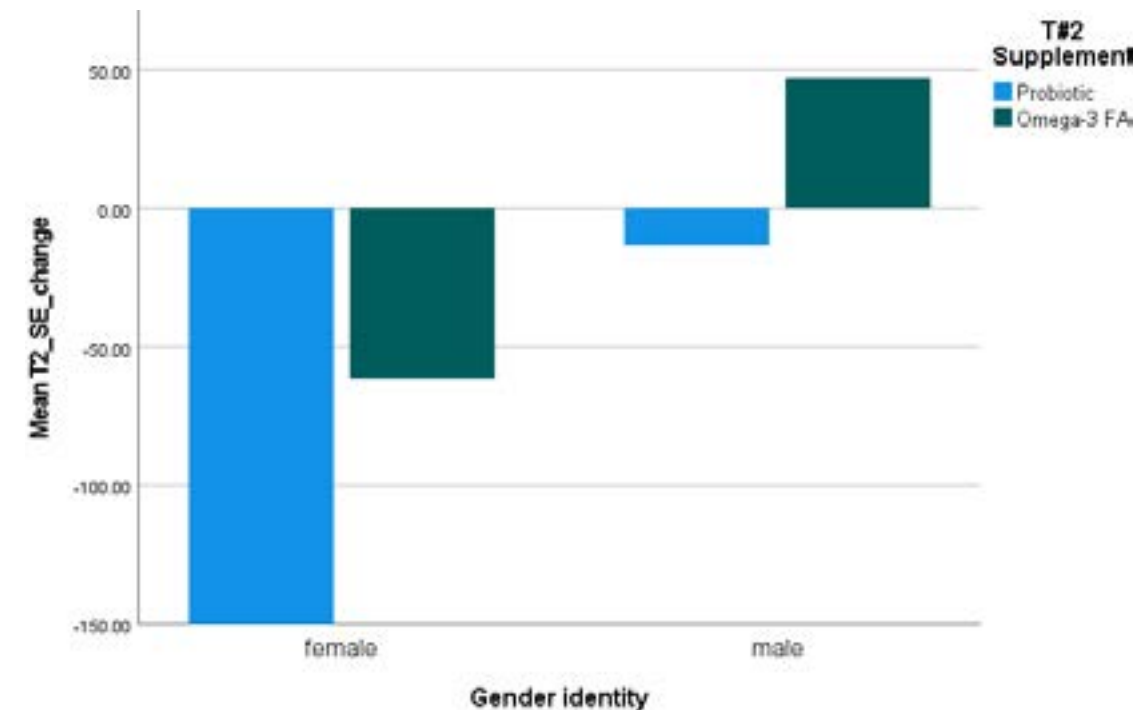


Figure H2. Gender identity vs. Mean Stroop Effect Change During 2nd Treatment Period

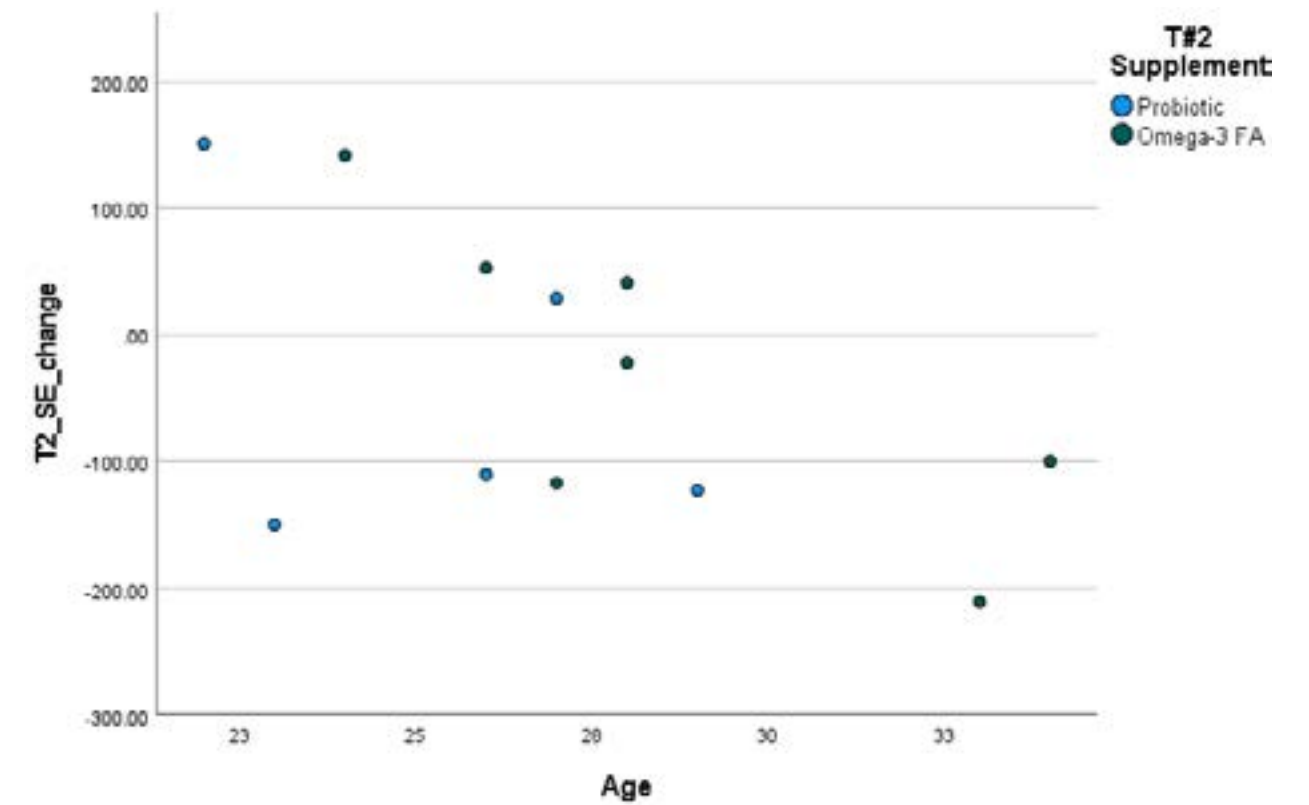


Figure I2. Participant Age and Stroop Effect Change During 2nd Treatment Period

Appendix J: Sub Analysis—Race/Ethnicity Categories and Mean Stroop Effect Change

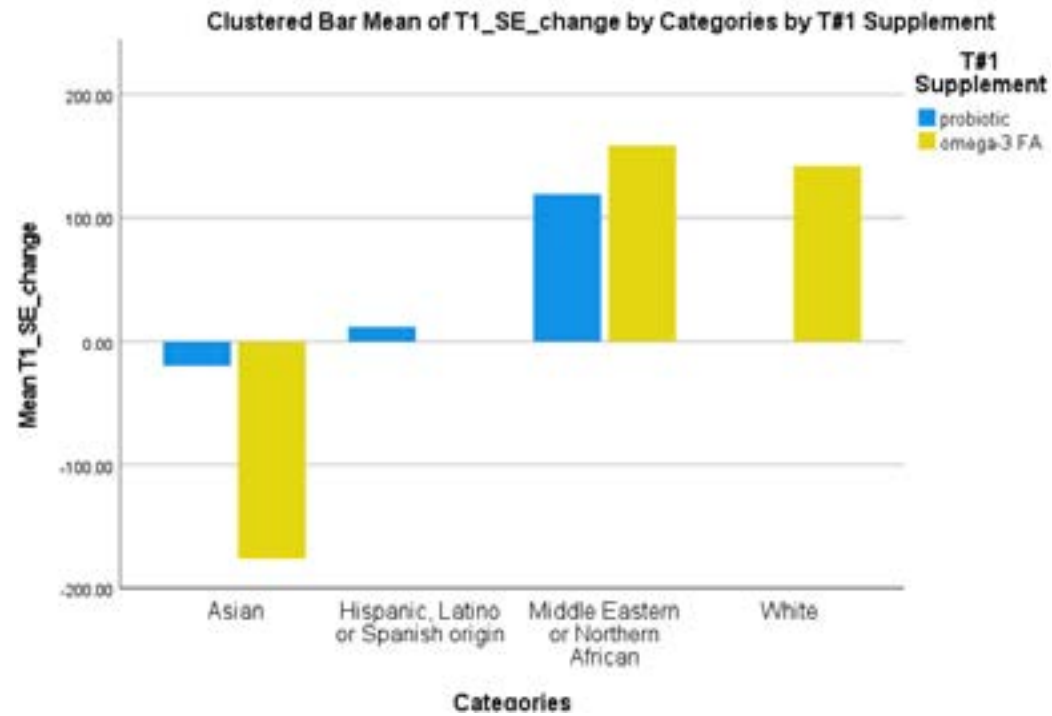


Figure J1. Race/Ethnicity Categories vs. Mean Stroop Effect Change During 1st Treatment Period

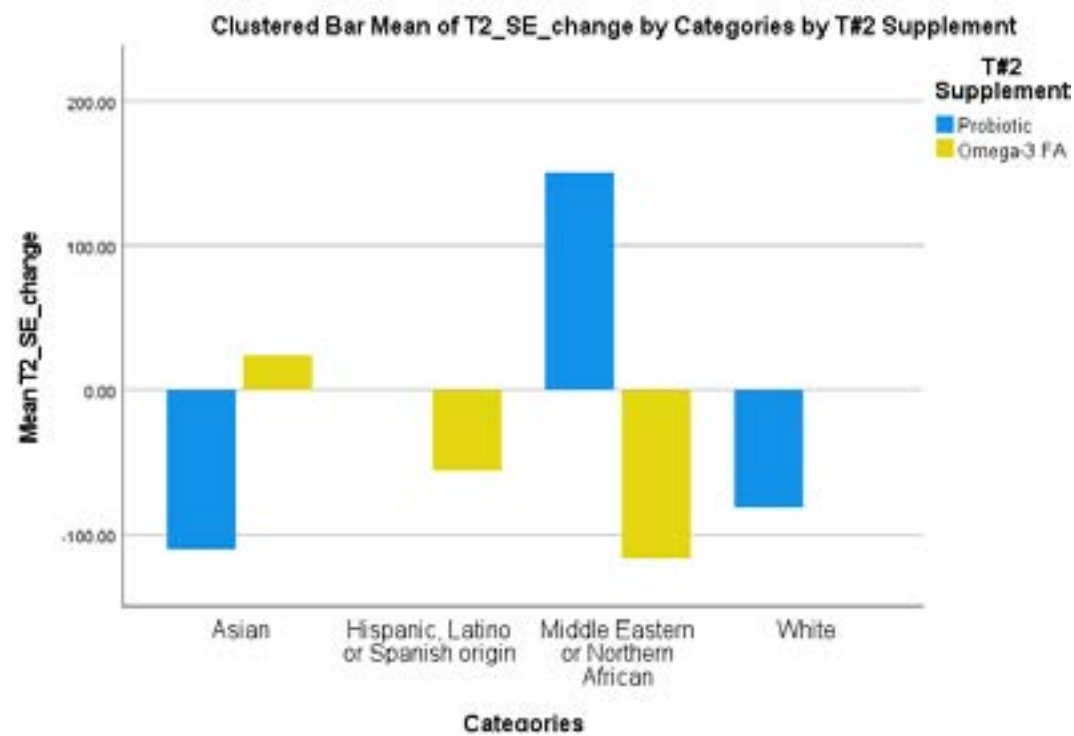


Figure J2. Race/Ethnicity Categories vs. Mean Stroop Effect Change During 2nd Treatment Period

Appendix K: Participants' Change in Average Heart Coherence During Each Testing Session

Table K1. Change in Average Heart Coherence During Baseline#1 Testing

Participants	Avg heart coherence during Meditation	Avg heart coherence during Stroop test	Change in Avg Heart Coherence
1	1.7	1.8	+0.10
2	1.5	1.1	-0.40
3	4.4	1.7	-2.70
4	2.2	1.0	-1.20
5	1.4	1.3	-0.10
6	1.5	1.4	-0.10
7	1.4	.7	-0.70
8	2.0	1.5	-0.50
9	1.2	1.2	.00
10	2.1	.3	-1.80
11	1.4	1.3	-0.10
12	1.1	1.4	+0.30
13	1.8	1.0	-0.80

Table K2. Change in Average Heart Coherence During End of Treatment#1 testing

Participants	Avg Heart Coherence during Meditation	Avg Heart Coherence during Stroop Test	Change in Avg Heart Coherence
1	1.7	1.9	+0.20
2	1.8	-	-
3	3.4	2.1	-1.30
4	2.4	1.0	-1.40
5	1.7	1.1	-0.60
6	1.7	2.0	+0.30
7	1.4	.8	-0.60
8	1.1	2.0	+0.90
9	1.6	1.4	-0.20
10	.8	1.0	+0.20
11	2.1	.3	-1.80
12	.9	1.5	+0.60
13	1.5	.9	-0.60

Appendix K (Continued)

Table K3. Change in Average Heart Coherence during Baseline #2 Testing

Participants	Avg Heart Coherence during Meditation	Avg Heart Coherence during Stroop test	Change in Avg Heart Coherence
1	1.6	1.6	.00
2	1.1	1.7	+.60
3	2.4	1.5	-0.90
4	1.7	1.3	-0.40
5	.9	.9	0.00
6	1.5	1.4	-0.10
7	1.0	.3	-0.70
8	1.4	1.5	+0.10
9	1.3	.3	-1.00
10	1.1	.8	-0.30
11	1.9	1.4	-0.50
12	1.4	1.2	-.20

Table K4. Change in Average Heart Coherence during End of Treatment #2 Testing

Participants	Avg Heart Coherence During Meditation	Avg Heart Coherence during Stroop Test	Change in Avg Heart Coherence
1	1.6	.6	-1.00
2	1.6	1.1	-.50
3	1.9	.7	-1.20
4	2.1	2.0	-.10
5	1.5	1.5	.00
6	1.5	3.7	+2.20
7	1.4	.5	-0.90
8	1.6	1.0	-0.60
9	1.2	1.4	+0.20
10	.8	.4	-0.40
11	1.6	1.7	+0.10
12	1.6	2.0	+0.40

Appendix L: Participants' Change in SPANE Total Scores During Each Testing Session

Table L1. Change in SPANE Total Scores During First Baseline Testing Session

Participants	SPANE 1 total	SPANE 2 total	SPANE 3 total	Overall change
1	6	6	6	-
2	11	8	7	↓
3	7	7	6	↓
4	6	6	6	-
5	6	6	6	-
6	11	7	11	-
7	8	6	6	↓
8	6	6	6	-
9	7	6	6	↓
10	13	7	10	↓
11	9	7	7	↓
12	26	16	7	↓
13	6	6	6	-

Table L2. Change in SPANE Total Scores During End of 1st Treatment Period Testing Session

Participants	SPANE 1 total	SPANE 2 total	SPANE 3 total	Overall change
1	6	6	6	-
2	7	7	6	↓
3	7	6	6	↓
4	17	8	6	↓
5	16	12	11	↓
6	14	9	7	↓
7	25	14	17	↓
8	6	6	6	-
9	7	6	6	↓
10	9	0	6	↓
11	6	6	6	-
12	13	9	10	↓
13	14	6	6	↓

Appendix L (Continued)

Table L3. Change in SPANE Total Scores During Second Baseline Testing Session

Participants	SPANE 1 total	SPANE 2 total	SPANE 3 total	Overall change
1	7	7	6	↓
2	6	6	6	-
3	13	10	9	↓
4	7	6	6	↓
5	12	7	7	↓
6	13	8	7	↓
7	15	11	11	↓
8	6	7	7	↑
9	9	8	8	↓
10	9	9	6	↓
11	8	6	7	↓
12	9	6	6	↓

Table L4. Change in SPANE Total Scores During End of 2nd Treatment Period Testing Session

Participants	SPANE 1 total	SPANE 2 total	SPANE 3 total	Overall change
1	6	6	6	-
2	8	7	7	↓
3	7	6	6	↓
4	6	6	6	-
5	24	21	17	↓
6	8	6	7	↓
7	6	6	6	-
8	6	6	9	↑
9	6	6	6	↓
10	9	6	6	↓
11	9	8	8	↓
12	20	18	12	↓

Appendix M: Diet and Mean Stroop Effect Change

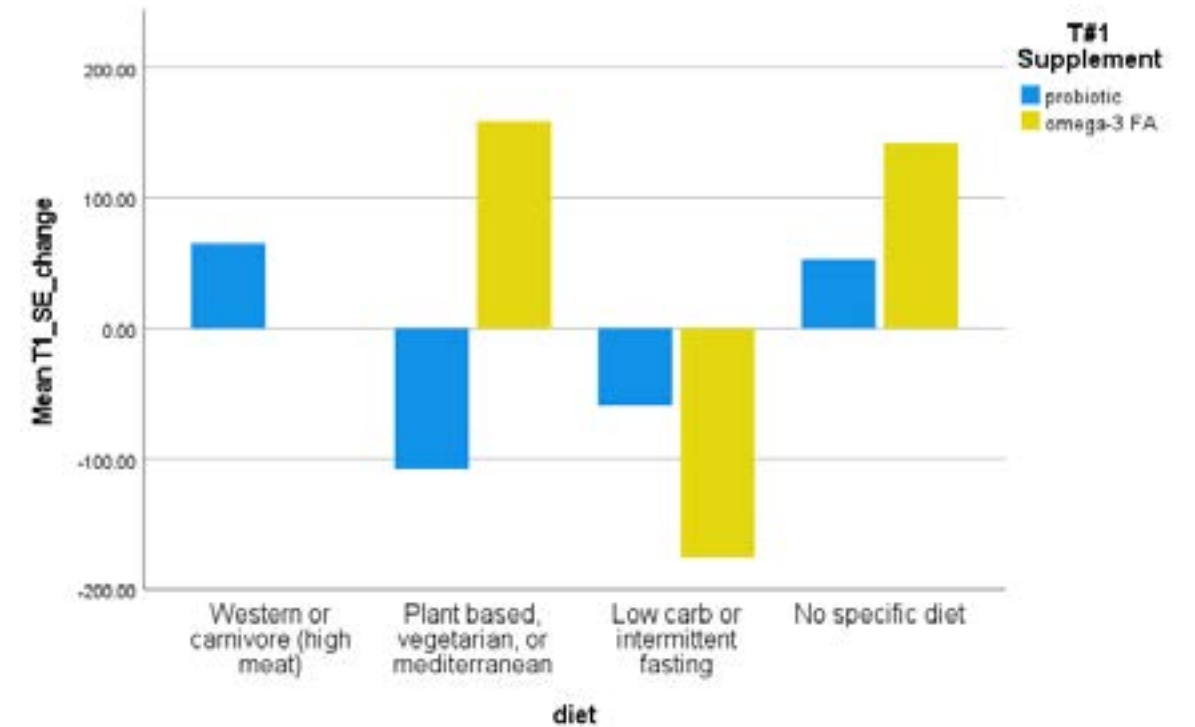


Figure M1. Participant Diet and Mean Stroop Effect Change During 1st Treatment Period

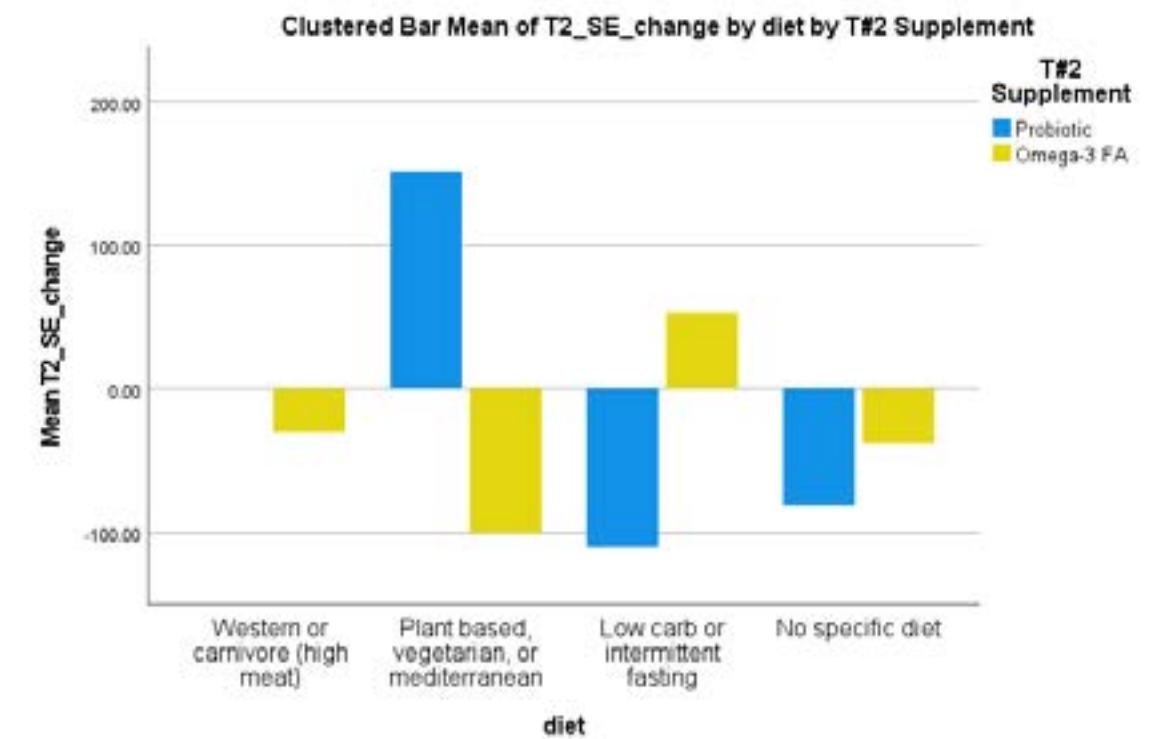


Figure M2. Participant Diet and Mean Stroop Effect Change During 2nd Treatment Period

Davis Eliel* **The Romantic Experiences of Black Women in Higher Education**

Dr. Morales

Introduction to Research

College campuses are where students will experience some of their first romantic relationships as emerging adults. Colleges provide students with an opportune context to meet potential romantic partners (Allison & Ralston 2018). Increased independence from guardians, a high concentration of young adults, on-campus housing and events, as well as the development of hook-up culture create a unique context for romantic relationships (Kuperberg and Padgett 2015; Mulder et. al 2002; Uecker 2015). There is a multitude of literature on dating among college students; however, the research focusing on black women dating in college is far less extensive.

Heterosexual Black women go through a fundamentally different dating experience than other race-gender groups. Black women endure racism and sexism simultaneously. Black women date within their own racial group at higher rates than any other race-gender group, while they are the least sought out by men of other races (Passel et. al, 2010)(Yancey, 2016). Systemic barriers limit the accessibility of college for black students, especially black men. Black women outperform Black men on every determinant of college enrollment (Davis & Otto, 2016), therefore they have the smallest pool of potential partners on almost all college campuses. The intersectional identities black women must negotiate on college campuses make their experiences unique. Literature focused on the romantic experience of college students as a whole fails to capture this experience.

Although research on the romantic experience of black women in college is expanding, (Stackman et. al 2016; Stephens & Thomas 2012;), much of this literature focuses on the sexual health risks, or risks of violence (Alleyne & Gatson 2010; Smith et. al 2003). Racism and Sexism affect all Black women's romantic experiences in college as a group, but also as individuals. I chose to utilize interviews to analyze the personal romantic experiences of 5-10 black women on campus in order to highlight this. The interview questions focus on the participants' own romantic experiences. They are open-ended in order to bring out unique perspectives that may not have been captured in the current literature.

I will use 5- 10 semi-structured interviews with black women college students, this study addresses the following questions.

Research Questions

This study aims to find out:

- How do Black women experience the effects of their race and gender while dating on college campuses?
- How does being a black woman affect your romantic relationships ? (ask second)
- How does your gender affect your romantic relationships ? (ask this question first)
- How do Black women perceive and navigate the sex ratio imbalance on college campuses ?
- How do Black women experience eurocentric notions of beauty while dating on campus?
- How do Black women perceive and/or experience interracial dating?
- How do Black women weigh the social costs of their romantic decisions?

Keywords

- Sex Ratio (noun)- The number of males for every 100 females in a population. Male to female ratio.
- Hookup - Physically intimate encounter with or without the expectation of a relationship after
- Sneaky Link a.(noun - person) - A consistent or semi-consistent sexual partner that is not in an official romantic relationship
- Sneaky Link b.(noun-action) - A sexual encounter usually done late at night without others' knowledge.
- Talking - The process of initially getting to know a potential intimate or romantic partner. Sometimes precedes a relationship, sometimes does not.
- Talking Stage - The period of time to get to know potential intimate or romantic partners.
- Jezebel Stereotype - Stereotype displaying black women as sexually insatiable to justify sexual violence against them. Derived from the days of slavery.
- Colorism - Discrimination based on skin tone.
- Intimate relationship - Any non-platonic interpersonal relationship. Does not have to be an official romantic relationship

Review of Literature

Sex Ratio

A sex ratio is the number of males for every 100 females in a population. The African American community has a particularly low sex ratio. Both mass incarceration and early mortality rates create a shortage of eligible black men for heterosexual black women to form romantic relationships with. According to Dr. Enrique Pouget and his colleagues' study on sex ratios, a shortage of males in the community produces a power imbalance between the lower number of men and the surplus of eligible women. These men have more alternatives and do not face the same social stigma for having multiple partners; therefore, men have less incentive to commit to monogamous relationships. This gives black men unbalanced bargaining power in negotiating intimacy with Black women (Pouget et al., 2010). There are even fewer black men on college campuses. Black men fall behind every other race-gender

group in practically all predictors of college enrollment (Davis & Otto, 2016). The lower enrollment and retention rates of Black men exacerbate the sex ratio imbalance on college campuses. This study will ask questions deciphering participants' perceived partner quality and availability.

Eurocentric Beauty Standards

Black college students also must navigate a beauty standard determined by European Americans. Black women must observe themselves in relation to the thin frames, fair skin, light-colored eyes, and straight hair promoted by eurocentric beauty standards. Dr. Lanice Avery and others' study found a positive correlation between acceptance of dominant beauty standards and greater sexual guilt, shame, emotional distancing, and sexual self-consciousness among Black women. They also found a negative relationship between sexual assertiveness and satisfaction (Avery et al., 2021). Black students are underrepresented at most higher education institutions. Black students' separation from European features limits their ability to participate in campus dating culture. This experience, combined with their minority status, could lead them to internalize eurocentric beauty standards. Black women on campus could have different dating experiences based on their proximity to eurocentric features. Women will have the opportunity to answer what personal characteristics influence their dating experiences.

Interracial Dating

George Yancey's study found that African Americans are the least willing racial group to date people outside their race. Additionally, African Americans are the least sought romantic partners by other racial groups (Yancey, 2016). This shrinks the potential dating pool for African American Students even further at institutions where they are the minority. While black men and women were the least willing to date outside their race, this may not apply to hookups. Hookups are intimate experiences where there are no relationship expectations. Black Men (and Asian Women) have shown lower rates of racial homophily in hookups than other race-gender groups. African Americans are hypermasculinized which may benefit black men seeking hookups from other races while being a detriment to black women (Spell, 2016). Campus hookup culture may amplify the differences between the romantic experiences of black men and women. Black men may have an easier time finding hookup partners from other racial groups than black women do. Although Carolyn J. Field's research did not find evidence that black men are more supportive of interracial relationships than black women, their actual dating practices may not reflect this (Field et al., 2013). According to Passel, Wang, and Taylor's Pew Research, Black men are twice more likely than Black women to date outside their race (Passel et al., 2010). Not only are there less black men on college campuses, but those black men are more likely to date interracially than Black women. The interviews will ask black women their experiences of interracially dating, as well as how their feelings on interracial dating.

Social Costs

Black women endure both racism and sexism simultaneously. As a result, they face unique social costs for participating in campus dating culture that people who are non-black,

and/or male do not face. Dr. Farvid highlighted that although casual sex has become more socially acceptable in Western culture, a double standard still exists for women. The "threat of garnering a negative sexual reputation" is ever present as women participate in intimacy (Farvid, 2016, pp. 544-560). Black women are hypersexualized on top of this. Dr. Leath and colleagues found that black college women feel pressure to alter their expression and behavior in order to avoid the Jezebel stereotype; the stereotype that black women are sexually insatiable, which has been used since American chattel slavery to justify sexual violence against them (Leath et. al, 2021). At most college institutions, black students are the minority and their cultural circles reflect this. Simran Subramaniam's thesis highlights the lack of privacy afforded to women dating within minority communities. Due to the intimate nature of these circles, members are aware of their peers' romantic involvement. Women can be sexually stigmatized for sleeping with multiple group members. Additionally, romantic interest in the same men can cause competition within the community (Subramaniam, 2022). Black women risk compromising social harmony when dating within their cultural in-group. This interview may provide insight into how black women weigh the social costs of dating within their communities.

Conclusion

Black women have a limited pool of potential romantic partners on college campuses which awards them less bargaining power in navigating these relationships (Passel et al., 2010)(Yancey, 2016)(Davis & Otto, 2016). College is also an environment where they may face social costs to participate in intimacy freely (Farvid, 2016)(Leath et. al 2021) (Subramaniam, 2022). This research is designed to highlight how black women perceive and navigate these factors.

Methods

Demographics

The targeted research participants are heterosexual Black Women in college preferably in the 18-25 year age range.

Recruitment:

There will be a convenience sample of 5 - 10 Black Women who are students of California State Polytechnic University, Pomona. I will use a snowball sampling method starting with a few Black Women I know on campus, and then have them refer other Black female students.

After finding each potential participant and obtaining contact information, I would schedule an intake meeting either in person or through zoom based on convenience. During this meeting, I will explain the topic of my research and provide a disclosure form that will include information on informed consent. Participants will then be able to decide whether or not they would like to be interviewed.

Procedure

The targeted research participants are heterosexual Black Women in college preferably in the 18-25 year age range.

First, I will recruit 5 - 10 Black Women who are students of California State Polytechnic University, Pomona using snowball sampling. I will start with three Black Women I know on campus, and then have them refer other Black female students. Potential participants will be contacted and asked if they would like to participate in a semi-structured interview. If they agree I will schedule an intake meeting either in person or through zoom based on the participant's choice. Before this meeting, participants will be given an electronic copy of the approved, IRB-stamped consent document through email so they have as much time as they need to read through the consent form. During the intake meeting, I will verbally walk them through the contents of the consent form to ensure they have understood all the procedures. The participant will be instructed that if they agree to participate in the study, they must return the signed and dated consent document by email. If they sign the consent form agreeing to participate, I will interview the participant in person. Upon interviewing the respondent, I will allow them the opportunity to specify any information they would not like to go into the study's data.

The interviewee will be asked to comment on a series of questions about their romantic experiences as college students. These questions will pertain to their experiences both on and off campus. Any information that inadvertently comes up in the conversation that is outside the scope of this project will be strictly excluded from our notes. The interviews will last between 60 and 90 minutes on average. The data from the interviews will be digitally recorded and stored on password-protected devices only accessible to Dr. Morales and me. I will be writing notes on key points for reference when transcribing and coding the interviews. All documents and recordings will be stored in One Drive and recordings will be deleted once transcribed.

Interview Guide:

Demographic Questions:

1. How has your day been so far?
2. What is your class standing at Cal Poly?
3. What is your major?
4. Where are you from?
5. Do you live on campus or do you commute?
6. What made you decide to attend Cal Poly?
7. How do you like the school?
8. Are you currently in a relationship?
9. Is your partner Black?
10. Does your partner attend Cal Poly?
11. What role does dating have in your life currently?
12. What characteristics, qualities, and qualifications are most important to you in romantic partners?

Interview Questions:

13. What characteristics, qualities, and qualifications do your current or previous romantic partners have?
14. Which of your characteristics and qualities are desired the most by potential romantic partners?
15. What are your thoughts and feelings on interracial relationships in general?
16. What are your experiences with interracial relationships?
17. How would you describe your racial preferences when it comes to romantic partners?
18. How have your racial preferences impacted your romantic experience at Cal Poly Pomona?
19. Do you think skin color plays a role in dating at Cal Poly Pomona? (why or why not?)
20. How do you think your skin color has impacted your dating experiences?
21. How would you describe the dating climate of Cal Poly Pomona?
22. What is your experience with the pool of potential romantic partners at Cal Poly Pomona?
23. In your experience, what characteristics, qualities, and qualifications are most important to potential partners at Cal Poly Pomona?
24. What factors influence whether or not you choose to date Cal Poly students?
25. How would you compare and contrast your romantic experiences with men who attend Cal Poly Pomona, and those who do not?
26. How would you describe the romantic experiences in your social circles and friend groups?
27. Describe the relationship between your social and dating circles. Do they intersect? (why or why not?)
28. How would you compare and contrast hookup culture and dating culture in college?
29. How would you describe your personal experience navigating hookup culture and dating culture in college?
30. How has your race and/or ethnicity impacted your romantic experiences as a college student?
31. How has your gender impacted your romantic experiences as a college student?
32. How does being a black woman impact your romantic experiences as a college student?

Data Analysis

I was inspired by Dr. Tierra Ellis's utilization of Johnny Saldaña's coding methods for qualitative research; specifically, the code-to-theme model (Figure 1) for qualitative inquiry in her doctoral thesis (Saldaña 2016) (Ellis 2018). The recording will be transcribed. During this process, I will change all names mentioned in the recording to pseudonyms. I will go over the transcriptions line by line on the google doc and look for significant or notable sections of conversation the participants voiced. I will highlight these key segments of transcription and insert a comment to assign these key sections a code word or code phrase. These codes will then be divided into categories based on common context. Codes and categories will be cross-examined across all interviews in order to find common themes, and themes that stood out

(Saldaña 2016). I will then record how prevalent these themes were across interviews. After this I will email the findings to participants through @cpp.edu emails so they can affirm whether the results reflect their perspectives. Participants will have the opportunity to suggest codes or themes that accurately reflect their perspectives.

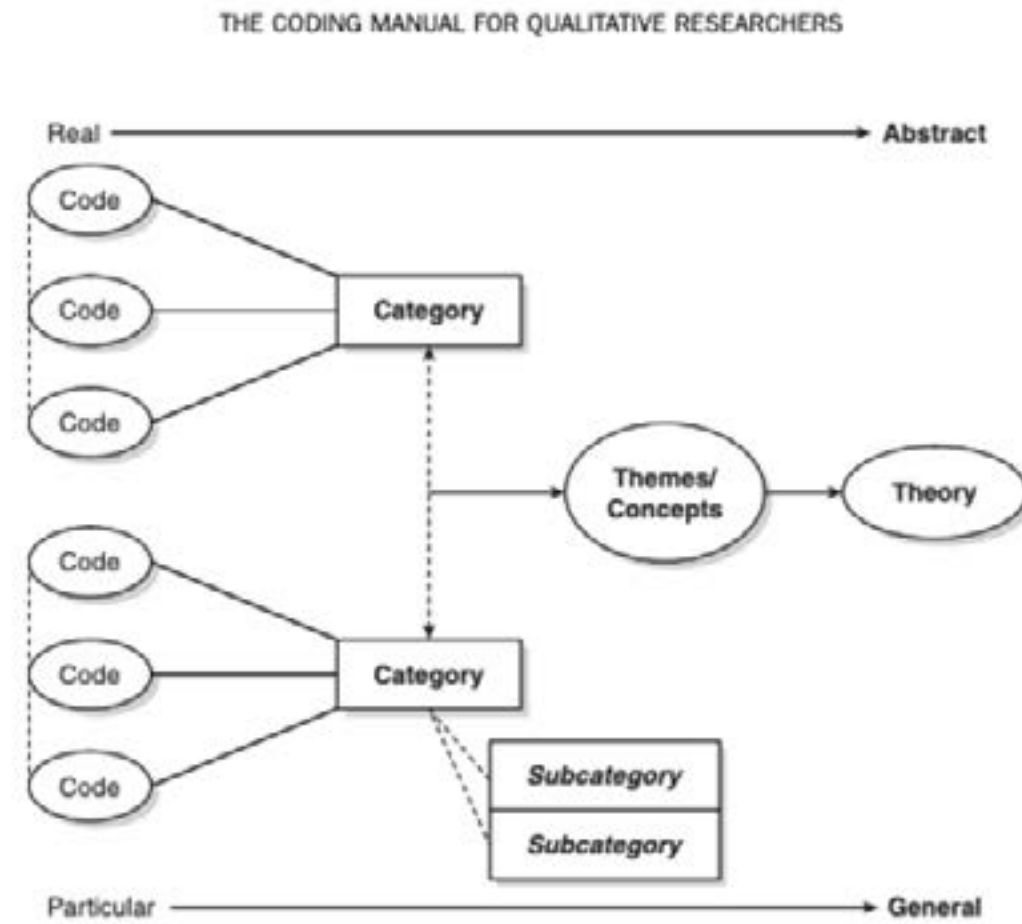


FIGURE 1.1 A streamlined codes-to-theory model for qualitative inquiry

Figure 1. Saldaña (2016) code-to-theme model for qualitative inquiry.

Credibility

This study will utilize method checking and triangulation to better ensure the accuracy of findings. Participants will be emailed to determine if the themes found are an accurate representation of their perspectives. Participants will then have the option to offer themes. This study will utilize triangulation to analyze themes from multiple sources. These sources include themes that arise from coding the interviews and themes suggested by the participants.

Ethical Considerations and Limitations

As a Black male student on campus, I recognize my positionality in carrying out this study. I have had my own experiences dating on campus that could influence my preconceptions going into this research. I am active on campus within the black community. Many of the women participating in this study will be my peers and share the same social and cultural spaces as I do.

This study only sought out students at California State Polytechnic University, Pomona. Additionally, there will only be 5-10 participants who will be interviewed. This may not be fully representative of the target population. Cal Poly Pomona is also unique in that it is a Hispanic Serving institution. This may make the dating experience different than at a predominantly white institution.

Preliminary Themes:

Sex Ratio:

Participants mentioned that there are not enough black men on campus to choose from. They feel limited in their options. Participants mentioned that they date off campus to supplement the lack of black men on campus.

Racial Preferences:

Every single participant had a preference for black men. The majority of them are open to dating men of other races. Of the participants who were open to dating men of other races, half of them mentioned the fear that they would be fetishized by partners of other races. Participants expressed frustration about black men who date outside of their race. Although the act of black men dating non-black women didn't bother all of the participants, they stated that black men are unnecessarily disrespectful to black women when justifying these relationships.

Hook-Up Culture:

All of the participants, especially the ones in lower classes expressed how men on campus are more interested in hooking up than long-term monogamous partnerships. Participants mentioned how they must anticipate whether or not potential partners are honest about their intentions to commit.

Social Costs:

Participants mentioned how their personal dating history is known by members of their social circles. Because of the small campus community, participants mentioned how their dating and social circles intersect. Dating friends leads to drama and social tension among other members of their social groups.

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Flores
Barbara

**Complement Receptor 1 is Not Required for Trogocytosis of
Trichomonas Vaginalis by Neutrophil-like-Cells**

Abstract:

Trichomoniasis is one of the leading Sexually Transmitted Infections (STI) in the United States, and is caused by the unicellular parasite *Trichomonas vaginalis* (*Tv*). Once infected with a pathogen such as *Tv*, white blood cells known as neutrophils act as the first line of defense against the infection. While neutrophils have multiple means of effectively killing pathogens, a novel method known as trogocytosis is used against live *Tv*. During trogocytosis, neutrophils swarm the parasite, ultimately surrounding it, take 'bites', and kill the parasite. There is still much unknown about trogocytosis such as which surface-level receptors are responsible for mediating neutrophil-parasite contact during trogocytosis. However, we hypothesized that the surface-level receptor CR1 helps mediate the process of trogocytosis, due to its involvement in phagocytosis, adhesion, and its other associations with innate immunity. We tested CR1's involvement in trogocytosis by genetically modifying neutrophil-like cells (NLCs) with CRISPR-Cas9 to remove the CR1 gene. We confirmed knockout of CR1 in our NLCs and performed cytolysis assays and trogocytosis assays to determine the effectiveness of the neutrophil trogocytic killing of *Tv* in the absence of the CR1 gene. Here, we show that CR1 is not required for trogocytic killing of *Tv* by NLCs; there was no biologically meaningful significance in the percent death of *Tv*, trogocytosis, or number of NLCs swarming the parasite when CR1 knockout NLCs were used. Understanding the cellular and subcellular mechanisms by which *Tv* are trogocytosed may aid in creating a preventative treatment and improve treatment for after an infection.

Introduction:

Trichomoniasis is the most common non-viral Sexually Transmitted Infection (STI) in the world, and it is caused by the protozoan parasite *Trichomonas vaginalis* (*Tv*) (Cudmore & Geber, 2010). Although Trichomoniasis is one of the most common STIs, it remains a neglected disease due to lack of research on the subject. The mechanisms of infection are not yet well understood (Secor et al., 2014). Currently the treatment for someone infected with *Tv* is purely drug-based, as there is no current vaccine, and common treatments include antibiotics such as Metronidazole & Tinidazole (Centers for Disease Control and Prevention [CDC], 2017). However, drug resistance has been a concern for the treatment of Trichomoniasis as resistance is on the rise, with an estimated 2.5-9.6% reported infections having increased drug resistance to Metronidazole (Cudmore & Geber 2010). It is known that the parasite adheres to host cells through cytoadherence, in which it alters its structure (Mercer & Johnson, 2018). Cytoadherence is believed to broaden host cells surface area coverage, and *Tv* primarily targets host epithelial cells (Midlej & Benchimol, 2010). Additionally, infection with *Tv* may increase the rate of infection with human immunodeficiency virus (HIV) and the malignancy of cervical cancer in the case of co-infection with human papillomavirus (Bhakta et al., 2020).

One of the main symptoms of Trichomoniasis is inflammation at the site of infection, which is commonly in the cervix for females and in the prostate in males (Centers for Disease Control and Prevention [CDC], 2017). Inflammation is a common symptom for most infections, and it is generally caused by leukocytes known as neutrophils. It is established that neutrophils are the first line of defense the innate immune system has to fight pathogens (Punt et al., 2019). Neutrophils dominate the beginning stages of inflammation as they release inflammatory cytokines such as IL-8, effectively recruiting additional neutrophils (Kołaczowska & Kubes, 2013). Neutrophil IL-8 secretion also activates the production and release of other pro-

inflammatory factors, that also recruit additional neutrophils (Kołodziejewska & Kubes, 2013). In addition, neutrophils have the capability to recruit other neutrophils more precisely to the site of the injury by releasing leukotriene B4 (LTB4) (Lämmermann et al., 2013).

When neutrophils are recruited to the site of an infection, they perform a process called transmigration in which they can pass through the capillary walls (Kołodziejewska & Kubes, 2013). Some neutrophils can do reverse transmigration which may help them increase their lifespan as they return to the bone marrow (Deniset & Kubes, 2016). Neutrophils have multiple means by which they can effectively eliminate pathogens such as phagocytosis, degranulation, & NETosis. In the process of phagocytosis neutrophils fully engulf a pathogen, while in degranulation they release toxic granules, and in NETosis neutrophils release condensed chromatin known as NETs to effectively trap the pathogen (Bhakta et al., 2020). It has been found that neutrophils are also capable of a process known as trogocytosis to effectively kill cells (Mercer et al., 2018). Trogocytosis is broadly defined as a cell nibbling on another cell or pathogen (Zhao et al., 2022). Neutrophils have been found to trogocytose opsonized cancer cells, sperm cells and *Tv*. (Matlung et al., 2018, Olivera-Valle et al., 2020, Mercer et al., 2018). In the case of trogocytic killing of *Tv*, once neutrophils come across the parasite, they will swarm the pathogen ultimately surrounding and it, and they then take 'bites' out of the parasite (Mercer et al., 2018). A notable difference in trogocytosis as compared to phagocytosis is that trogocytosis is only performed on live *Tv* while phagocytosis may occur on living and dead cells (Bhakta et al., 2020). It is hypothesized that death of *Tv* occurs once there is an excess amount of 'bites' taken from the parasite; however, there is still much unknown on the specifics of trogocytosis of *Tv*.

As the trogocytic killing of *Tv* by neutrophils is a novel process much is still unknown on the cellular and subcellular mechanisms that may help mediate the interaction between neutrophil and parasite. It has been found that neutrophils trogocytose *Tv* only in the presence of human serum (Mercer et al., 2018). Human serum contains the non-clotting proteins of the blood, which include complement factors, and antibodies (Fanali et al., 2012). It is believed that complement factors, and antibodies, which are created by B-cells, help mediate the process of trogocytosis as they are both capable of opsonization (Punt, 2019). Opsonins function by coating the surface of a pathogen and may help facilitate in recognition and binding of neutrophils to the pathogen. It was found in the absence of antibody binding, the trogocytic killing of *Tv* was reduced about 50% (Mercer et al., 2018). As this only accounts for half of the killing, there is still 50% of killing that is not accounted for. We therefore hypothesize that other surface level receptors known as Complement receptors (CRs) may help mediate the process of trogocytosis, due to the contact-dependent nature of trogocytosis and the CR's capability to bind to opsonins.

The complement system is a major component of the innate immune system, and it is made up of various proteins that can eliminate pathogens or alert leukocytes to the pathogen. There are three main methods for complement activation known as the Alternative Pathway, Classical Pathway & the Lectin Pathway, by which complement can be used to eliminate pathogens. Both the Lectin Pathway & Alternative pathways can be activated by pathogens and result in the creation of protein C3b which functions as an opsonin (Sarma & Ward, 2011). Complement factor I can further cleave C3b to create iC3b which renders it unable to form Membrane Attack Complexes thus it is only capable of opsonization (Xu et al., 2017). As iC3b functions as an opsonin, it is known to aid phagocytosis by increasing the susceptibility of pathogens to being phagocytosed. iC3b is recognized by three Complement receptors that are

present on neutrophils, Complement Receptor 1 (CR1), Complement Receptor 3 (CR3), & Complement Receptor (CR4). In this paper we will focus on CR1's role as previous data support that phagocytosis is mediated by CR1 (Holers et al., 1992). Since both trogocytosis and phagocytosis are contact-dependent methods that neutrophils use to kill pathogens, we hypothesize that mechanisms used in phagocytosis may also be crucial in trogocytosis. Thus, we hypothesize that CR1 mediates trogocytosis of *Tv* due to its role in neutrophil phagocytosis.

Neutrophils however, are the most abundant leukocyte circulating in the blood, they are very short lived and have a circulating half-life of 6-8 hours (Summers et al., 2010). Due to neutrophils short-lived life span it is difficult to utilize them for in vitro experiments, as daily access to human blood would be necessary. An alternative to this is the use of cell lines that can be differentiated into Neutrophil-like-cells (NLCs). Promyelocytic cells lines PLB-985 and HL-60s are commonly used to mimic human neutrophils and have been found to have similar gene expression to primary human neutrophils (Rincon et al., 2018). HL-60s and PLB-985s can be differentiated into NLCs using DMSO and can then be used in experiments to mimic primary human neutrophils. Due to the limitations in access to daily human blood we will use both promyelocytic cell lines HL60s and PLB-985s.

To test our hypothesis that CR1 mediates the process of trogocytosis, we will use CRISPR/Cas9 to knock out the CR1 gene, to assess the effects of neutrophil killing of *Tv* in the absence of the CR1 gene. There are other genome editing tools such as restriction enzymes & zinc finger nucleases, but CRISPR/Cas9 is fast, accurate, and inexpensive to use (Ferreira & Choupina, 2022). CRISPR/Cas9 is a genome editing tool that originated in the adaptive immune system in bacteria, but it has been engineered to be a genome editing tool that can be used in many cells (Ma et al., 2014). CRISPR/Cas9 can be used to disrupt, delete, or insert genes. The

CRISPR/Cas9 complex is made up of the Cas9 enzyme, and a guide RNA which has a target specific sequence. The complex will then bind to the complementary strand of the target DNA sequence; and this will initiate the unwinding of the DNA and cause a double-stranded cut in the DNA. After the double stranded cut, DNA will repair itself by either non-homologous end-joining (NHEJ) or homology directed repair (HDR). If there is no other DNA template available, the cleaved DNA will undergo NHEJ, and the DNA will be disrupted due to potential frameshift mutation, but if there is another DNA template added, it will be used to repair the break and introduce a new sequence (Zhang et al., 2021). Using CRISPR/Cas9 with HDR repair, we knocked out the CR1 gene, and tested the effects on the neutrophil killing of *Tv* in the absence of the CR1 gene. We found that CR1 is not required for killing of *Tv*.

In presence of Heat-inactivated Human Serum, total percent parasite death is reduced.

We had previously found that complement factors may play a role in neutrophil trogocytic killing of *Tv* (Mercer et al., 2018). Due to the short-lived nature of neutrophils (Rincon et al., 2018) it is not feasible to use them in our lab setting as we do not have continued access to human blood. Due to this, we use promyelocytic cells lines HL-60 and PLB-985 in the lab, that can be differentiated into NLCs. To test whether complement proteins were playing a role in neutrophil-like-cells (NLCs) trogocytosis of *Tv*, we needed to remove complement proteins from human serum. We denatured the complement proteins in human serum by heat-inactivation and assessed the amount of parasite death through a cytolysis assay, in which *Tv* and NLCs were co-cultured together with either heat-inactivated human serum or regular human serum. We concluded that complement is playing a role, as there was ~50% reduction in the parasite killing in the presence of heat-inactivated serum compared to regular human serum (Figure 1). Figure 1 shows a significant reduction in the amount of parasite death across NLC: *Tv* ratios 16:1, 8:1, 4:1, 2:1, and 1:1 in the presence of heat-inactivated serum compared to regular serum.

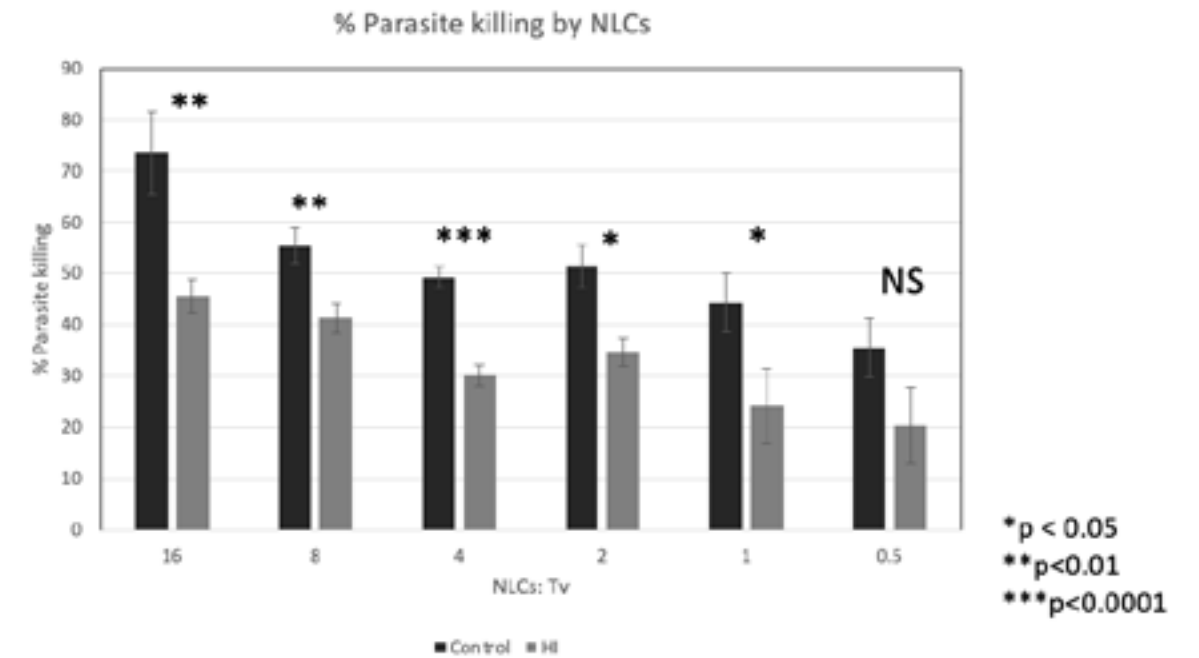


Figure 1: In heat-inactivated serum total percent parasite killing is reduced. Complement factors were denatured in human serum. Both NLC's and *Tv* were co-cultured in regular human serum and heat-inactivated serum for one hour at 37C. Cells then fixed with 4% PFA then analyzed using flow cytometry. Data is the average of two experiments with three replicates across both experiments.

CR1 is expressed on NLCs

Since we found that heat-inactivated serum had reduced NLCs trogocytic killing of Tv, we concluded that complement factors in human serum may play a role in the process. Complement Receptors 1, 3 and 4 (CR1, CR3, CR4) are known to bind opsonin C3b. In this study we are studying CR1. Although neutrophils are known to express CR1 on their surface, it was unknown if both promyelocytic cell lines also express CR1. Both HL-60s and PLB-985 cells lines were treated with differentiation media into NLCs and then NLCs were stained with FITC anti-human CD35 (CR1) antibody and the signal was compared to the isotype control. We observed over 90% CD35 expression in differentiated NLCs (Figure 2). Both cell lines had increased CD35 expression after differentiation, but both undifferentiated cell lines have varying CD35 expression (Figure 2). The cell line chosen to continue experiments with was PLB-985, as other students studying complement receptors in the lab also utilized PLB-985's for their experiments.

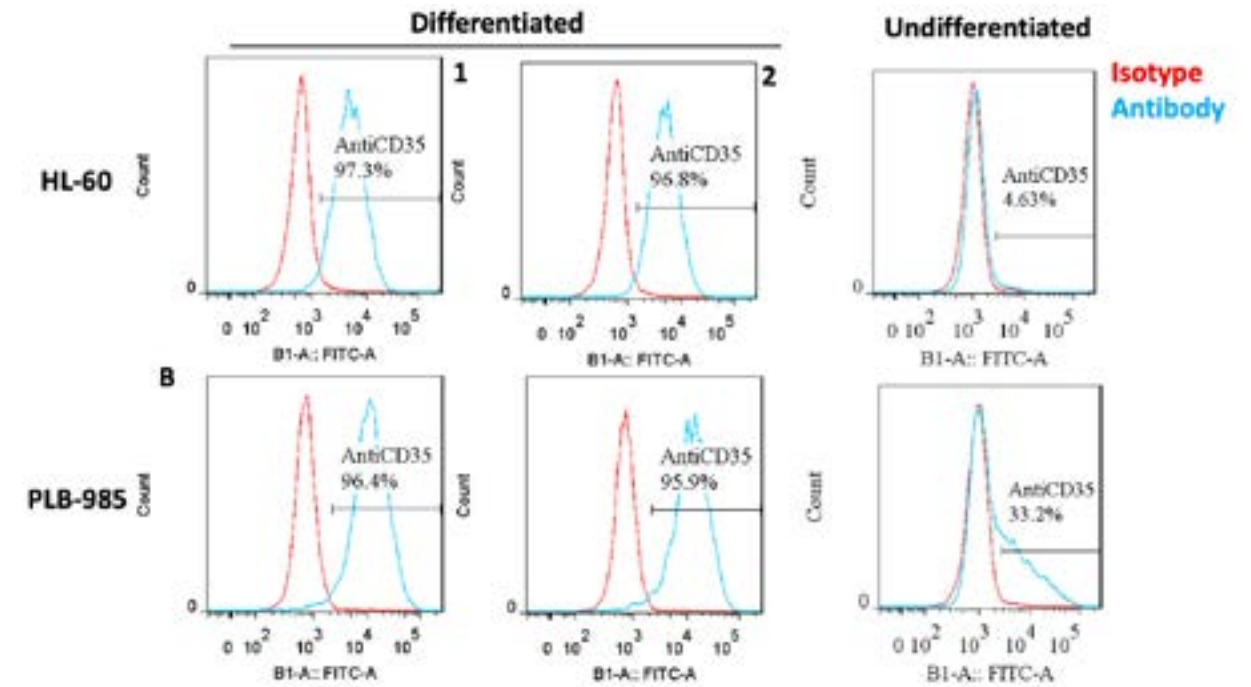


Figure 2: CD35 is present on both cell lines HL-60 and PLB-985 after differentiation into NLCs. Cells stained for CD35 with Anti-CD35 FITC or Isotype MlgG1k. Cells were analyzed using flow cytometry. Images shown are representative of triplicate experiments.

CR1 crRNA design and validation transfection

To examine whether CR1 is required for maximal NLC trogocytic killing of Tv, we aimed to knockout the CR1 gene from the PLB-985 cell line. We designed three crRNAs using the Integrated DNA Technologies (IDT) Predesigned Alt-R CRISPR-Cas9 guide RNA tool for CR1 (Supplemental figure 1). We tested the crRNAs' effectiveness in knocking-out CR1 through RNP transfection using Neon electroporation. We found that we could successfully reduce CR1, using all three crRNAs (Figure 3). Antibody staining showed two populations of cells after transfection, cells that express CR1 and cells that do not express CR1. However, all three crRNAs had varying success rates. We chose to continue with crRNA#2 as it produced the fewest percentage of cells expressing CR1 (Figure 3). However, we also continued with crRNA#1 as an alternate crRNA.

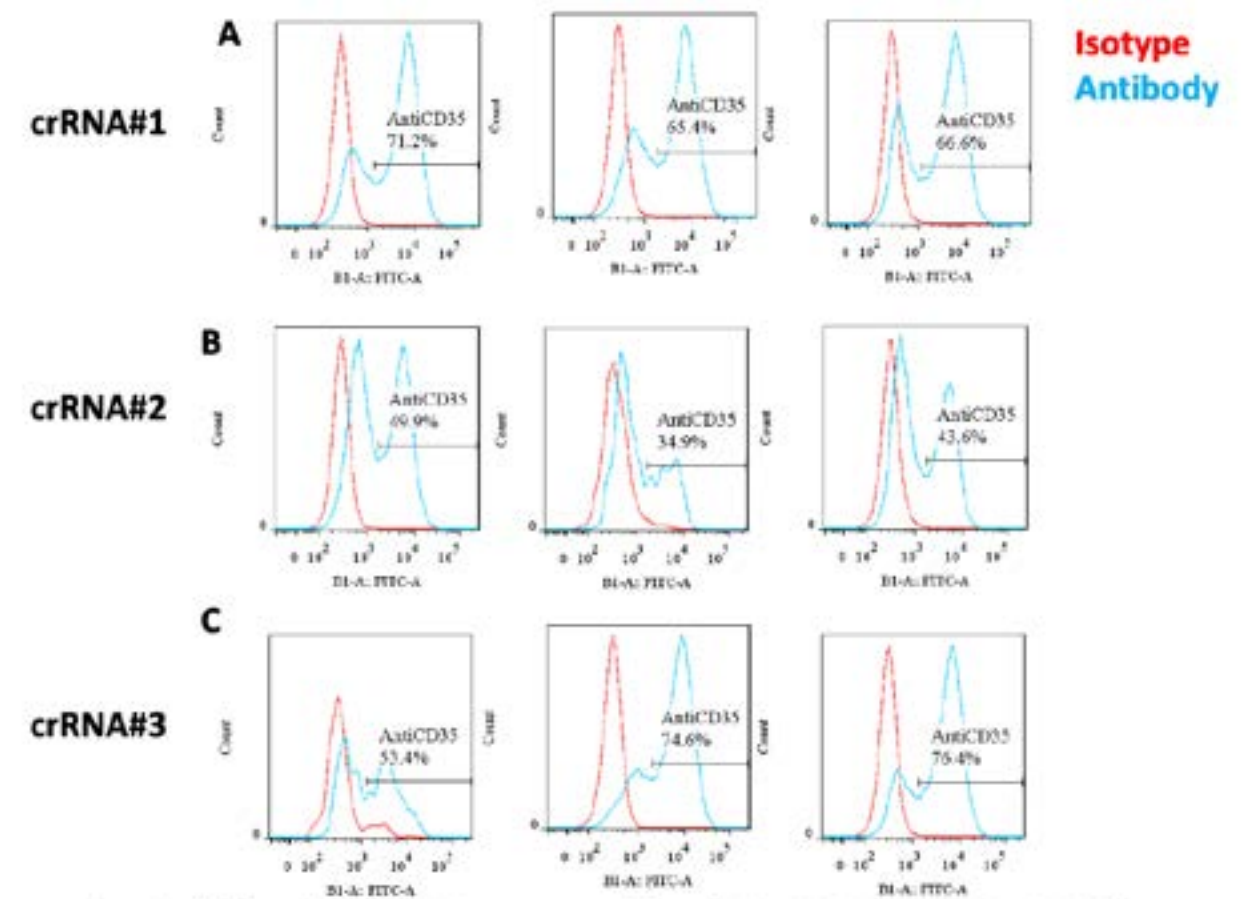


Figure 3: All three designed crRNAs are successful in reducing CD35. Promyelocytic PLB-985's were transfected with crRNA, tracrRNA and cas9 enzyme through Neon electroporation. Cells were then stained with Anti-CD35 FITC or Isotype MlgG1k after recovery and differentiation. Cells were analyzed using flow cytometry. (A) crRNA#1 shows ~30% don't of cells don't express CR1. (B) crRNA#2 shows that ~50% of cells integrated the crRNA. (C) crRNA#3 shows that ~25% of cells integrated the crRNA. Each crRNA done in triplicates.

HDR oligonucleotide transfection

To ensure that transfected PLB-985s had the desired genotype we aimed to ensure that transfected PLB-985s underwent Homology-Directed Repair (HDR) instead of Non-homologous end joining (NHEJ) to avoid unintended mutations. We therefore designed oligonucleotides for crRNA#2 and crRNA#1 with IDT HDR Design tool. We designed HDR oligonucleotides to incorporate a stop or silent mutation at the cut site. We then did a transfection with crRNA#2 HDR oligonucleotides, which had a predicted rate of recombination of 45%. We did the experiment in triplicates, but we chose to continue with conditions Silent 1, Silent 2, Stop 3, and Stop 4 (Figure 4). We also did a transfection on PLB-985s with crRNA#1 in which the HDR oligonucleotide rate of recombination 30% and Silent 3, Silent 4, Stop 1, Stop 2 were chosen to continue with. (Supplemental figure 1).

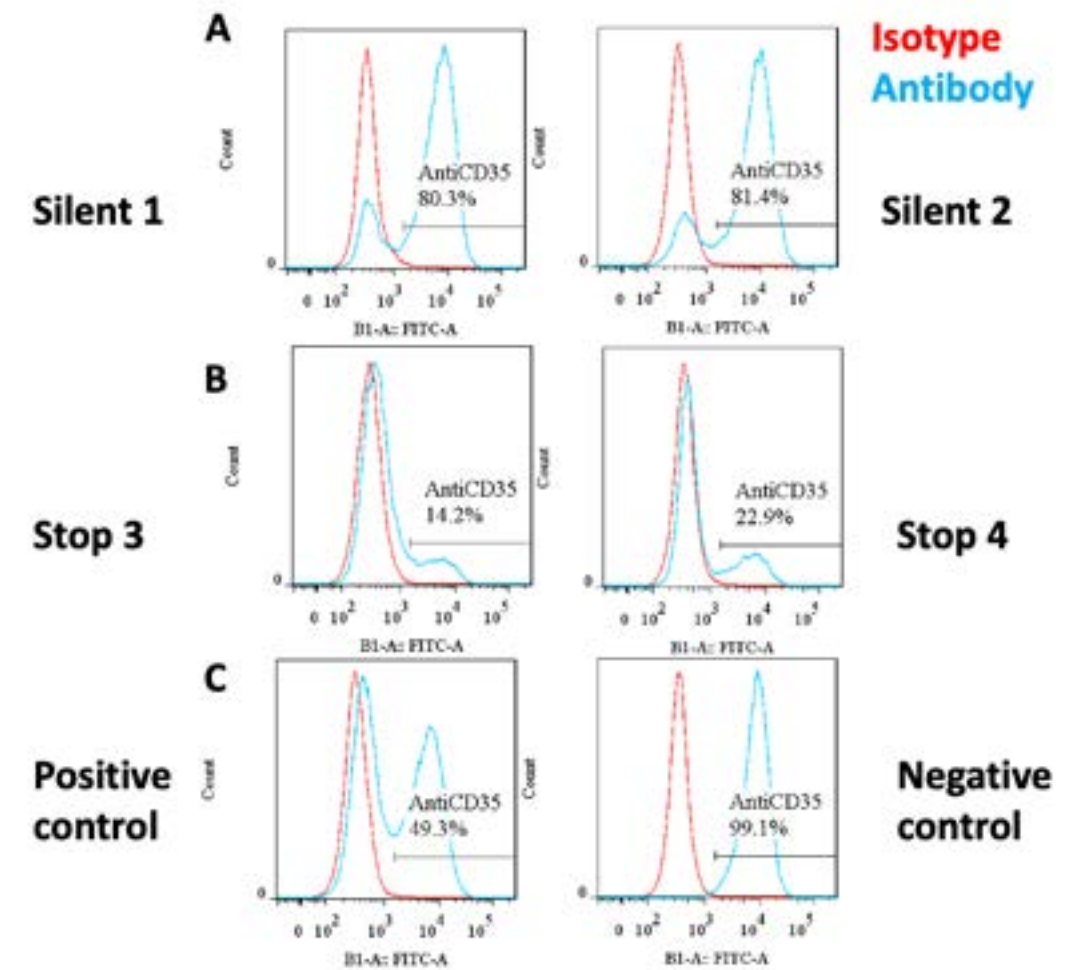


Figure 4: crRNA#2 HDR oligonucleotide transfection successfully rescue or enhance CD35 knockout. Promyelocytic PLB-985's were transfected with crRNA#2, either stop or silent HDR oligonucleotide, tracrRNA and Cas9 enzyme using Neon electroporation. After cells recovered and were differentiated into NLCs they were stained with Anti-CD35 FITC or Isotype MlgG1k. Cells were analyzed using flow cytometry. Images shown are bulk populations chosen to continue with, experiment done in triplicates.

Obtaining Stop and Silent mutant clones for functional assays

To obtain homogenous cell populations with our desired mutations we did single-cell dilution of chosen bulk populations for both crRNAs 2 and 1. The confirmation of the phenotype for the desired mutation was done through antibody staining. We examined whether silent clones expressed CR1 and whether stop clones did not express CR1. All chosen stop clones have minimal expression of CR1 <5% expression, while all silent clones express CR1 >80% (Figure 5). To confirm the genotype, we designed primers to amplify the genomic region surrounding our crRNAs. We then got positive results from our PCR and agarose gel electrophoresis for our DNA, and DNA isolated the samples that had a positive PCR product. We then sent the DNA samples for DNA sequencing. We received confirmatory sequencing results for three stop mutation clones and three silent mutation clones, and these clones were used for cytolysis and trogocytosis assays (Figure 5). However, crRNA#1 had no successful clones at the genotype level and was chosen at this stage to not continue with (Supplemental Figure 2).

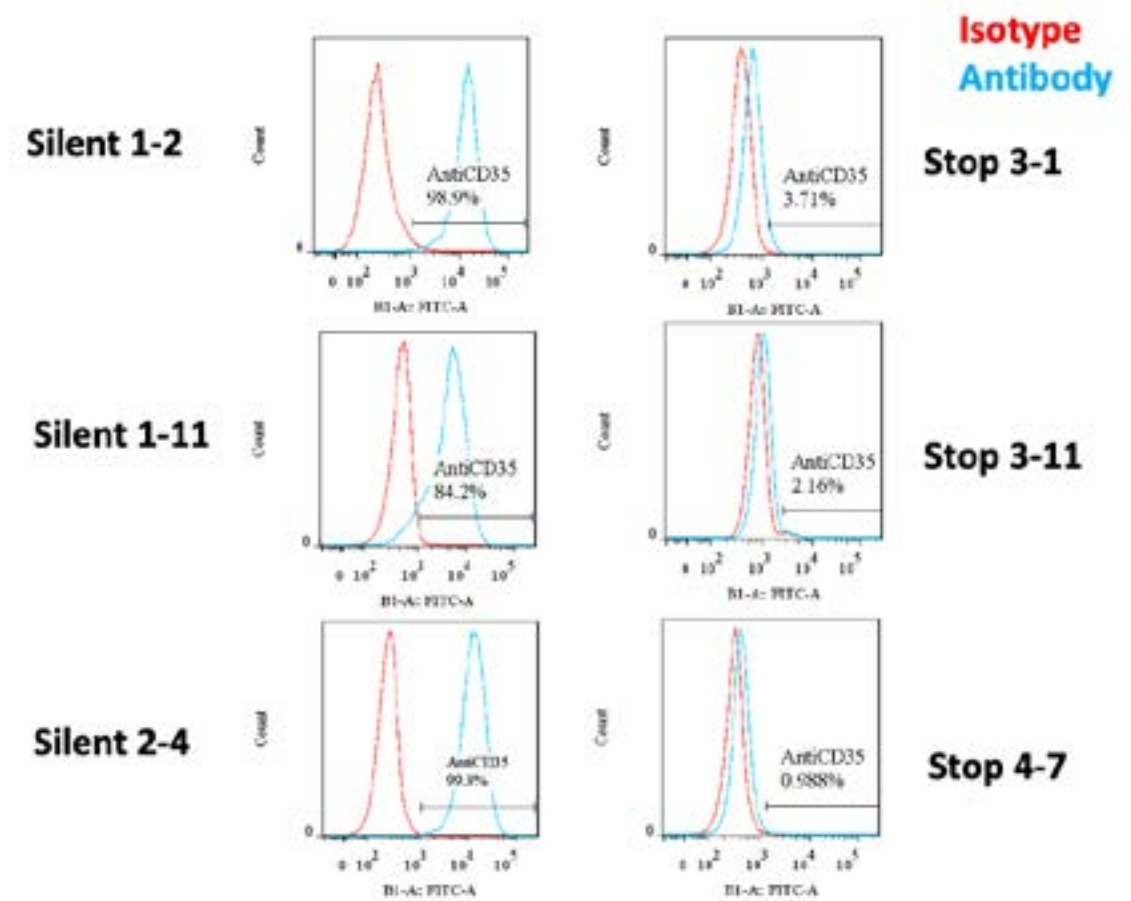


Figure 5: Successfully achieved homogenous populations with either Stop or Silent HDR oligonucleotide incorporation in crRNA#2 transfected cells. Bulk populations underwent Single-Cell Dilution, then PCR and DNA sequencing. Images shown are chosen clones with either Silent or Stop mutation incorporated confirmed by DNA sequencing and phenotype is shown through flow cytometry. Cells stained with Anti-CD35 FITC or Isotype MlgG1k. Cells were analyzed using flow cytometry. Clones named by Mutation Bulk population-Clone number.

CR1 is not required for killing of *Tv*

To examine if there is a difference in percent *Tv* death, we co-incubated *Tv* with both homogenous silent clones as our control, and with our stop clones as our knockout cells. In the absence of CR1 there was no overall significant reduction in the killing of *Tv* with crRNA#2 knockout clones compared to our control clones. There was a significant reduction in the killing of *Tv* in both 8:1, and 2:1 conditions, but it was not as substantial as the decrease in killing in the heat-inactivated cytolysis assays (Figure 6). This indicates that CR1 is not responsible for the almost 50% reduction in killing caused by complement factors as shown in the heat-inactivated cytolysis assay (Figure 1).

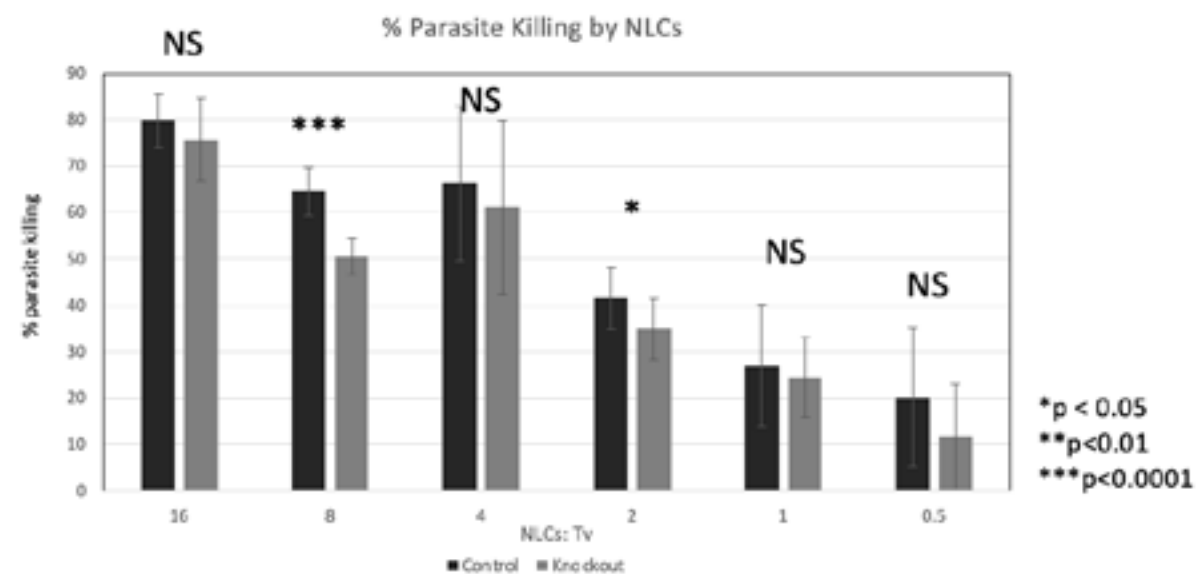


Figure 6: Absence of CD35 shows minor to insignificant reduction in NLC killing of *Tv* in crRNA#2 cells. NLCs and *Tv* were co-cultured with regular human serum, either with silent (control) or knockout (silent) clones. Cells were co-cultured together for one hour at 37°C. After incubation cells were fixed with 4% PFA and cells analyzed using flow cytometry. Data shown is composite of three experiments done in triplicates.

CR1 deficient clones show minimal difference in swarming or bites taken of *Tv*

We did trophocytosis assays to examine if CR1 plays a role in NLCs capability to swarm or take bites of *Tv*. We did trophocytosis assays by co-incubating either homogenous silent clones with *Tv*, or homogenous stop clones with *Tv*. We took note of how many NLCs swarmed the parasite and how many bites they took out of *Tv*. Trophocytosis assays done with crRNA#2 CR1 deficient cells exhibit no biologically significant difference between the number of bites taken per NLC, or in the number of NLCs swarming the parasite at both 10- and 15-minute co-incubation time points. There was a significant decrease in the swarming of NLCs to *Tv* in the stop condition at 15 minutes, but it should not impact our quantification of the number of bites taken by the NLCs overall, because we normalized the data as bites/ NLC to account for the reduced swarming of CR1 knockout NLCs. Overall, we observed little to no difference in trophocytosis of *Tv*, between stop and silent NLC conditions (Figure 7).

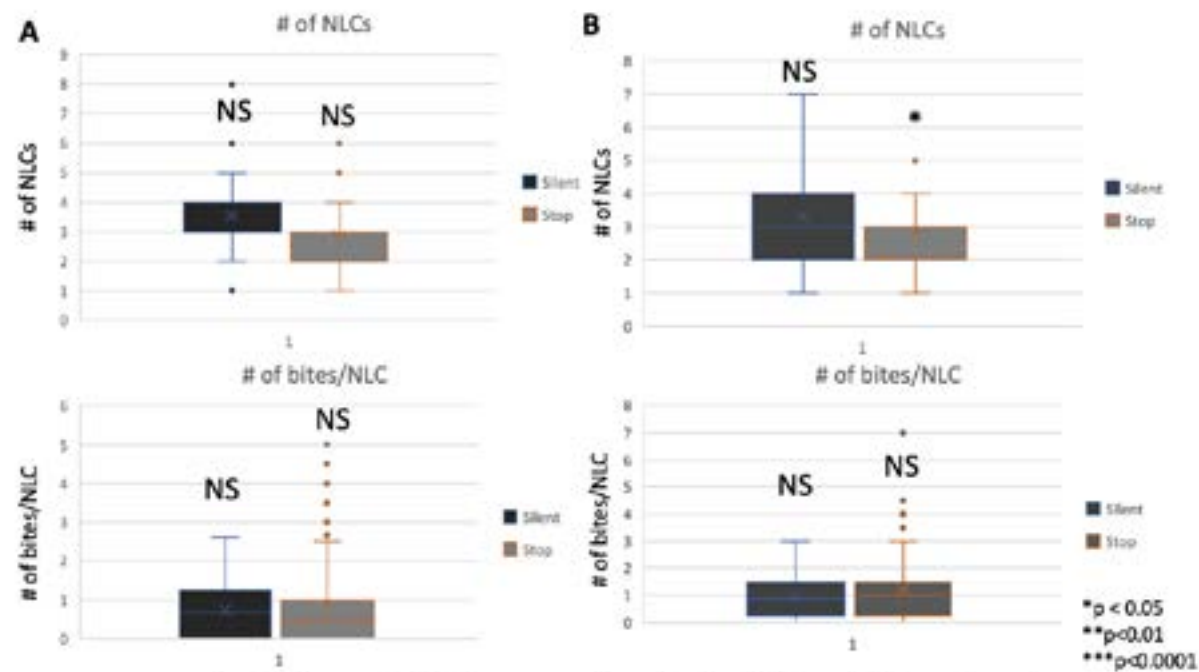


Figure 6: Absence of CD35 shows no or minor reduction in bites per NLC or number of NLC swarming *Tv*. NLCs and *Tv* were co-cultured together on a coverslip at 10- and 15-minute time points. After desired time point cells were fixed with 4% PFA and mounted onto slides. Slides then were examined using confocal microscopy and the number of bites taken from each parasite and number of NLCs swarmed were quantified. **(A)** 10-minute co-incubation time point. **(B)** 15-minute co-incubation time point.

Discussion:

As trogocytosis is a novel mechanism that neutrophils use in killing *Trichomonas vaginalis* (*Tv*), the subcellular and cellular mechanisms are still unknown. There is data to suggest that the complement system may play a role in the trogocytic killing of *Tv* by neutrophils. There is an elimination in the killing in the absence of human serum, which contains both antibodies and complement proteins (Mercer et al., 2018). To determine which complement proteins do play a role in the killing of *Tv*, we knocked out Complement Receptor 1 (CR1) to assess its function in the trogocytic killing of *Tv*. Through this we have determined that CR1 is not required for the trogocytic killing of *Tv* done by Neutrophil-Like-Cells (NLCs).

We further confirmed that complement does play a role in the trogocytic killing of *Tv* by NLCs. This was confirmed in a cytolysis assay with heat-inactivated and regular human serum, as complement proteins should be denatured in the heat-inactivated human serum. In these experiments we observed approximately 50% reduction in the death of *Tv*. We believe it may be due to the opsonization of C3b/iC3b being unable to occur. It has been found that iC3b can bind to *Tv* (Mercer et al., 2018). Complement receptors 1, 3, and 4 are also known to bind to iC3b (Verhoef 1998).

It has been found that CR1 aids in adhesion, phagocytosis and it can bind C3b, and is present on neutrophils (Dustin, 2016), and we show here that it is also present on NLCs (Figure 2). Additionally, data support that phagocytosis is mediated by CR1 through the activation of myeloid cells either through Fc receptors or other immunoreceptors (Holers et al., 1992). Phagocytosis is another method of killing neutrophils use in which they engulf whole pathogenic materials (Uribe-Querol and Rosales, 2020). As both phagocytosis and trogocytosis are known to be contact-dependent, and they acquire pathogenic materials it is possible that many mechanisms used in phagocytosis may also be necessary in trogocytosis (Miyake & Karasuyama, 2021). In

fact, there are several proteins that are used in both processes (Uribe-Querol and Rosales, 2020) however, our results indicate that CR1 may be one protein that discerns the two pathways, because although it plays a role in phagocytosis, it does not play a role in trogocytosis.

Although CR1 is not a key player in mediating the process of trogocytosis, it does play a role in other processes besides engulfment. CR1 has other general functions such as blocking the complement cascade through removal of opsonized antigens, thus regulating the complement system (Oliveria et al., 2019). As previously mentioned, CR1 does play a role in neutrophil phagocytosis. CR1 mediates the process of phagocytosis between salivary neutrophils and *Streptococcus mutans* (Luthfi et al., 2019). CR1 also plays a role in NETosis, as during a blockade of CR1 the induction of NETs was significantly reduced when exposed to *Staphylococcus aureus*, *Aggregatibacter actinomycetemcomitans* and *Actinomyces viscosus* (Palmer, 2015).

Since we found that CR1 is not responsible for mediating the interaction between NLCs and *Tv*, we are interested in the roles of other complement receptors found on neutrophils and our NLCs such as CR3 and CR4. Based on preliminary data it appears that CR3 is playing the major role in mediating the contact between the NLCs and iC3b. It had been found that in cytolysis assays done with NLCs deficient in CR3, there was a reduction in the percent parasite death (~50% compared to the control) in CR3- knockout NLCs (Trujillo, Flores et. al. 2023, manuscript in review). As both complement deficient cytolysis assays (Figure 1) and data from CR3 deficient cytolysis assays have similar percent death of parasites, it is likely that out of the complement receptors, CR3 is the key player in mediating the process of trogocytosis in NLCs. Overall, it appears that CR1 does not have a biologically significant role in the trogocytic killing

of *Tv* by NLCs, but our data show that complement proteins are required for maximum trogocytosis (Figure 1), therefore we hypothesize that CR3 mediates most of this effect.

Material & Methods:

Designing crRNAs:

Integrated DNA Technologies (IDT) Predesigned Alt-R CRISPR-Cas9 guide RNA tool was used, by inputting species, input format, designs per gene and gene name. The tool then produced three recommended crRNA. These recommended crRNA were then tested against the transcript variants and complete genomes taken from National Center for Biotechnology Information (NCBI) and analyzed through an open-source software ApE (A plasma Editor). During cross analysis of the gene sequences, we aimed to find three key criteria.

- 1) Gene sequence present in all DNA, mRNA transcript variants or their reverse complements.
- 2) Presence of a PAM sequence downstream.
- 3) Preferred sequences closer to the beginning of the DNA, mRNA transcript variants or toward the end of their reverse complements.

Designing HDR oligonucleotides:

HDR oligos were designed using the IDT HDR design tool. The location of the crRNA sequence is shown in the tool, and we altered two amino acids next to the cut site and added ~40 bp homology arms on either side of the altered bases. We selected for our desired mutations and confirmed that the genomic DNA at that locus would be altered by searching for our homology arm sequences in NCBI. Then, we confirmed that the mutated sequence fell in an exon and confirmed that the mutations would give rise to stop or silent mutations through amino acid verification in ApE.

Primer Design:

Primers were designed using NCBI primer blast, such the amplified region would be ~500bp in length. We aimed to pick primer recommendations with low self-complementary scores. After selecting our primers, we confirmed our that mutation fell within the amplicon, and ensured that designed primers were specific to the gene. Primers were ordered from IDT.

Mammalian Cell Lines:

Cell lines HL-60 and PLB-985s were cultured in 10% RPMI + HEPES media (Fisher), which was completed with glutamax (Fisher), 10% fetal bovine serum (Fisher), and 1% penicillin-streptomycin (Fisher). Cells were kept in incubator at 37 Celsius with 5% CO₂ and kept at concentrations between 0.2×10^6 and 1.6×10^6 cells/mL.

Differentiation:

PLB-985 and HL-60 cells were differentiated at a concentration of 0.2×10^6 cells/mL using completed 10% RPMI media with added 1.3% DMSO (Fisher) and 100 ng/mL GCSF (Biolegend). Cells were added to differentiating media and kept in incubator at 37 Celsius with 5% CO₂ for 6-7 days until ready.

Antibody Staining:

Cells were stained with a fluorescent antibody specific for CR1 (CD35) FITC Anti-Human CD35 Antibody (CN: 333404 Biolegend) or isotype control FITC Mouse IgG1 kappa (CN:400108 Biolegend). Cells were incubated with antibody or isotype control for 30 minutes at a concentration of 1ug/mL. After incubation, stains were removed through multiple washes with FACS buffer (5% FBS, 0.1% Sodium Azide in PBS). After cells were washed, they were analyzed by Flow Cytometry (MACSQuant Analyzer 10), to measure the expression of CD35. Data was analyzed using FlowJo software.

RNP Transfection:

The protocol for transfection was adapted from "Alt-R CRISPR-Cas9 System: Delivery of ribonucleoprotein complexes into Jurkat T-cells using the Neon Transfection system" which can be found on the IDT website. For crRNA validation only the designed crRNA (IDT) was added alongside the Cas9 enzyme (IDT) and tracrRNA (IDT) to form the RNP complex. For HDR transfections the designed HDR oligos (IDT) and HDR enhancer (IDT) were added in addition. A negative control was also done in each type of transfection which was a mouse crRNA that does not target anywhere in the human genome. All cells were electroporated at [1600V, 20MS, 1 pulse] using the Neon Electroporation system (Fisher). After electroporation, cells were put into 48-well plates with 200uL of complete RPMI without penicillin-streptomycin. For HDR transfection, the HDR enhancer was washed away the next day and cells are placed into a different 48-well plate in the same method as before. Two days after transfection 100uL of the cells will be differentiated for Antibody Staining, and 100uL will be placed in complete RPMI with antibiotics.

Single Cell Dilution:

Cells underwent 10-fold serial dilutions. Cells were counted and serially diluted to a concentration of 5 cells/mL and were plated at 100uL in 96-well u-bottom plates. The outer borders of the plates were filled with 100uL of PBS & plasmocin to prevent contamination. The media was changed every 3 days by removing 40uL of media at an angle to not disturb any accumulation of cells at the bottom, and 50uL of complete RPMI media was added. After three to four weeks pellet formation was noticeable, and they were then expanded from the 96-well plate.

DNA isolation:

Cells were plated to be a 1.0×10^6 cells/mL and were centrifuged at 300g for 5 minutes. After spinning, the supernatant was removed and 100uL NaOH was added and heated on a heat block at 95 Celsius for 20 minutes. 10 ul of 1M Tris-HCl was added after the heating period and was centrifuged at high speed for one minute. After spinning 40uL of the supernatant was taken and put into Eppendorf tubes and frozen at -20 Celsius.

PCR & Gel Electrophoresis:

Samples were prepared with 23uL nuclease free water (Fisher), 0.5 uL of forward and reverse primer (IDT), 25 uL of Hotstart Taq polymerase (Fisher) and 1 uL of DNA isolate. The samples were then placed in the thermocycler at 95 Celsius at 4 minutes for initiation, 95 Celsius at 30 seconds for denaturing, 56 Celsius for annealing, and then at 72 Celsius for 35 seconds which ran 40 cycles of denaturing and annealing. Samples are then held at 8 Celsius, after the samples were loaded at 10uL with 2 uL of loading dye on a 1% agarose gel with Ethidium bromide (Fisher) for 15 minutes at 100V. Bands were then visualized under a UV light box.

DNA Sequencing:

PCR products were purified using invitrogen PCR purification kit and the protocol provided in the kit. The purified products were then sent to Laragen Sequencing, and results were analyzed by comparing the company's results to the sequencing of our designed HDR oligonucleotides, and the wild type of the gene in ApE to confirm if desired stop and silent mutations were present.

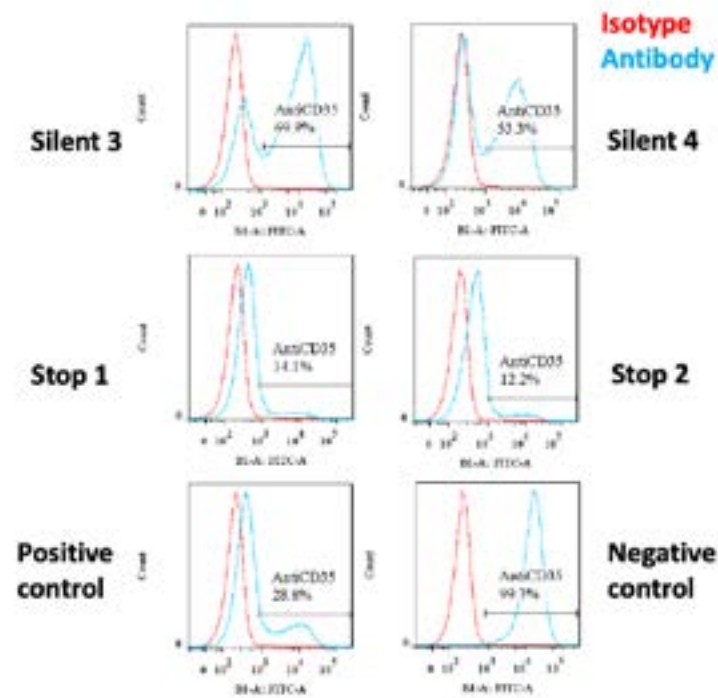
Cytolysis Assay:

Assays were performed by staining *Tv* with Cell Tracker Green (Fisher) and then cells were incubated for 45 minutes in the dark and were then rescued. NLCs were stained with Cell Tracker Deep Red (Fisher) and incubated for 15 minutes separately of *Tv* in the dark. After

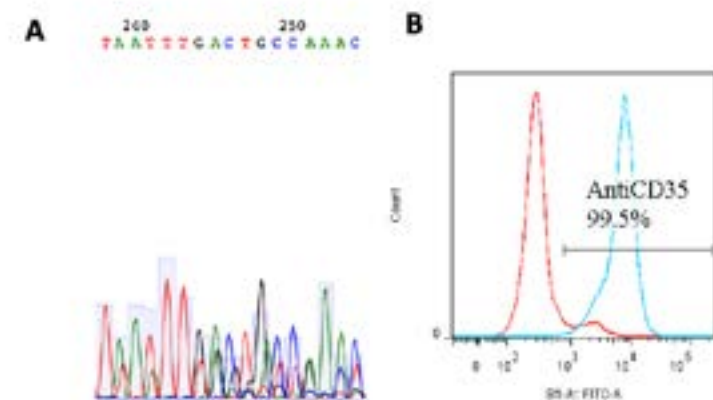
incubation with the stains, both parasites and NLCs were resuspended in complete RPMI. NLCs were resuspended to be at a concentration of 240k cells/50uL. Parasites were resuspended to be at 15k cells/50uL. Cells were then co-cultured with 10% human serum in the dark in the incubator for one hour. Cells were plated at NLC:*Tv* ratios of 16:1, 8:1, 4:1, 2:1, 1:1, 0.5:1. After the one-hour incubation, cells were fixed with 4% PFA (Fisher) to be analyzed by Flow Cytometry (MACSQuant Analyzer 10) on the same day or following day. The Software Flowjo was used to determine the number of live parasites, to calculate the percent cytolysis.

Trogocytosis Assay:

Assays were performed by preparing coverslips with Poly-L-Lysine which was then washed off in preparation of co-culture of *Tv* and NLCs. To prepare *Tv* they were labeled with EZ-link biotin (Fisher) and Streptavidin Alexa-488 (Biolegend) and resuspended at 0.4×10^6 cells in complete RPMI. NLCs were resuspended to be at a concentration of 4×10^6 cells in complete RPMI. NLCs were combined with human serum at a 4:1 ratio and were plated on the coverslips in 12-well plates and put in the incubator for 20 minutes. After the 20 minutes 900uL of parasites were then added in dropwise fashion and were placed back in the incubator for their desired time points at 10 minutes and 15 minutes. Plates were then fixed with 4% PFA (Fisher) and coverslips mounted on microscope slides for imaging. The slides were then imaged on a confocal microscope to determine the number of NLCs, and the number of bites taken per NLC.

Supplemental Figures:

Supplemental figure 1: crRNA#1 HDR oligonucleotide transfection successfully rescue or enhance CD35 knockout. Promyelocytic PLB-985's were transfected with crRNA#1, either stop or silent HDR oligonucleotide, tracrRNA and Cas9 enzyme using Neon electroporation. After cells recovered and were differentiated into NLC's they were stained with Anti-CD35 FITC or Isotype MlgG1k. Cells were analyzed using flow cytometry. Images shown are bulk populations chosen to continue with, experiment done in triplicates.



Supplemental figure 2: crRNA#1 failed to produce clones which successfully incorporated HDR oligonucleotides genotypically. (A) shows clone crRNA#1 Silent 3-16 DNA sequencing which shows a successful incorporation of silent mutation; however, the DNA sequencing is very low confidence. (B) Clone crRNA#1 Silent 3-16 Antibody Stain, differentiated cells stained for CD35 with Anti-CD35 FITC or Isotype MlgG1k. Histogram shows phenotype of CD35.

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Flores
Johanna*

Latinx/a/o Parents' Knowledge and Perceptions of Social
Emotional Learning

Research Problem

There is an abundance of research on social-emotional-learning (SEL) and its various subcategories (e.g., SEL programs, SEL cultural responsiveness), as well as studies examining the opinions of what schools, teachers, and professionals like administrators and school psychologists think about SEL and its varying subcategories (Durlak, et al., 2011; Marisha et al., 2018). However, there is a lack of parent presence in the SEL academic conversation and including parents in this conversation could be helpful as parents/caregivers play a big role in their child's development. SEL curricula and teachers do play a big role in aiding in the success of social-emotional learning, but parents have an equal or bigger role in aiding in that success too. Yet, there are scarce studies demonstrating how parent involvement can aid in cultivating SEL skills learned. Furthermore, there are even fewer studies solely focusing on parents and their thoughts and knowledge on SEL (i.e., which fuel the research on how parents can help cultivate SEL skills learned). To illustrate this, when I searched social emotional learning in PsycInfo, it led to 2,792 entries but adding the keyword "parents" led to roughly ten entries and adding the keyword "Latino" roughly led to three entries. Given these gaps in the literature, this study incorporated parents' voices, specifically Latinx/a/o parent voices, into academic conversation by investigating their experience, such as knowledge and perceptions, of SEL to fuel greater academic conversation and future directions. For example, to help researchers and practitioners to more effectively include Latinx/a/o parents in SEL programming, amplify underrepresented voices, and more.

Purpose Statement

What is Social-Emotional Learning

In 1994 the Fetzer Institute a nonprofit located in Michigan held a conference with people from various disciplines (e.g., researchers, educators, etc.) with "diverse interests related to meeting the developmental, psychological, educational, and general health needs of children" (Elbertson et al., 2010, p.1) to address varying issues (e.g., violence and drug use among youth) and find solutions to promote healthy behaviors/choices and help in the prevention of unhealthy ones (Elbertson et al. 2010). From the conference, the term social-emotional learning came to be and was described as "a framework for providing opportunities for young people to acquire the skills necessary for attaining and maintaining personal well-being and positive relationships across the lifespan (Elbertson et al., 2010, p.1)." In sum, social-emotional learning (SEL) is about holistic development. So, it is about helping youth grow and develop their social-emotional skills (i.e., their self-management skills, interpersonal skills, self-awareness skills, self-control skills, prosocial behaviors, etc.).

This conference also led to the creating of the Collaborative for Academic, Social, and Emotional Learning (CASEL) with the goal of “establishing high-quality, evidence-based SEL as an essential part of preschool through high school education (Elbertson et al., 2010, p.1).” Currently a big proponent of pushing SEL is CASEL whose headquarters reside in Chicago, Illinois.

In addition, the California Department of Education (CDE) uses CASEL’s SEL research/core principles to inform their SEL implementation (“California Transformative SEL Competencies - Social and Emotional Learning (ca Dept of Education),” 2020). Not only does CASEL provide and try to spread awareness and knowledge on SEL backed by empirical research that help inform others like the CDE; they also try to implement SEL research into action. For example, through CASEL’s Collaborating District Initiative they have partnered with various school districts across the country with the goal of trying to steadily implement SEL systemically. In addition, they provide “free field-tested resources to support SEL implementation in districts and schools” as a part of their District Resource Center and Guide to Schoolwide SEL (“Our Mission and Work - CASEL,” 2021). Furthermore, they have ‘Learning Together SEL Workshops’ for educators to help them integrate SEL in their schools and school community. However, CASEL doesn’t stop there, they’re also a big player in trying to inform SEL policies and more information about CASEL and their SEL policy implementation and actions can be found on their website: <https://casel.org/about-us/our-mission-work/>. So, a big proponent for SEL and SEL programs is CASEL, but the people who determine when and how SEL is implemented is the state, the state’s department of education, and the school’s administration and whether they can and want to implement SEL programs in their schools (Wallace 2021).

Research shows that SEL, specifically SEL programs, are tailored as prevention and promotion programs and the foundation of the successfulness of these programs are partnerships between a child’s school, family, and community (Zins & Elias, 2007). Furthermore, research has also shown the various positive effects of SEL and SEL programs. Not only does it have positive personal effects, but it predicts academic success, especially for early childhood school readiness and classroom adjustment (Denham & Brown, 2010). So, with research stating that it takes an integrated and coordinated system to support and help children learn and cultivate SEL skills: Are parents as involved as teachers or their school community? Well, there aren’t many SEL programs that are parent friendly/inviting. For example, out of Los Angeles Unified School Districts’ (LAUSD) SEL unit programs only one of four had a parent/caregiver support program. In addition, parent programs/classes offered aren’t readily available and some aren’t cost friendly. For example, the top parent organizations available when parent classes are typed into google is Child Parent Institute, The Parent Project, and Family Paths. Out of those top three organization the only thing close to a parent SEL support program is a class on positive parenting. Furthermore, if a parent needs/wants to take a parent class in person there is no free or cost-friendly options available. This limits parents severely, especially parents that don’t have internet/technology access or knowledge. Moreover, one of the few parent programs that is adopted by school districts and offers SEL support for parents is The Incredible Years Program. But this program is only offered by certain school districts like Pomona Unified School District and promotion isn’t big for it as parents that join, join because they have been referred to. Therefore, we see that there are little to no SEL support program

options available and that there are many hurdles parents have to get through (e.g., financial and accessibility) to even attempt to attend one. And parents have many other responsibilities (e.g., family and personal life, job, life, etc.) and things to hurdle over and parenting classes/programs shouldn’t be a hurdle deterring parents. So, in knowing that parents also play a vital role in their child’s SEL development and cultivation of skills learned it would be logical to have parents involved: but they’re not.

Latinx/a/o Parents

According to the United States Census Bureau, (2020) Latinos are the second largest racial/ethnic group and the largest ‘minority’ group in the United States. And what it means to be of Latinx/a/o background is any person of Mexican, Puerto Rican, Cuban, Central or South America, or other Spanish culture or origin, regardless of race. Moreover, the Latinx/a/o population has reached a whopping 62.1 million in 2020 and was one of the fastest growing groups between 2010 and 2020 according to the U.S. Census (2020). Furthermore, the U.S. census states that with the growth of the Latinx/a/o population Latinx/a/o enrollment has also risen. So, we can infer that the majority of K-12 enrollment in the U.S. is comprised of Latinx/a/o youth. Moreover, according to new U.S. Census population projections (U.S. Census Bureau, 2019) there is going to be a Latinx/a/o population boom where most of the younger generation is going to be Latinx/a/o.

Given that the Latinx/a/o population is large and growing, it is important to make sure that interventions are effectively targeting this group. For SEL, a key step is to help Latinx/a/o parents understand the purpose and process of the practices and to know how to reinforce these learning at home. It’s also important to investigate Latinx/a/o parents because research by Castro-Olivo and others revealed that SEL specifically school-based SEL programs are extremely beneficial in helping Latinx/a/o immigrant youth’s coping skills develop to help mitigate the life-changing transitions they must face (Castro-Olivo & Merrell, 2012). Therefore, awareness/knowledge of SEL and SEL programs are critical to Latinx/a/o parents because they can help their child learn and cultivate SEL skills to help them navigate the barriers of living as an immigrant youth or person of color in the U.S.: or help them have the awareness/knowledge to seek out SEL-based programs or materials.

Current Study

Current SEL and SEL program-based literature shows that SEL has academic and personal benefits (Domitrovich et al. 2007) (Denham & Brown, 2010). In addition, a key element of SEL is the inclusion of teachers, administrators, school psychologists and other voices in research (Durlak, et al., 2011; Marisha et al., 2018). However, as mentioned, there is a considerable gap in the involvement of parent voices in the SEL academic conversation; there are much fewer “minority” voices like the Latinx/a/o voices as demonstrated in the beginning with the lack of PsycInfo results. Thus, this the purpose of the study is to address current gaps in research with relevance to the growing Latinx/a/o population by examining and exploring Latinx/a/o Parents’ knowledge and Perception of Social Emotional Learning.

Implications

These findings can inform school administrators and faculty on how to effectively communicate and engage Latinx/a/o parents regarding SEL, especially communicating SEL in a culturally sensitive way. Furthermore, findings can help make sure that SEL and SEL interventions can help support all youth (e.g., immigrant youth).

Research Question(s)

1. What are Latinx/o/a Parents' knowledge of Social-Emotional Learning?
2. What are Latinx/o/a Parents' Perception of Social-Emotional Learning?

Methods

Approach and Methodology

The study's research objective is to explore and understand Latinx/a/o parents' knowledge/awareness and their perceptions/attitudes of social-emotional learning.

Sampling and Recruitment

The study consisted of six participants who are from a Latinx/a/o background meaning any person of Mexican, Puerto Rican, Cuban, Central or South America, or other Spanish culture or origin, regardless of race. The purpose of six participants is to try and attempt to recruit participants with children of different ages to gain a range of perspectives within this group. Convenience sampling will be utilized to recruit participants and there will be inclusion criteria for people to join the sample (i.e., parents, being Latinx/a/o).

Due to the multigenerational makeup of the population, various methods of recruitment were utilized, including emails, interest surveys, and physical flyers posted at churches, community centers, libraries, and other public areas. Additionally, snowball sampling was utilized to recruit participants as the researcher asked their personal and professional network to help connect them with Latinx/a/o parents they know of. From there the researcher followed up with participants based on their preferred contact method and reviewed the purpose/aim of the study while describing what they will be doing. The researcher then identified what interview modality works best for participant: in person or virtual and from there secured a safe location that is best for the participant. Additionally, participants were given \$10 as a thank you for their participation.

Data Collection Tools and Strategies

For this study, the methodology that was utilized was semi-structured individual interviews with open-ended questions. In addition, participants were asked to complete a demographic questionnaire covering topics such as race/ethnicity, generation, gender, educational level etc.

The logistics of the interviews were as follows: the interviews ranged from 45 minutes to 1 hour long, involved one interview per participant, and were conducted in English or in Spanish based on interviewee preference. The interview process was as follows: participants were asked to provide informed consent and then complete the demographics survey. After that the interviews began and if the parent doesn't know about SEL, then information materials and didactic reviews were completed with the parents and then follow up questions were provided. From there, transcriptions were created from the individual interviews and there was proper security and safety of files (i.e., it was kept behind a password protected computer and that is stored in an encrypted cloud folder managed by Microsoft and the laptop is kept in a secure room behind a closed door that is locked with a key only accessible to the researcher).

Data Analysis

An inductive approach to thematic analysis was utilized (i.e., researcher looked at the transcripts and by using In vivo where the researcher allowed themes to arise from the data) to analyze data. Furthermore, the researcher's thematic analysis was guided by two qualitative coding approaches (i.e., in vivo coding and pattern coding) and was utilized to help to code where an interrater reliability score will be reported. There was a total of four researchers that helped in the theme creation process and three researchers that helped in the coding process. Finally, the researcher used bracketing to mitigate impacts of bias.

Results

There were two research questions that this study was aiming towards answering. The first was what are Latinx/a/o parents' knowledge of social emotional learning (SEL) and the second was what are Latinx/a/o parents' perception of social emotional learning (SEL). Specifically, what was trying to be investigated in terms of knowledge was seeing if parents know about SEL, what their goals are, what the practices are, what's being done at their children's schools, etc. In terms of perception the aim was to investigate what do parents think about SEL, do they think it's good or bad, do they have any misconceptions, do they think it's needed/useful, etc. With having those investigative questions in mind, the semi-structured interview guide consisted of thirteen questions framed to answer each research question. From those thirteen questions three main points came from the data, which was exposure to SEL, feelings about SEL, and concerns with SEL.

Knowledge/Exposure to SEL

To see what participants knew about SEL, they were first asked if they have had previous exposure to SEL. From that inquire it what was found that the majority (n = 4, 67%) said they have heard/been exposed at some point and time about SEL, but only (n = 2, 33%) knew what SEL was about and specific things it entailed (i.e., knowing that SEL was about being able to have control over emotions, relationship skills, responsible decision making, etc.).

To further investigate parents' knowledge of SEL, they were asked how they came to know about SEL and from that inquiry two themes arose. The first one was incidental learning which was defined as being exposed to or learning about SEL by accident or through education per a requirement for a specific major. The second theme was indirect experiences which was defined as leaning or being exposed to SEL through spaces that are considered personal (e.g., like through a conversation) and/or public (e.g., parenting classes, work, etc.). From these two themes the majority (n = 4, 67%) of participants had been exposed to SEL through incidental learning specifically through higher education per a social science major. In addition, (n = 2, 33%) there were two participants who were exposed to SEL through indirect experiences such as work and parenting classes.

Perception of SEL

Regarding perception/feelings about SEL various questions were asked to capture what participants thought of SEL and if they had negative or positive views on the term. The first question asked was, In your opinion, when you hear the term social and emotional learning (SEL) what comes to mind? The major theme that arose from this question was mother perspective defined as a mother answering the question in regard to her duty as a mother (e.g., talking about their kids, their experiences as a Latinx parent, and super mom pressure). To demonstrate this, when asked what comes to mind when they hear SEL one mother stated:

"The first thing that came into mind was my mother perspective because my kids are always like, even when I answer questions in class, I always think about my kids."

Another mother stated:

"The first thing I think of um well my mind is always about my kids. I honestly, my three-year-olds and their tantrums..."

Another question that was asked was, How do you feel about SEL? And all participants (n = 6, 100%) felt that it was a convenient social skill which was the major theme for that question. Convenient social skill was defined as parents believing SEL is important and sees benefits for all types of people (e.g., kids/adults). To demonstrate here are excerpts from two parents that echo's and shows how all participants viewed SEL as a convenient social skill:

"I think it's a great skill, like a lot of skills everybody should learn, and especially as teachers and parents and everybody to know."

"I think it's a good thing for kids and adults to be exposed to because I had never heard the term previously, um so I had no idea what that meant. But I think it's something good to start to implement into either an adult's or a child's life because I think it will greatly benefit them as a person."

From the main question about asking participants how they felt about SEL followed two probing questions to further gain insight on parents' perceptions of SEL. The first probe was, Do you think it's useful/necessary? Where all participants (n = 6, 100%) said yes, they think it's useful. From that followed the second probe where participants were asked, Do you have any concerns about it? From this probe emerged a theme of multicultural concerns with SEL which was defined as parents expressing the want for SEL to be applied in a culturally specific context (i.e., applying SEL within multigenerational systems and cultural norms and dealing with social dilemmas like living in a multigenerational household). Provided are some quotes to illustrate the common concerns with parents not knowing how to mitigate conflict caused by multi-generational thoughts on SEL and how to parent around SEL related practices-and concerns with culturally embedded norms and how to move away from harmful ones like using a sandal as a form of a threat:

"I still live in, like, a multi-generational household, so it's...us and we have a pretty large family in one household, so there are many players that apply um for sure pressure, because even when I want to raise my kids a certain way, you've got those other players where it's like oh yeah we're going to do things this way..."

"I mean, we are trying to like change the way that we were like you know um raised with like you know the chancla, like for me it's hard not to use the chancla to scare my kids when uh like that's what I grew up with..."

A minor theme that came up was lack of knowledge which was defined as participants not knowing about SEL and wanting or wishing they knew more about it and believing that everyone should know about it. This theme only came up for two parents (n = 2, 33%) for this question and these were some of their concerns:

"No misconceptions. It's just when you grow without being exposed to it as a child all the way up to adulthood, it's difficult to try to implement that into your adult life and then try to implement that or show your child how to have it or how to use it everyday life."

"Yes [has concerns with SEL], I would like to know more about it."

Intergenerational Experiences

Within investigating parents' knowledge and perceptions of SEL a reoccurring theme came up throughout the interview and that was parents talking about their intergenerational experiences and how those experiences shaped their thoughts and perceptions as well as their parenting style when it came to things related to SEL. Intergenerational experiences was defined as, participants sharing their experiences of growing up and how they were raised (i.e., experiencing having strict or emotionally unavailable parents), sharing how their personal experiences affected them (i.e., having low-self-regulation skills, not being patient, etc.), reflecting on their childhood experiences, personal interactions involving SEL, and recognition of importance of SEL due to the lack of SEL they had from their past experiences. Some excerpts of this theme include:

"...my parents were always like, we don't show our feelings, um which was hard for me growing up because I was actually a very emotional person"

"I had a rough childhood in the sense that I... didn't have love at home, and that's also important. And so I had like to go out and learn everything on my own and from making mistakes"

"I do tend to like raise my voice a lot, and um and then that's something that like I would always told myself. Like I don't want to be like my mom always yelling, you know but then but I catch myself..."

"I'm trying to...try to like change it when I raised my kids, but a lot of the past of how I was raised is also it slips out sometimes too..."

"I remember like back in my past when I was a kid being so like angry sometimes and not knowing how to communicate with my parents, um and I didn't want that for my kids"

With participants being reflective of their intergenerational experiences came them talking about how they developed certain parenting practices due to those experiences. From there the minor theme of developing parenting practices emerged which was defined as participants using past experiences to guide their parenting. Below are some quotes that help illustrate this:

"...for me, it was important that everything that I didn't have growing up that my child had. So that was important for me. I didn't want him to have to lack all these skills at an early age because I knew that growing up, it was going to affect him, like, in terms of his self esteem, and it was going to just affect them"

"I wasn't taught to be like they didn't they didn't come and explain to me, like, hey, this is why you're getting punished you know look at the point of views of things. Like so I I do I do um discipline my children a little bit more different than when my parents would discipline me."

"...there's a lot of difference between the way I was raised and the way I'm raising my kids"

Children and SEL implementation/Knowledge

Discussion

The present qualitative study used semi-structured interviews to explore what were Latinx/a/o parents' knowledge and perceptions of social emotional learning (SEL). Specifically, what was being explored was to see if parents had previous knowledge of SEL and if so how did they come to learn or know about it among other things. Furthermore, the other thing investigated was seeing what perceptions parents had about SEL (i.e., did they think SEL was good or bad, did they think it was useful, etc.). The key results found was although the majority of parents heard or knew a little about SEL the majority didn't fully understand or know key principles of SEL nor implementation practices. In addition, there were no negative feelings or misconceptions about SEL reported. On the contrary all participants stated positive feelings towards SEL, however, there was significant

multicultural concerns posed.

So, what does this all mean? Representative of my sample who was working-middle class middle-aged parents who for the most part had at most a college degree---yes have heard of the term SEL but the overwhelming majority didn't fully know what SEL was (i.e., what the goals are, practices, or what it entails like responsible decision making etc.). This poses major concern because if this part of the Latinx/a/o population (i.e., middle-aged, working-class, college educated) didn't know about SEL then there is a very high chance that the majority of Latinx/a/o parents don't know about SEL even with a college degree or higher (i.e., unless their field of study was related somehow to SEL) So, there seems to be a disconnect of information for parents, specifically, Latinx parents about SEL. There seems to not be enough awareness about this concept nor any place, city, school that is Latinx serving that's promoting this concept either. This lack of publicized SEL was evident when parents were stating that they don't know if their child's school has an SEL program in place or SEL programs in general. Furthermore, the one parent that said yes there is an SEL program in their child's school didn't know anything else about it. As illustrated earlier there are few school-based SEL programs that have a parent program component and even less programs that have culturally tailored content. With that said, there is a clear accessibility problem with acquiring SEL knowledge within the Latinx community. In addition, the data showed that the participants had the necessary tools and willingness to learn about SEL and implement its practices but didn't know how or where to start nor aware that some of their parenting practices were related to SEL.

With that said, why do these results matter? To reiterate why SEL and Latinx parents is an important topic to investigate is because the Latinx population is the second largest racial/ethnic group and growing. So, we can infer that the number of Latinx parents and school enrollment will increase. Given that inference, it's important to see how SEL can be used as a tool to help this population as SEL has been established to have long-lasting benefits that not only help interpersonally and interpersonally but academically as well. In addition, as mentioned, Castro-Olivo and others revealed that SEL specifically school-based SEL programs are extremely beneficial in helping Latinx/a/o immigrant youth's coping skills develop to help mitigate the life-changing transitions they must face (Castro-Olivo & Merrell, 2012). So, we can infer that SEL programs and awareness are super important for this population and is reinforced by what was found in the study by one participant. One parent had mentioned they couldn't do things or build relationships because they were non a U.S. born citizen and that impacted their adjustment and social and emotional skills. Had there been an SEL program in place to mitigate these life-changing adjustments that parent would probably not have gone through the hardships they did. So, we can see why this awareness that SEL isn't known or accessible to the Latinx/a/o population matters.

Furthermore, the stories documented by these parents helped shed light on issues that pegged them because of culture specific norms/customs and provided researchers with culturally specific recommendations for future thought/implementation. For example, throughout the interviews parents would talk about their parenting style and practices and from there researchers came to realize that some parents were not knowingly doing SEL related practices. And when it was pointed out to them, and they were getting those things acknowledged and highlighted it was noted even after the study was over these parents

that received strengthen-based praise continued that behavior and shared that those behaviors do lead to the beneficial outcomes SEL can have on kids. This matters because we can highlight that programs and people should come from a strength-based background and highlight things that parents don't really pick up on themselves to help build their self-awareness.

However, this study doesn't go without its limitations. Some limitations include, having a limited sample. The studies sample wasn't diverse as it didn't include voices from non-English speaking Latinx parents and undocumented Latinx parents. In addition, there were no male participants who joined the study, so this data is primarily based from a Latinx mothers view. With that said, some implications of the study include to help researchers and practitioners to include Latinx/a/o parents more effectively in SEL programming and discourse and well as amplifying underrepresented voices.

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**Radical Trans Joy: Gender Euphoria from the TBIPOC
Community**

Abstract

In a culture that privileges gender dysphoria, this research centers gender euphoria. To me, gender euphoria is wearing an all pink outfit after years of despising pink for making me look too feminine; it is the small hairs under the bottom of my chin from taking testosterone. It is my voice dropping. Although I did not experience gender dysphoria for many years, contrary to the normative trans narrative, it was gender euphoria that taught me to celebrate my transness. This project amplifies the joyousness of gender euphoria and most importantly, explores how we can dismantle the myth that gender dysphoria is a critical component of the normative trans narrative. Additionally, this study is intersectional and centers BIPOC folks. There are already very few papers on gender euphoria, and so focusing on TBIPOC folks is crucial. Using a testimonio method and a theoretical framework that centers queer theory and intersectional feminist theory, this study seeks to define the communal and personal narratives of TBIPOC in regards to gender euphoria; furthermore, this project is to see how TBIPOC folks transform the normative, medical model of gender dysphoria if they center and/or uplift gender euphoria. Three themes were discovered through this project: “floating joy” as gender euphoria, “grief” and “displacement” as gender dysphoria, and “white trans people lack nuance” as tbipoc wisdom. Theme one is a testament to the joy that is found in trans lives; it speaks to how being trans is an inherently joyful experience, and that our lives consist of more than just suffering and pain. My second theme is an acknowledgement of that pain that can come from being trans in this world. Our current political climate in most of the world is doused in anti-trans sentiment, especially in the United States. This second theme is a way of naming the pain we face, and being able to know within ourselves that that pain comes from society’s hatred of us and our community. Lastly, my third finding is a love letter to all the TBIPOC out there that have felt alienated and ignored by white trans people. As TBIPOC, we have so much wisdom and knowledge to share with white trans folks, and it is about time that they listen to all that we have to offer.

Introduction

To me, gender euphoria is wearing an all pink outfit after years of despising pink for making me look too feminine. Gender euphoria is the small hairs under the bottom of my chin from taking testosterone. It is my voice dropping. For a long time, gender euphoria was what validated and affirmed my gender identity. I did not experience gender dysphoria for many years; contrary to the normative trans narrative, it was gender euphoria that taught me to celebrate my transness. I hope that, with this project, we can begin to chart out the map on gender euphoria. This can manifest in many different ways, such as amplifying the benefits of gender euphoria, or shining a light on the experiences of trans people who solely experience gender euphoria, because not every trans person experiences gender dysphoria. Hopefully, this research, most importantly, can help to dismantle the myth

that gender dysphoria is the normative trans narrative. How many people are having a similar journey, of discovering their transness through their gender euphoria instead of their gender dysphoria? How many people are learning to fall in love with their transness after years of only focusing on their gender dysphoria? Gender dysphoria is defined as:

“a marked incongruence between one’s experienced/expressed gender and assigned gender” that is associated with “clinically significant distress or impairment.” ...the...World Professional Association for Transgender Health’s Standards of Care (2012, 2) defines gender dysphoria as “discomfort or distress that is caused by a discrepancy between a person’s gender identity and that person’s sex assigned at birth (and the associated gender role and/or primary and secondary sex characteristics).” Accompanying gender dysphoria is a larger hegemonic narrative that dominates medical and mainstream cultural representations of trans identities. This narrative includes a sense of being “born in the wrong body,” displaying gender non-conformity since childhood, and seeking medical transition to express an authentic inner self (Jacobsen 2022).

Because gender euphoria taught me self-love, body-love, and contributed to an overall positive body image, I hope to focus my research project on the wealth of trans-centered knowledge that gender euphoria brings. It taught me to center the parts of me that I loved more than the parts that I hated. Gender euphoria changed my life positively in so many ways, and I have spoken with many other trans people that have shared similar stories with me. Gender euphoria has made me feel like I have agency over my identity, and that my experiences are authentic ones. Before, I felt so confined by the normative narrative of gender dysphoria. All around me, there was this all-encompassing idea that I had to hate my body, and that would be my only ticket to the true trans experience. Gender euphoria has taken apart that belief in me; it has made me realize that being trans is not something that can be confined. It is a wide, colorful rainbow expanse of territory uncharted. You can be whoever you want to be when you are trans. Because of my personal experience with gender euphoria, I have wanted to research it for so long, especially when I saw the gap in the current pool of research available on gender euphoria. A large portion of the literature lacked trans Black, Indigenous, and people of color (TBIPOC) perspectives on gender euphoria.

For this research, I wanted to focus explicitly on the trans Black, Indigenous, community of color; historically, trans research conducted by TBIPOC folks has been minimal. If there are trans researchers present, they are often white. Amplifying my underrepresented community will go a long way towards closing that research gap. Because of that, I have outlined in my research question that I am searching for the narratives of TBIPOC. Trans medicalists and the medical model of gender dysphoria serve as gatekeepers within the community, in that they expect trans people to experience gender dysphoria in order to obtain all forms of gender affirming medical care, from surgeries to hormone replacement therapy. I chose to use the word narratives in my research question because choosing to focus on gender euphoria within the TBIPOC community instead of gender dysphoria is shifting the recognized narrative. That is why I say gender dysphoria is the normative narrative (Burke 2011; Johnson 2019).

There are parameters to the normative narrative of gender dysphoria. This normative narrative is born out of white supremacist cisheteronormative ideology, and is upheld and regulated by cishetereopatriarchy and white supremacy (Caldwell and Leighton 2018; Hsu 2022). The normative narrative of gender dysphoria relies on the gender binary. Another facet of this normative narrative of gender dysphoria (Burke 2011; Johnson 2019) is the idea that you have to hate your body instead of celebrate and love your body for all that it has done for you. Gender, as the social construct we know it as today, was largely conceptualized by western cultures (Lugones 2007; Bem 1993; Lorber 1994). As we know from our intersectional framework, race and gender are often intertwined, as proven by the way whiteness influences our ideals of gender presentation, and gender identity. Intersectionality as a lens reveals that BIPOC are those most likely to be excluded from the normative narrative that centers whiteness, thinness, and rigidity. BIPOC and their gender presentations and identities will never be accepted when the normative narrative is one of whiteness.

But as I gather my testimonios— a Chicane-made methodology inspired by a love for Indigenous tools of keeping history and sharing lived experiences— from BIPOC community members, I want to focus on how TBIPOC believe this narrative shift from gender dysphoria to gender euphoria will change the community at large. This is why I include the language of communal narratives as well as personal narratives. To achieve a balanced picture of how gender euphoria stands as a concept with individual people, but also the ripples it can make on a larger, communal scale, we need to focus on both narratives.

Literature Review

The purpose of my research is to expand upon the available pool of gender euphoria related literature by focusing explicitly on the TBIPOC community through the lens of a trans Latine researcher. As I found through my literature review, most of the available literature on gender euphoria is by white trans researchers, and almost all participants were white trans people as well (James 2022; Jacobsen 2022; Beischel et. al 2021). To me, that signals an obvious and large gap in the research that is currently on hand when it pertains to gender euphoria.

Gender euphoria, as a researched topic, has been around for less than a decade. The range of the papers I will analyze in this literature review were published in 2021 and 2022. This range of published works also demonstrates the need for this research study, as we are all building on one another within a year of each other.

The first paper I will be reviewing is: "A little shiny gender breakthrough': Community understandings of gender euphoria," written by Will J. Beischel, Stéphanie E. M. Gauvin, and Sari M. van Anders. According to the authors, the aim of the paper was, "...to better understand how trans community members and others conceptualize the term 'gender euphoria,' including its relationship to gender dysphoria, as well as the contexts and behaviors that elicit gender euphoria" (Beischel et. al 2021). The authors found five consistent themes from their research, which are, "(1) gender euphoria describes a joyful feeling of rightness in one's gender/sex, (2) gender euphoric experiences can be external, internal, and/or social, (3) 'gender euphoria' originated in and circulates in online and in-

person gender/sex minority communities, (4) dysphoria describes a negative feeling of conflict between gender/sexed aspects of one's self, and (5) the relationship between euphoria and dysphoria is complex" (Beischel et. al 2021). For my study, I want to see the ways in which my participants' definitions differ from those of these participants. I suspect that the race and/or ethnicity of my participants will influence these definitions, and perhaps even deepen the meaning of these definitions to include nuances that the majority white participants from this study did not think to consider.

My second paper is "Joy Production: Gender Euphoria in Trans University Student Lives," written by Gabs M. James. In this thesis, James uses a unique methodology called photovoice, which is a branch of participatory action research. With this methodology, James found five participants to be part of their thesis. The objective of James's thesis was to gather definitions of gender euphoria from transgender people within a university setting. This differs from my research plan; I would like to expand beyond the university and higher education in general. My hopes are that I will find participants outside of academia, who can offer unique perspectives as people outside of the ivory tower, so to speak. University students will still be included in my research undoubtedly, but I do not wish for them to be the sole focus of my paper.

The final paper is, "Moving from Gender Dysphoria to Gender Euphoria: Trans Experiences of Positive Gender-Related Emotions," written by Kai Jacobsen. Similar to my goals, Jacobsen wanted to fill the gap in the research pool concerning gender euphoria versus gender dysphoria. Jacobsen noticed, just as I did, that there was a lack of research about gender euphoria. Jacobsen, like Beischel et. al, used interviews as their methodology. Their findings are, "gender euphoria refers to positive emotions resulting from affirmation of one's gender identity or expression and can include a wide variety of emotions and experiences" (Jacobsen, 2022). As stated before, I hope to build upon this foundation, expanding it outward from the university and from a pool of participants that are mostly white people. I hope to gather the unique experiences and nuances and stories of TBIPOC when it comes to how they perceive gender euphoria.

In Beischel's paper, Beischel and their fellow researchers set out to find out how people define gender euphoria, along with how people experience gender euphoria. In order to gather this data, Beischel and their compatriots utilized a qualitative survey sent out online, and gathered data from forty-seven participants. Not all participants were trans; thirteen participants identified as cisgender. But most importantly, of the forty-seven participants who completed the survey, only seven of them were identified as BIPOC. We see this pattern is continued in my other two research papers that I am reviewing. In James's paper, there were four participants that took part in this participatory action research project, and of those four, only one of them was a BIPOC. In Jacobsen's paper, which used qualitative interviews as their methodology, we see the same thing. Five people participated in the study, and two of them identified as biracial. We can spot a pattern emerging, in which white researchers are only including one or two BIPOC to fulfill their racial quota, or not actively making sure to include BIPOC at all. Only Jacobsen's paper mentioned specifically searching for BIPOC to include within their study. The other BIPOC participants joined Beischel's and James's research studies through means other than being there to fill a diversity quota.

Along with almost all of these research participants being white people, all three researchers I am discussing within this literature review are white. This demonstrates another gap in the research. Being a trans Latine researcher comes with a unique point of view; a view on what it means to be a multiple marginalized person. White trans people are looking at this topic of gender euphoria only through the lens of a white person. TBIPOC have a more diverse view on gender, because gender is a heavily racialized social construct. We experience gender differently than white people experience gender. Because of this, I will be able to add my own personal lived experiences into this research paper, which automatically diversifies the accessible literature on this topic.

Additionally, as a trans Latine researcher, I will be contributing a new form of methodology to the literature, as I will be using testimonios. Testimonios is a methodology born out of Chicane researchers. It is often used to honor the diverse ways in which we as humans share our lived experiences and our cultural stories, and it was conceptualized to center these divergent tools of communication because, as we've seen so often, Indigenous ways of sharing and recording history have been denigrated. Western white society sees physical recordkeeping as a superior form of communication and historical bookkeeping. Testimonios as a methodology was made in the hopes of pushing back against this racist belief.

Theoretical Framework(s)

For my frameworks, I will be researching through the lens of intersectional feminist theory and queer theory. Kimberlé Crenshaw was the scholar that coined the term intersectionality, and first used it as a framework. In an interview with Crenshaw, she defines intersectionality as, "...a lens through which you can see where power comes and collides, where it interlocks and intersects" (Columbia Law School 2017). Crenshaw wanted to highlight the experiences of multi-marginalized folks, but especially Black women. Since then, intersectionality has expanded, being used to describe and analyze multi-marginalized peoples experiences across the globe. I chose a framework of intersectionality because I wanted to be able to acknowledge the ways in which TBIPOC are marginalized on multiple axes of oppression, such as gender and race. It is important to center multi-marginalized people like me, who I will be solely gathering testimonios from in order to center my own community. Oftentimes in research, people with multiple marginalizations are sidelined, forgotten, or even blatantly erased within research projects. As a trans Latine person, I want to put us into the spotlight. I want research that centers on our knowledge and our experiences and our narratives. And intersectionality is especially important because without this framework we could not adequately discuss how being a multi-marginalized person impacts someone, or even enhances their life, because there is joy to be found in our identities that other people may claim are all pain and suffering. In the experiences of TBIPOC in particular, intersectionality is very important. A very prevalent problem in communities of color is homophobia and transphobia. Often, this can lead to family members believing that being queer is an identity that only white people can have. Therefore, TBIPOC are erased and not recognized within their communities.

But the experience of being queer as a BIPOC is much more nuanced and complicated than, say, for a white cis gay man. When you are a TBIPOC, gender is often projected onto you through the lens of whiteness (Bernard 1999). It makes it hard to find peace in your body and gender identity when the normative narrative of gender specifically does not accept narratives from people like you.

Queer theory first came about in the 1990s, where it was coined by scholar Teresa de Lauretis (Illinois Library 2022). Queer theory seeks to "queer" normative narratives when it comes to gender, sex, sexuality, and more. I am utilizing queer theory as a framework because I am hoping to queer the cisnormative narrative of what it means to be trans, and what you must experience to be considered a trans person. Through my research, gender euphoria will be amplified as a more dominant part of what it means to be a trans person. In my research, gender dysphoria will no longer be the central narrative of trans people. By using queer theory as a framework, I am also hoping to honor the work of those Black, Indigenous, scholars of color that came before me when using queer theory, like Gloria Anzaldúa.

Furthermore, I will be using the word queer as a verb. This is referred to as "queering" (Sedgwick 1990; Butler 1990). The definition of queering that I will use is: subverting the cisnormative narrative that all trans people experience gender dysphoria, and that trans people must first move through gender dysphoria to obtain gender euphoria, which is a common thought within the current literature. Thus, we will be queering these narratives, transforming them into something more realistic and something that pertains more widely to the community at large.

Methodology

My chosen methodology is testimonios. Testimonios mainly emerged from Chicana Studies, popularized by writers like Gloria Anzaldúa and Paulo Freire. The definition of testimonios I will be operating off of is, "an account told in the first person by a narrator who is the real protagonist or witness of events. This definition focuses on testimonios as evolving from events experienced by a narrator who seeks empowerment through voicing her or his experience. Thus, the politicized and self-conscious element in this point of view is paramount in this definition. A testimonio must include the intention of affirmation and empowerment" (Reyes and Curry Rodriguez 2012, 527). I will be searching for three people to give their testimonios when it comes to gender euphoria and their experiences with it—personally and communally—using the snowball technique. My initial search for participants will begin in the Pride Center on campus, along with the other cultural centers. Once I find my first participant, I will then search online for a second participant, preferably without a college education, and a difference in age from the people normally found on a college campus. Lastly, I will search for my third participant in the Pomona Pride Center, which will hopefully serve to diversify my age range of participants, as well as education levels. I want as wide a range as possible when recruiting participants. Testimonios will be offered in multiple formats for the purposes of accessibility. Virtually, through Zoom or whatever other medium they prefer. Recorded, if issues with time compatibility and/or anxiety is an issue, and finally, in-person. In-person testimonios and virtual testimonios will be recorded by phone, or by a screen-recording mechanism, in the case of Zoom. Each participant will be

given cash compensation for their labor.

Findings

Theme #1: “floating joy” as gender euphoria

Defining gender euphoria has been a big facet of my research project. Like gender dysphoria, gender euphoria can have many different, unique definitions. Almost every trans person is going to experience euphoria or dysphoria, and because of this, each and every trans person that has experiences with these concepts will have their own definition for it. Gathering these definitions is important work; these diverse interpretations of a singular concept allow for this term to be expanded on. This is what studying gender euphoria is all about: transforming how people think about trans people and their experiences with their gender.

When asking my participants for their own definitions on gender euphoria, my first participant, M, defined gender euphoria as, “floating joy.” Floating joy represents an, “open mesh of possibilities, gaps, overlaps, dissonances and resonances, lapses and excesses of meaning when the constituent elements of anyone's gender, of anyone's sexuality aren't made (or can't be made) to signify monolithically” (Sedgwick 1994, 8). This concept of floating joy cannot be made into a monolithic experience of all TBIPOC; floating joy is expansive. It flourishes within the wide open field of queerness, where creating playful definitions to our experiences is inherently queer. M described the experience of floating joy as, “the sandbags being cut off an air balloon.” This definition helps demonstrate the diverse experiences of TBIPOC folks specifically when it comes to how they interact with their gender. Additionally, this is proof that being a TBIPOC is not an inherently miserable experience like the dominant, monolithic cultural narrative of transphobia would like society to believe. Being a TBIPOC is joyful, and that joy can make you feel so light that you feel like you may blow away, carried past everything that has brought us pain and suffering, like transphobia, cisnormativity, and the Western gender binary; floating joy can carry you past many oppressive systems and beliefs, such as eurocentric beauty standards. One participant of mine, Maia, said, “rejecting social norms is gender euphoria.” Floating joy helped many of my participants— Maia, A, P— push back against white supremacist values, like how many of us, as TBIPOC, are forced to fit into white gender norms. This is radical trans joy. Trans people's lives can include many hardships because of oppressive systems and structures— family, medicine, school, capitalism, and media to name only a few— but there is more to us than misery and fear and pain. There is joy.

As mentioned before, the dominant cultural narrative of trans people in general is one of suffering, hatred, and depression. In the spaces of the medical community— doctors, psychologists, psychiatrists— trans people have been seen as a group of individuals who are suffering from intense discomfort in their bodies and their minds. From their perspective, all trans people experience this distress— this gender dysphoria— and there is no other path way to identifying as trans; however, “trans theorists and community members have criticized this focus on dysphoria for its sole attention to the negative, over-medicalized aspects of gender/sex minority” (Beischel et al., 2021). In the community, there is more to being trans than our gender dysphoria. Being trans is a more expansive experience in

general, when looking at it from the community's perspective. But still, in non-trans spaces, trans people are often assumed to hate their bodies so intensely that they would default to self mutilation in an effort to help themselves feel more comfortable in their bodies. A lot of the times when receiving gender affirming care, trans people are asked ridiculously invasive and personal questions before they are allowed access to this care. Most trans people go into these doctors appointments expecting to have to prove that they will live a miserable existence without this care. I have heard stories of trans people being pressured into vaguely admitting that they will kill themselves if they do not receive this medical care. But gender euphoria— floating joy— pushes back against this narrative; it allows us to queer and muddy the supposed boundaries that are being forced onto trans people without allowing us to get a word in edgewise. Queering the normative narrative of our experiences as trans people is essential to centering floating joy in our lives. Many of my participants talked at length about how their lives had changed for the better once they started focusing more on their joy instead of their distress. My participant, J, said, “[Floating joy] for me is like... a feeling of kind of just like how you feel when you're happy about something; it's kind of just that internal happiness, internal relief...” Happiness and joy inherently make us feel lighter as human beings, and the same thing happens for the trans community when we reach this stage of floating joy. Trans people talking about the joy they experience being trans is something that we must try and uplift every moment of every day.

Theme #2: “grief” and “displacement” as gender dysphoria

Many of my participants argued that gender euphoria and gender dysphoria are inherently linked. I cannot write about one without writing about the other as well. But what this section will not do is reaffirm the harmful medicalization of trans lives and trans narratives. This will be a dissection of gender dysphoria from the perspectives of TBIPOC. Gender dysphoria is more than simply a product of ourselves; it stems from harmful systems that we are forced to live under, like white supremacy, and a Western gender binary. It is not our fault when we struggle with the split of our bodies and our minds because it is through these systems that this split happens in the first place. And additionally, not all trans people experience dysphoria. Not all trans people learn that they are trans through dysphoria. Some trans people come into their transness via gender euphoria. Some come into their transness via gender neutrality (a feeling of intense apathy towards one's perceived gender where the individual does not care how they are identified by society or through self-identification). Queering this normative narrative of gender dysphoria is very important to this work, as it allows more trans people to come into their identities as trans people. It allows flexibility and nuance when talking about something as heavy and serious as gender dysphoria. Finally, it allows cis people who may not fully understand trans people and our struggles to have a deeper understanding about what dysphoria actually is to us.

My first participant, M, defined gender dysphoria as, “a form of grief.” When first identifying as trans, there can be a lot of grief that is felt. Many times, it can feel like our lives are over once we come to terms with our gender. There is an acknowledgement that we are no longer normative; we are now the Other. Our lives will never be the same again, and sometimes we can start to think that we may never be happy again. Simultaneously, we are grieving for our families and our friends. We are aware of dominant narratives surrounding transness, and we worry about how our parents will react, how our friends will react, how

even our coworkers and managers will react. We look to the path ahead and see nothing but hardships and despair; life will be what everyone tells us it will be for trans people: death, misery, and pain. Uncomfortable in our bodies, uncomfortable in our lives, uncomfortable in our identities. Sometimes, we can undergo a process of mourning. But from grief comes healing, comes restoration, comes happiness. A lot of trans people run headfirst into this barrier of grief, of gender dysphoria, and a lot of trans people make it out on the other side, full and happy and complete.

Another participant of mine, A, described gender dysphoria as, “displacement... because it is both mentally draining as well as an out of body experience.” Dysphoria is a different disconnect than what the medical industrial complex makes it out to be. Dysphoria does not simply make us feel uncomfortable or distressed in our bodies; it makes us feel as if our bodies are not a part of us at all. It is uncomfortable and upsetting. This displacement is in our bodies, in our minds, and is what separates us from everyone else. We feel apart from everyone around us. There is no connection to be made, no common ground, no community in dysphoria. This is why we need to queer what it means to be trans; more people need to see that gender dysphoria cannot be our only way of identifying ourselves as trans. We cannot allow this to be how the outer world sees us all. There is so much more to being trans than our displacement and our disconnection. There is community to be found in love and in joy and in happiness.

Theme #3: “white trans people lack nuance” as TBIPOC wisdom

Compiling my literature review, I was able to see that all of these papers on gender euphoria lacked one major thing: the voices of BIPOC. In all three research papers, there was either a small percentage of TBIPOC included in the research as participants, or, when it was qualitative interview data, there were only one or two participants who were TBIPOC (Beischel et al., 2021; Jacobsen 2022; James 2022). As a researcher who is a trans person of color, it was very important to me that I include the voices of TBIPOC that were not being included and heard in this new field of research. TBIPOC and their perspectives are incredibly important and necessary, especially in this day and age when trans people are being targeted, but especially TBIPOC. We owe so much to TBIPOC, and it is our duty to uplift the voices of TBIPOC as often as we can.

For my research, one of my main goals was to gather wisdom from the TBIPOC community to give to the white trans community. I asked all of my participants what wisdom they would like to give to the white trans community, and all of their responses were best summarized by my third participant, Maia, who said, “white trans people lack nuance and understandings of gender and cultural norms in non-western places.” What Maia and I began to talk about was how white trans people have a very 2D view of gender. White trans people often are only resisting the western gender binary, with no regard for conceptions of gender that exist outside of this western binary. What this white perspective often results in is a very flat examination of TBIPOC and how they present themselves, how they talk about their genders, and how they conceptualize their gender, either in relation to these western gender norms, or completely outside of it. Simply put, TBIPOC have a more complex and deeper understanding of gender, within the western binary and outside of it. As racialized people who have been subjected to this western and white ideal of gender, we have learned

the system inside and out, and because of this, we have a stronger understanding of it than most white people. White people have always easily fit into this western system of gender, and as a result, have never had to deeply think about their position within it. They have never had to think of how they construct their gender within eurocentric beauty standards, or how they construct their gender through this binary system. White trans people have only thought about this on a very shallow level, because as trans people, we all have to think about the system of gender and how we fit within it. But even then, white trans people only engage with this system on the basis of gender. Intersectionality comes into play here, because intersectionality allows us to examine the ways in which gender and race/ethnicity interact with each other to create unique experiences and unique oppressions. Gender and race/ethnicity combine to help inform the individual’s ideal of their gender, and how their gender relates and interacts with their race/ethnicity.

Additionally, being a TBIPOC, many of my participants talked about this lack of nuance in two ways. The second way is in relation to family, and how important family is to TBIPOC. My participant J said, “[the white trans community] can learn about the euphoria you get from acceptance from very traditional, conservative, minority families.” Multiple participants of mine mentioned how unhelpful white trans people have been when it comes to supporting TBIPOC in their journeys with their families and coming out to their families. They said that, often, white trans people will simply tell them to cut out family members that are deemed problematic, and family members that are deemed problematic generally means everyone. If they are misgendered or dead named by their family, they should simply no longer associate with that family, but for all of my participants, our family is often our last cultural link. Without our families, we would lose our culture, especially because white trans people dominate what people consider trans culture, so we would be unable to find representation and community for our racial or ethnic identities within trans culture.

All in all, it was crucial to my participants that white trans people learned that they are far from the dictators on what gender means, what gender is, and how gender is determined. My participants wanted white trans people to know that they have a very narrow and small view on gender, and that TBIPOC are the ones that are expanding and changing and making gender every single day. They are the ones changing it for all of us, so all of us can live more comfortably within this concept of gender.

Conclusion

This research has taken me on a journey through many different conceptualizations of gender. It has given me so much wisdom from other TBIPOC. I hope that this research will expand the breadth of gender that cis and white trans people alike can take from. This research has taught me that TBIPOC are the future. They are the future dreamers of our world; they are bringing to everyone so much love and joy and happiness. I hope that they will all continue to share their light and joy with us for many years to come.

Two things that I have been curious about from my research is the importance of family for TBIPOC, and how perceptions of gender euphoria will compare when held up against other TBIPOC. I used white trans people as a basis for this research project, through my literature review which had mostly white trans people as the research

participants, and then I brought in my TBIPOC as my participants. I compared these two groups on how they conceptualized and discussed concepts like gender euphoria and gender dysphoria, but I believe that there is more to be learned from TBIPOC specifically about gender euphoria and gender dysphoria. As I said before, we are the ones that are expanding the concept of gender in ways that white trans people could never even begin to dream of.

Because of the time constraints of this research project, I was only able to recruit six TBIPOC as my participants. This is a very small pool of participants, even though they all had a lot to say about this topic. I was able to gather a lot of data from them, but this project is all about expansion and growth. It is all about dismantling monolithic interpretations of the trans community, but especially TBIPOC. To continue my goals of queering the dominant narrative of the trans community, I need to find more participants to share their testimonios with me in the future.

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Appendix

Guiding Questions:

Dysphoria Subsection:

- How do you define gender dysphoria for yourself?
- Is gender dysphoria, as a concept, functionally useful to you/to the community?
- Do the narratives of gender dysphoria reinforced by your racialized and/or ethnic community? Why or why not?
- What oppressive systems and/or structures (family, school, media, medicine, etc.) inform these narratives?
- How would you feel if you chose to center gender euphoria in your life instead of gender dysphoria?

Euphoria Subsection:

- How do you define gender euphoria for yourself?
- How do you "live" or express your gender euphoria?
- Do you think the concepts of gender dysphoria and gender euphoria are inherently linked? Why/why not?
- What narratives do gender euphoria open or invite?
- What narratives does gender euphoria challenge?
- What oppressive systems and/or structures (family, school, media, medicine, etc.) inform these narratives?
- Do you find political/social/personal power in claiming gender euphoria?
- How would you feel it would change the community if we focused on gender euphoria?
- How do you think gender euphoria would transform our medical care, if at all?

TBIPOC Subsection:

- How are your experiences as TBIPOC distinct from your white trans counterparts?
- What narratives are nonconsensually placed on your TBIPOC body (either because of white supremacy, cissexism, and/or something else)?
- What are the ways you engage with euphoria and joy as a TBIPOC? Does, for example, community bring you joy as a TBIPOC?
- As a TBIPOC, what do you think the white trans community can learn about narratives of gender euphoria from TBIPOC?
- What are the wisdoms you carry as a TBIPOC? What have you learned?
- Is the shift away from dysphoria toward euphoria important for you as a TBIPOC? Why or why not?

**Green
Cherise**

Feminist Resilience Among Student-Parents

We use Flynn, Brady, and Soritin's (2012) *Feminist Rhetorical Resilience* to define resilience among student-parents. Feminist resilience is relational, rhetorical, and a continual process. From this reading, we learn that rhetorical resilience is not necessarily a cultural inheritance or a psychological qualm, but instead, a relational term that defines one by the various experiences faced throughout early childhood into adulthood. When placing resilience and feminism together as one complete term we may understand the many complexities women endure through the lens of feminism. Resilience is an essential concept to understand when intertwining the term with rhetorical feminism. Feminist rhetorical practices promote the development and evolution of these theories. These notions justify the struggles rooted in the social, cultural, and body construct. Different institutions carry unspoken patterns people assimilate to; the assumption that these patterns are normative is a justified reason for people to carry on with their lives without realizing how harmful it is to their physical, mental, emotional, and psychological well-being. Struggle as well as the emotional responses towards struggle are two different concepts that are infrequently discussed yet they hold tremendous power to change society's current state. With different feminist theories supporting the overall definition of resilience, we can implement them to learn about our university community and how they represent resilience.

The readings provide the basis for our research questions and methodology. Our research questions are: What obstacles do student-parents face pursuing higher education? How does the student-parents institution support their educational goals? What is the difference in the mental and tangible workload carried between student-mothers vs student-fathers? We hypothesize that women in the student-parent dynamic carry the heaviest load and therefore must carry forward a great deal of resilience while navigating their higher education journey. We use a qualitative approach using a survey with open-ended response options and in-depth, semi-structured interviews that will be used as content for our podcast. Participants were recruited through faculty distribution from various departments and clubs on-campus. Data collection is ongoing for this project.

LITERATURE REVIEW

Feminist Research Methods It is imperative, as researchers, that we practice intersectional reflexivity in order to navigate the dynamic power process in research. Patricia Hamilton's (2020) work on black motherhood reveals the importance of going beyond simply understanding intersectionality. This is achieved by viewing positionality as a dynamic process. Hamilton (2020) defines intersectional methodology and demonstrates how it "offers a model of reflexive, ethical practice that is responsive to dynamic relations of power that inform the research process" (Hamilton 522). Hamilton outlines the importance of reflexivity as it allows scholars from various backgrounds to navigate how their social upbringings and cultural experiences inform their positionality within the research they may present. Patricia Hamilton uses these two terms simultaneously in order to reflect on her experiences in navigating research as a black woman with other black women and how their positionality affects their overall research process.

Jaqueline Jones Royster (1996) offers three scenes to call for "cross-boundary exchange to refine theory and practice" (29). The first scene is analysis: understanding these ideas. The second scene is reflection: how we can take initiation with passion as well as hold ourselves accountable by being mindful. The third and final scene: how can we make this applicable to everyone? Stories like Royster's are not individual experiences, rather these stories make up a large body of evidence affirming the need for transformation. This includes embracing subjectivity to view "voice" as something spoken, read, and as a "thing heard, perceived and reconstructed" (Royster 30). Rather than speaking for others, it is imperative to speak with one another to achieve true understanding. Royster's work speaks to the way dominant ideology is intertwined in our institutions and even the way the stories of "others" are understood. The power of voice is more than speaking morally; it is a pattern of educating one another by holding each other accountable. It is a constant movement that we have to continue enduring until everyone understands each other without the divide of experience and privilege. As researchers, our goal is to answer Royster's call to action in the way we hear, understand, and communicate the stories we share.

Aya Y. Martinez (2018) addresses the privilege in academia using Critical Race Theory counterstory as a tool for marginalized voices to find empowerment. Martinez does this with her own counterstory that depicts her carefully curated steps to conform to dominant expectations yet still experiences racism. In Martinez's essay, she details two forms of privilege within academia that include the right to occupy space and feel comfortable in those spaces. Martinez urges those in possession of said privileges to challenge dominant ideals and to serve as "accomplices in the struggle" (231). This counterstory contributes to Royster's "litany of evidence" further emphasizing the need for feminist scholars to transform dominant systems (30). In practice, our commitment to this cause includes being critically aware of the positions we hold and actively pushing beyond comfort toward tangible change.

The Western lens that alienates the Indigenous perspective creates a form of research that cannot holistically understand the populations it studies. Research as a Ceremony communicates the Indigenous view of research which entails preparation and relationality, "all things are related and connected" (Wilson 61). As a ceremony, research requires thorough preparation and viewing ontology, epistemology, axiology, and methodology as a circle rather than distinct concepts. This informs the approach we use as researchers as we aim to embrace methods that incorporate the importance of emotional and cultural experiences. From the Indigenous paradigm, research is not an individual feat, but one that is relational and subjective. Wilson details the three R's of an indigenous research paradigm, "respect, reciprocity, and responsibility" that we will use to inform our research methodology (77). Using this as the foundation for our approach will allow our team to transcend the objective, scientific lens enforced in Western research practices.

Listening to the voices of minorities and including their voices is essential to the rhetorical feminism research process. "Hearing a testimonio is not the same as listening to a testimonio (Lenkersdorf, 2008)" (Bernal 368). Listening to the voices often left unheard allows for other perspectives to properly be dissected and widely understood within the academic realm. Dolores Delgado Bernal defines testimonios as the "...sense of political urgency to address educational inequities within Chicana/o and Latina/o communities"

(Bernal 363). These first-person narratives provide solidarity within the Chicana/o and Latina/o community as the perseverance sets their voice apart from the rest. As researchers, we respect and honor their experiences by processing and grasping onto their feelings regarding their experiences to truly understand their struggles in a society that does not accommodate them with the highest respect.

Modern approaches to research should adhere to the modern issues presented. By working with what is at hand rather than relying on tradition, the accommodation is sensible to fixing issues that can further arise. Gesa Kirsch and Jacqueline Royster (2010) in *Feminist Rhetorical Practices: In Search of Excellence* explain how historical “fragments weave together...a better understanding of women’s lived experiences, past and present” (640). By being attentive and proactive, the authors suggest following the three critical forms of engagement: critical imagination, strategic contemplation, and social circulation. To sympathize with the person, we broaden our perspective in humanity where we recognize where the person’s struggles root. Next, we engage in how we can solve the issue by fixing these institutions. Lastly, branching out to other communities of people with solutions allows development and evolution.

Feminist Rhetoric in Digital Spaces and Technology Promoting feminist works by utilizing social media as a platform allows social media users outside of the projects’ local demographic to engage with them. Social media has the ability to connect unlimited users together under one voluminous voice; however, this voice is undermined by attitudes that oppose these works. In Carleigh Davis’ (2019) *Feminist Rhetorical Practices in Digital Spaces*, the author claims that “[d]igitality cannot consistently rely on diversity, be characterized by feminist ways of being and knowing, and continue to perpetuate narratives of hostility and exclusion” (Davis 140). Essentially, behaviors and attitudes on gender narrow the overall view of gender to the status quo. These prejudiced feelings carry onto public institutions through their practices. To counteract these attitudes, educating people on different fields as well as the definition of gender will drown out public generalizations. Changing the direction of the voices rather than shutting them down entirely, allows people to recognize the issues; they are more likely to change if the approach is an alternative route. As researchers, providing viewers with background on the art of resilience allows them to understand where these stories are rooted through their storytellers.

Technology and rhetoric do not exist as opposites to one another evidenced by Amy Koerber’s (2000) *feminist rhetoric of technology*. Feminist scholars work to critique, examine, and analyze the current limitations of technology. The feminist rhetoric of technology can ask questions about what technology says about our social world and the way in which it displays social beliefs on gender and power. Technology and rhetoric can be seen as synonymous in today’s society as we navigate research, views, and common methodologies via various digital spaces. The digital realm allows for rhetoric to be easily obtainable and influential through the lens of rhetorical feminism. Many voices that were once unheard have now been given a platform to extend their voices, views, and stances within the literary realm.

ANTICIPATED LIMITATIONS

Our study is expected to have some limitations as we navigate the interview process. Due to our research relying on expected cooperation from the student-parent population on the University campus, we expect that not every student that has filled out a survey will be willing to participate beyond the initial survey process. This may hinder the number of interviews we are available to conduct, thus giving us a limited sample size. Another anticipated limitation is our sample size largely consists of the female population, which gives us a limited sample and few to compare in terms of gender. This limitation may hinder our results and could possibly place a bias within our research findings.

Our limited access to student parents due to our restricted access to the various educational departments is another anticipated limitation. This limitation may not allow us to look at the student-parent population as a whole, but rather as a subset of one or two educational departments. These limitations are expected to affect some of our research findings.

METHODS

This study takes a qualitative approach to addressing the present research questions. To collect data, our team of researchers created a 5 question survey hosted on the platform Qualtrics. Participants were presented with informed consent to begin the survey. No compensation was provided for survey completion. This survey was distributed through faculty members in various departments on campus and a student-parent club on campus. Survey participants were asked at the end of the survey to report interest in participating in a supplemental interview by providing their contact information.

Interested participants were contacted by the researchers to schedule a time that worked for both parties. Participants were presented with an informed consent form that included consent to record audio. Participants were also provided with the set of prepared interview questions for their review. Once participants signed and gave clear consent, the researchers began the interview. Interviews were conducted via Zoom, a video communication platform that is accessible on most devices. Interviews were guided by a 20-question list that each researcher used for their respective participants. Audio from the interviews was recorded as content for the group podcast “Enactments of Feminist Resilience at Cal Poly Pomona.”

The expected sample size for the study is ten interview participants. To meet the criteria for eligibility, participants must be over 18, current students at Cal Poly Pomona, and identify as a parent/guardian. Participants must sign consent forms and give the approval to have their podcast episode publicly available on our group website.

Data analysis will occur after interviews have been recorded and transcribed. Data will be hand-coded line by line to identify descriptive codes that will be grouped into categorical codes, and then into the broader themes to address the research questions.

ANTICIPATED FINDINGS

Data collection is ongoing for this project for both the survey and the interviews. Based on a preliminary review of our collected data, we find that student-parents prioritize their role as parents, on-campus resources are limited, and student-mother bears the heavier load of household labor. Finally, student-parents describe their children as motivators to be resilient in higher education.

Student-parents communicate that their role as a parent superseded their role as a student. Student-parents prioritize their responsibilities as a parent while their student status can often be scheduled at a later time. Parenting is not something that can be pushed to the side, instead, a student-parent will miss class or submit an assignment late if their child is sick or needs them. Higher education assumes the role of students as the primary responsibility of their population. However, student-parents demonstrate the importance of institutions of higher education to support the needs of their students.

A second preliminary theme is the on-campus resources accessed by student-parents. Student-parents are aware of and utilize some resources on campus offered as support but these resources are limited. Resources like on-campus childcare require student-parents to add their names to a waitlist for an open spot. In addition, daily rates on-campus are higher than childcare offered by independent sources in the surrounding neighborhoods. Student-parents also discuss the need for more mental health resources provided on campus that are specific to their needs.

We also anticipate finding that student-mothers bear the heavier load of household labor and child-rearing. This is supported by the preliminary data collected. One student-mother states the following: "I try to balance keeping a household together, so if I have a little bit of downtime, I'll make dinner or if a homework assignment requires me to read something or watch a video, I'll do it while I am cooking." This mother finds time throughout the day and into the night to do homework, study, and complete requirements for her courses. She balances her duties as a mother and a student with the added load of managing the household.

Resilience among student parents is fueled by their children. Participants were asked in the survey, "Do you believe you are resilient, why?" with respondents recounting the adversities they have faced in higher education and the main reason for continuing on, their children. Children and the family were also motivators for interview participants with one mother stating her son was what made her decide to return to school after a leave of absence. Student-parents identify as resilient in navigating higher education while balancing both identities.

FURTHER WORK

For future contributions, we hope to inspire student researchers to continue the platform we started. To start off, assessing the thoughts and ideas of parents will expand the student-parent community on campus. With the ongoing resources provided such as the lactation room for parents and the on-campus student pantry, they only provide

supplementary accommodations, a complimentary benefit. Resources for student-parents should be multi-dimensional and versatile to accommodate their lifestyle. The goal in mind when establishing such sources is to make sure they sustain value and promote growth as well as accommodate their complex lifestyle. For instance, a student-parent on campus suggests hosting workshops for the youth to learn and explore career options. The children's center on the third floor of the university's library is another example of a multidimensional resource as it fosters a learning haven. These examples fulfill the ideal resource and the goal in providing assistance to student-parents to the fullest.

Additionally, future researchers can contribute their findings as they analyze parenting styles from both mothers and fathers. There are various factors that determine how a parent demonstrates resilience as they strive for higher academia; for instance, the parent's upbringing and the amount of children a parent has. By narrowing down these factors, common ground is established to better answer our hypothesis.

CONCLUSION

Rhetorical feminism is an ever-expanding topic within literary research that allows scholars to understand the various methodologies that define the literary genre as a whole. The methodologies presented within the various readings have allowed us to analyze and explore the relational terms presented by numerous scholars from various ethnicities. The nine readings have allowed us to explore rhetorical feminism while informing our overall understanding of the literary genre. This informs the methodology used to conduct this study and gives a strong foundation to support our findings.

As researchers, we are granted the opportunity to create a plethora of ideas to strengthen the bridge between the student-parent community on campus and the campus resources. Student-parents demonstrate an ordeal of resilience by maintaining their responsibilities as students and as caregivers. To lend them a hand, we want to be able to discover innovative sources that allow them to gain and utilize resources. Though there are several questions left unanswered, we as researchers were able to fully define resilience and demonstrate it through our student-parent community on campus. Our team hopes to provide a digitized support system with longevity that can serve as a place where student-parents can find resources, scholarship opportunities, and community on campus.

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Hernandez
George***Synthesis of Macrocyclic Bisbenzylisoquinolines by
Pictet-Spengler Cyclodimerization**Abstract:

The constant evolution of pathogenic viruses worldwide has caused millions of deaths due to growing resistances to current treatments many of which have toxic side effects. The family of Bisbenzyltetrahydroisoquinolines (BBTHIQs), compounds found in plant natural products, has shown a wide array of bioactive effects against various viral and non-viral illnesses. Of note, members of the BBTHIQ family have been found to serve as potential treatment starting points against the parasitic-borne disease leishmaniasis. Investigation into the synthesis of BBTHIQs thus has potential for novel drug therapies to reduce toxic side effects and potential for increased drug metabolism and pharmacokinetic results in the prevention and treatment of leishmaniasis as well as other illnesses.

Though studies on these compounds and their synthesis have been conducted, an effective route for their total synthesis and use in drug discovery has not been advanced upon in recent years, and synthetic derivatives have not been widely studied. This study thus aims to find a pathway for the total synthesis of the core structure of the BBTHIQ Tiliagine through development and employment of modern organic synthesis and catalytic methods. We propose a short synthetic route to two linear cyclization precursors forming a key 'head-to-head' bi-aryl linkage, culminating in a planned Pictet-Spengler cyclodimerization not previously explored in the synthesis of BBTHIQs. To-date, we have accomplished several synthetic steps towards the preparation of our cyclization precursor molecules. The end goal of this study is to investigate the potential of these efficiently synthesized molecules as starting points for novel therapeutics.

Background:

Leishmaniasis is a tropical disease caused by protozoan parasites known as trypanosomes of the genus *Leishmania*. The disease is found most frequently in the tropics and sub-tropics of areas of Asia, Africa, North and South America, and Southern Europe, though records have indicated its presence has been found in approximately 90 countries. Leishmaniasis is typically spread through the bite of infected sandflies, most often of the genus *Phlebotomus* or *Lutzomyia* depending on the area.^[5] Symptoms of the disease may manifest as cutaneous, mucocutaneous, and or visceral nodules or lumps that may end up forming ulcers which vary in severity and level of pain. Other times, carriers of the disease may be asymptomatic, showing no physical signs of illness at all. Additional symptoms may include weight loss, fever, and abnormalities in blood work.^[14] The visceral form of leishmaniasis is considered the most severe type and is usually accompanied by low blood cell counts and potential damages to the spleen, liver, or other internal organs.^[11]

Leishmaniasis currently affects over six million people worldwide with new cases per year ranging from about 700,000 to 1.2 million, though estimates show the number of new cases in recent years may be diminishing.^[4] The disease currently has treatments available, with the most popular being pentavalent antimonials, Amphotericin B, Miltefosine, and other heavy metal-based medications. Though treatments typically have high success rates, growing resistances among the trypanosomes have been encountered as well as some treatments having potentially detrimental side effects to those encountered.^[4] While the disease is treatable, some afflicted with extreme cases of infection may succumb to the disease leading to varying mortality rates throughout the areas. As such, synthesis of alternative medicines has been explored with natural products such as isoquinoline alkaloids and benzoquinolizidine alkaloids being among the family of different plant natural products that have shown anti-leishmanial effects with decreased toxicity when compared to the current heavy metal-based treatments.^{[2],[10]}

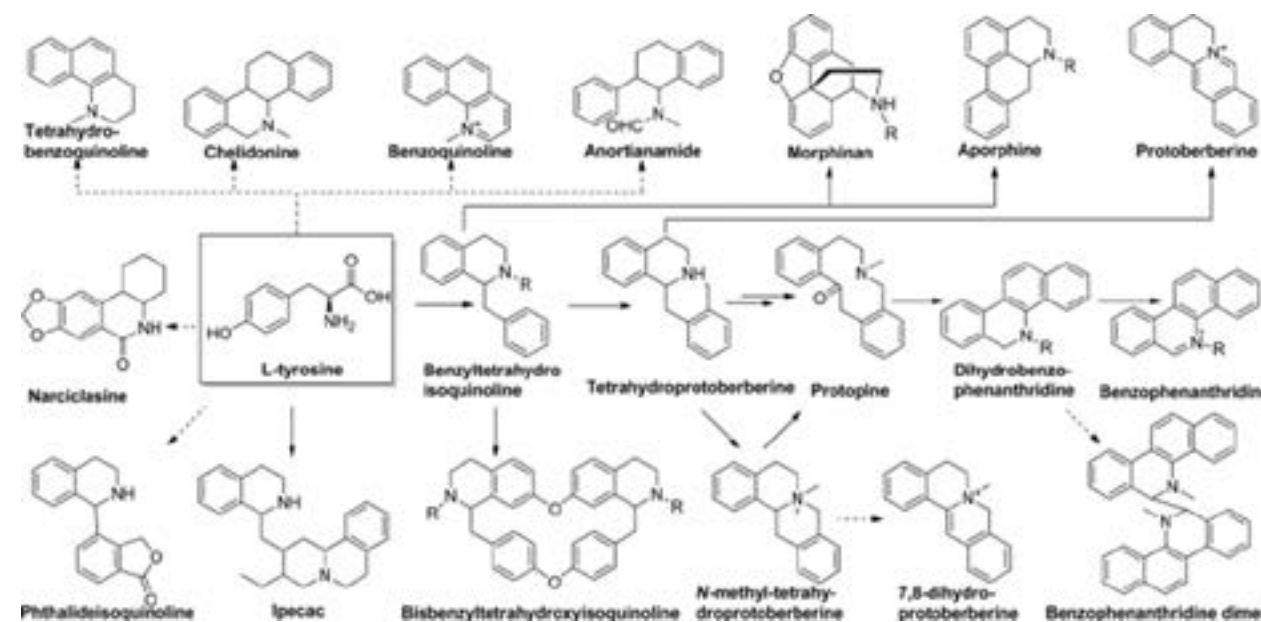


Figure 1 - Fragmentation of Isoquinoline Alkaloids

Bisbenzylisoquinolines such as Tiliageine have shown a wide array of bioactive effects, particularly serving as anti-viral and anti-malarial compounds for use as precursors to new pharmaceutical treatments. Considering the potential use of these naturally derived products as novel drug therapies, an investigation into the synthesis and evaluation of BBIQs such as Tiliageine could yield antileishmanial treatments effective against resistant strains of *Leishmania* with possible reduced severity of side effects. The investigation into alternative medicines through the synthesis and use of natural products can help us better understand viral infections and find ways to treat afflicted individuals while mitigating any detrimental side effects.^[3] Additionally, exploration of previously under utilized methods in the synthesis of complex natural products has potential for greater overall applications in the field of organic and synthetic chemistry leading to newer synthetic methods that can be employed for future reactions.

Methods:

Pictet-Spengler Reaction:

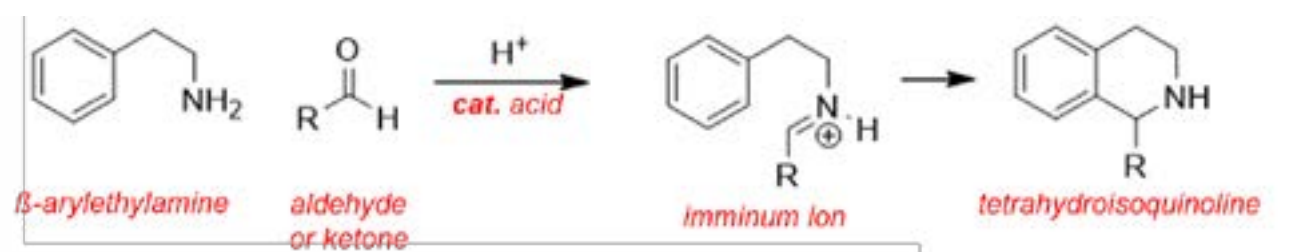


Figure 2 - Pictet-Spengler reaction converting a beta Phenylethyl amine and aldehyde into a Tetrahydroisoquinoline.

The proposed synthesis aims to utilize the Pictet-Spengler reaction, also known as the Pictet-Spengler tetrahydroisoquinoline synthesis, as the key novel step towards cyclodimerization of the target molecule. This is accomplished using an acid catalyst the first protonates the carbonyl oxygen on the aldehyde, which is then attacked by the Nitrogen from the amine reagent. Subsequent proton transfers and the release of water from the reaction generates an iminium ion intermediate which then cyclizes upon itself to form our tetrahydroisoquinoline product as well as regeneration of the acid catalyst used.

Tiliageine Retrosynthesis:

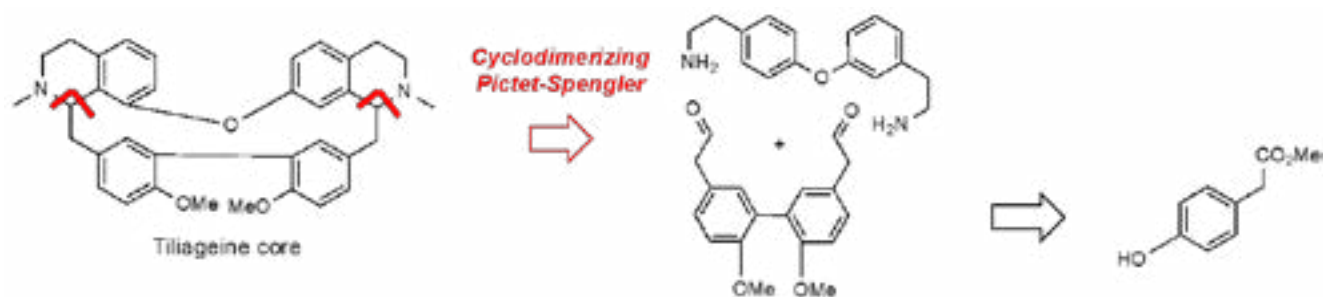


Figure 3 - Retrosynthetic Analysis of Tiliageine

In examination of the target molecule, we are able to isolate out a fused tetrahydroisoquinoline ring-like structure as part of the molecule itself. The amine group is seen as part of a six membered ring connected to a 'R' group while also being a fused bicyclic area of the molecule with the neighboring benzene. Fragmenting this molecule out into two distinct skeletal molecules allows us to see similar reactants as is typical of a Pictet-Spengler reaction – a beta arylethylamine as well as an aldehyde. Further fragmentation of these skeletal molecules allows us to propose that the synthesis can be started from simple commercially available starting material to be transformed into our target Tiliageine.

Proposed Synthesis:

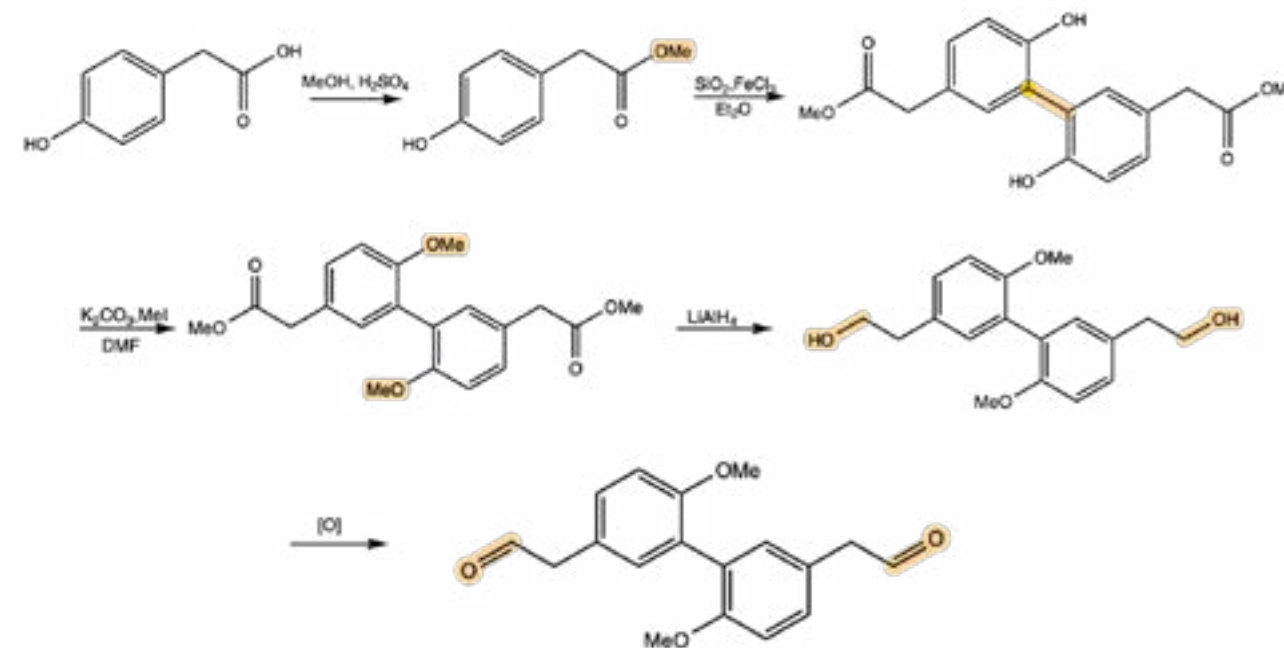


Figure 4 - Proposed route for the synthesis of half of Tiliageine core

The commercially available molecule used to begin the synthesis is 4-hydroxyphenyl acetic acid. The starting material will first be esterified utilizing methanol in the presence of a sulfuric acid catalyst. Following successful reaction, the resulting ester will then be subjected to a dimerization process facilitated by a silicon dioxide – ferric chloride catalyst ran in the presence of diethyl ether. Once dimerization has taken place, an ether synthesis will be ran using potassium carbonate and methyl iodide ran in dimethyl formamide. Reduction of the terminal esters will then be achieved by use of lithium aluminum hydride to afford the primary alcohol intermediate product. Finally, oxidation of these alcohols will yield the aldehyde side chains needed giving us one of our two proposed skeletal molecules of Tiliageine. This aldehyde half will then be reacted with the amine half worked on by a separate member of the lab in order to explore viability of the Pictet-Spengler cyclodimerization in fusing the molecules together to form our target Tiliageine product.

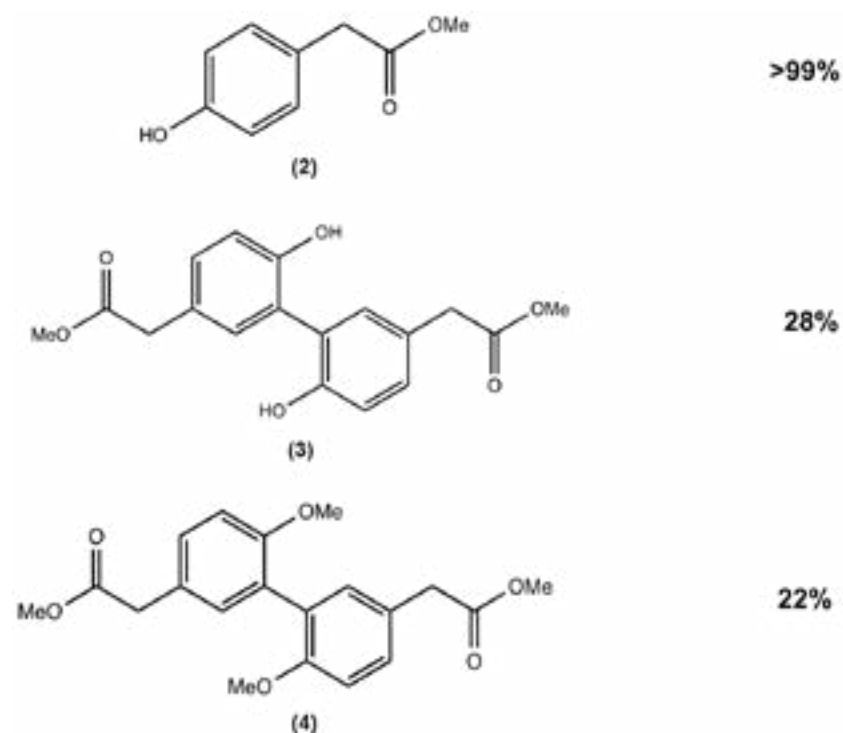
Results:

Figure 5 - Current synthesis steps accomplished with respective yields.

The starting material was first modified by using a commonly employed reaction known as Fischer Esterification. 4-hydroxyphenyl acetic acid was methylated utilizing a sulfuric acid catalyst in the presence of methanol and heated to yield methyl-4-hydroxyphenyl acetate (>99% yield). The resulting product was dissolved in Chloroform-D (CDCl_3) to confirm presence by proton nuclear magnetic resonance imaging (^1H NMR). Peaks were determined to match expected literature values to confirm transformation into acetate product. The resulting product was then dimerized by utilizing an iron-silica gel catalyst and heated slowly under vacuum. Crude dimer was then purified by column chromatography to remove excess iron and other byproducts before confirming successful reaction via ^1H NMR (28%). Alcohol subgroups within dimerized molecules were then converted to methyl groups by utilization of Williamson ether synthesis. The biphenyl compound was dissolved in methanol and heated in presence of potassium carbonate before being extracted out using a separatory funnel and dichloromethane. Resulting organic layer was then heated in solution of dimethylformamide and iodomethane before being purified and analyzed with ^1H NMR (18%). Additional run of this step was conducted in an attempt to increase the yield of the reaction, but technical issues were

experienced in the extraction process resulting in loss of a majority of solution. The crude sample was instead purified using preparatory thin layer chromatography in a 1:1 hexanes to ethyl acetate solvent. The largest observed band was then carved out of the preparatory plate and filtered out with additional solvent by vacuum filtration. The collected solvent was then evaporated out to yield our intermediate product and analyzed once again with ^1H NMR (22%).

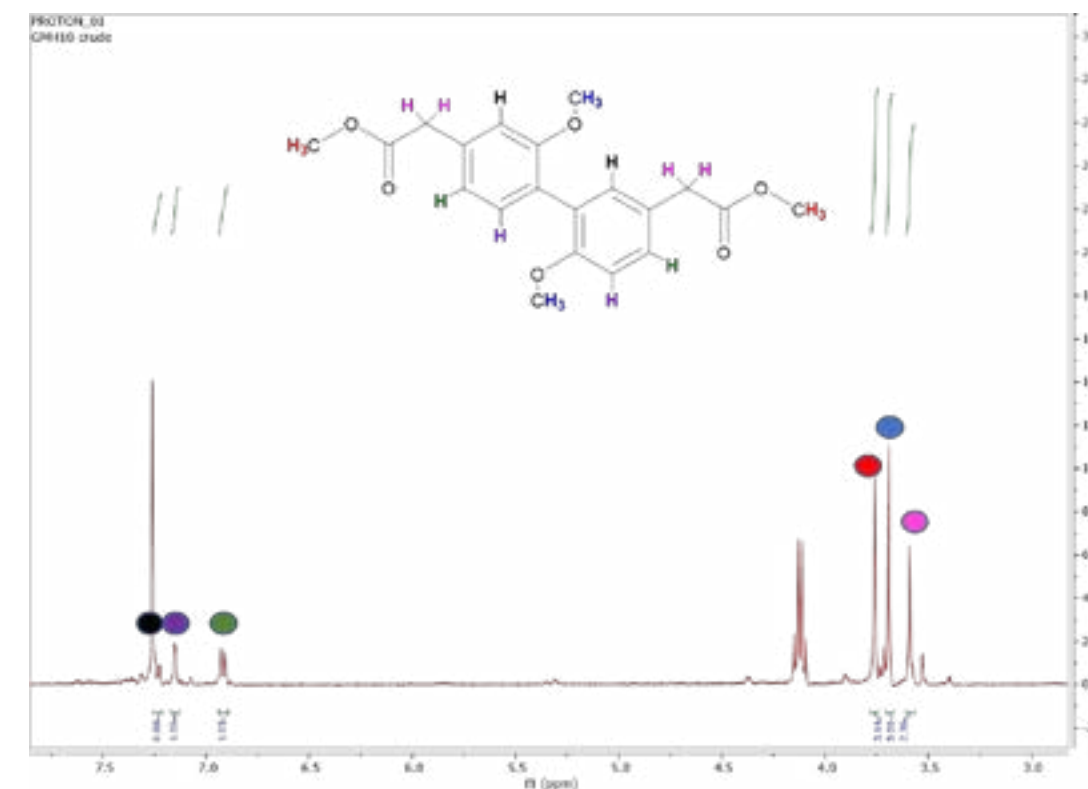


Figure 6 - Crude proton NMR of most recent synthesis intermediate. Key peaks identified: Singlet: 7.26ppm, Singlet: 7.18ppm, Doublet: 6.85ppm, Singlet: 3.80ppm, Singlet: 3.73ppm, Singlet: 3.60ppm

Analysis of the NMR spectrum of the most recent intermediate showed consistent results with literature values. The number of expected to appear in the aromatic region (3) ranging from 6.70 – 7.40 ppm were confirmed with the proper amount of integration and multiplicity. Some interference with excess solvent not evaporated out did cause a sharper peak to be observed, but the interference was able to be accounted for. The remaining protons in the molecule were able to match up with three of the remaining peaks with the expected ppm matching the shifts we would expect in the chemical environment. Excess solvent created additional noise in the area, though overall the spectrum confirmed that synthesis of our intermediate was successfully accomplished.

Future Work:

Synthesis of Tiliageine core will continue to be explored in additional steps with preliminary products achieved. Following high enough yield of methylation, carbonyl groups will be reduced through use of lithium aluminum hydride. Resulting phenyl alcohol groups will then be oxidized to create one half of our expected molecules core components. This half of the compound will then be reacted with a separate amine molecule currently being worked on as a separate project in research group. Once cores have been synthesized and confirmed via methods of thin layer chromatography and 1-H NMR additional synthesis steps will follow to conduct Pictet-Spengler reaction and employ cyclodimerization of expected molecule. Additionally, scaling up of current processes will be explored to ensure available material is always on hand to employ experimental synthesis.

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**Comparison of Hard Engineering verses Bioengineering for in
Stream Erosion Control**

**Dr. Seema
Shah-Fairbank**

ABSTRACT

Urbanization and anthropogenic activities are major causes of riverbank and riverbed erosion. Erosion has been known to change stream and river cross sections and profiles, which leads to potential damage to infrastructure (i.e., roads, bridges, levee) and aquatic habitat. To reduce the impact of erosion both hard engineered (i.e., concrete, large rocks, retaining walls) and natural bioengineered (i.e., pole planting, coir rolls, tree & brush revetment, root wads, timber walls) design solutions have been implemented for stream and river stability. In semi-arid climates, such as Southern California, the effectiveness of bioengineered solutions is uncertain. Most bioengineered solutions require a constant source of water to be viable, which is not always possible in the region. This study provides the purpose, material, advantages, and disadvantages of various types of instream and river stabilization techniques. This project is the initial step needed to create a guide for practitioners and researchers to identify the most effective technique to stabilize streams and rivers against erosion.

MAJOR OBJECTIVES

The purpose of this investigation is to evaluate the impacts of hard engineered and bioengineered solutions to mitigate bank and bed erosion in rivers. The goal is to identify trends such as type of material, location, stream classification, hydrologic criteria, types of erosion failure, and types of erosion protection to understand patterns in stream behavior that will evolve the way rivers are stabilized to reduce climate change impact. This will be accomplished by developing an inventory of past projects that have implemented hard engineering, bioengineering, or a combination of both. After a well-developed inventory is created, the objective is to design a design manual in the form of a collection of data sheets which lists a summary of the technique, pros and cons, and criteria on how to design the specific erosion control technique suited for Southern California. The goal is to make this design manual available to flood control agencies and engineering firms, so that professional engineers and practitioners can use when designing an erosion control technique.

LITERATURE REVIEW

RIVER AND STREAM CATEGORIZATION

While a channel is a physically confined, usually concrete-lined part of a river, a stream is known to be a smaller body of flowing fresh water that once joined with other streams to increase stream width is known as a river (National Geographic). A river is a large natural flowing watercourse composed of multiple streams. A stream and river will be used interchangeably throughout the literature review and proposal.

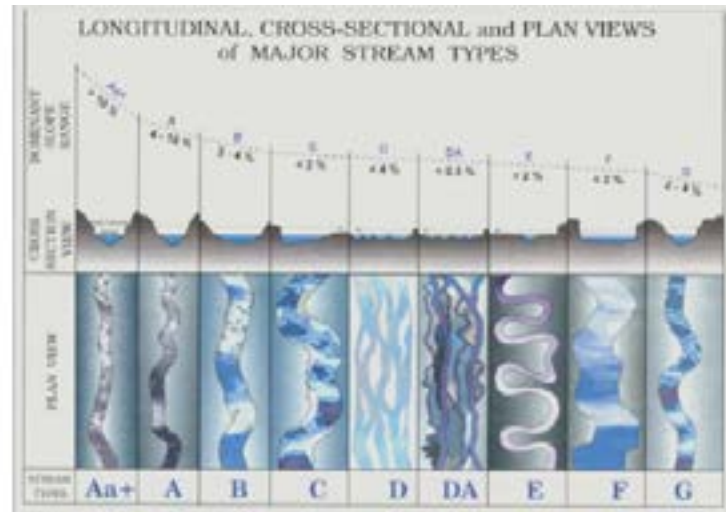


Figure 2: Level I Stream Classification (Figure from Stream Corridor Restoration: Principles, Processes, and Practices, 1998)

Streams are further categorized by their physical, hydrological, and biological properties (Montgomery County). Streams can also be classified as perennial, intermittent, or ephemeral streams. Ephemeral streams are those most common in Southern California because they experience flow only during or right after a storm event. Ephemeral streams do not have enough flow to be continuous streams. Meanwhile, perennial streams have continuous flow throughout the entire year. Intermittent streams fall into the middle category where only during specific seasons does the stream have a continuous flow and on dry seasons it does not (Montgomery County).

STREAM FAILURE

The number one cause of stream failure and water quality degradation is riverbank erosion and loss of sediments (Aldafae et al. 2020) followed by other less prominent causes such as channelization, incorrect construction of dams, slope failure, urbanization, and farming which have a detrimental impact on the stability of the stream (Doerfer and Urbonas 2004). Riverbank erosion is caused by a variety of factors including discharge magnitude, velocity, and water inflow (Julien 2002). Storm water runoff increases seepage and alters the sediments. These factors have adverse effects on streams and lead to erosion even if the river was thought to be designed effectively. Piping, soil gradation, and channel geometry may also lead to erosion (Julien 2002). Bank erosion causes the geometry of the channel to change. The material must seek its balance to stabilize the stream, yet this is when the stream destabilizes through transport of sediments.

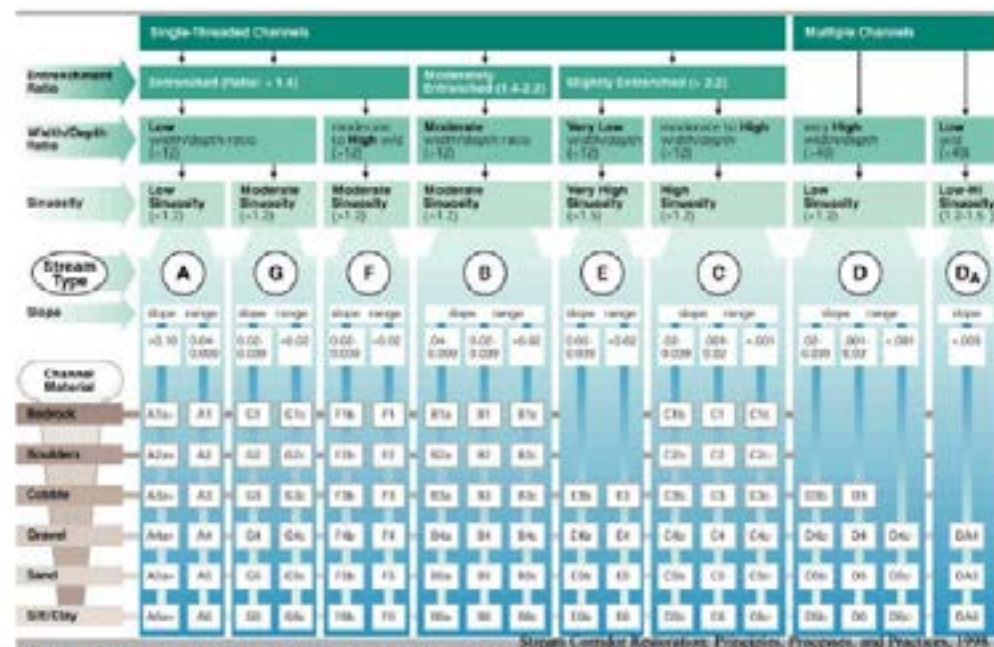


Figure 3: Level II Stream Classification (Figure from Stream Corridor Restoration: Principles, Processes, and Practices, 1998)

Bank Erosion

Erosion occurs when the streambank experiences failure. This takes place when the active force of flowing water is met by the passive forces of the bank material resisting the motion (Julien, 2002). Streambank failure is strongly associated with the streambank material, and erosion potential is accelerated by seepage, permeability, shear stress, and cohesion (USDA NRCS, 2009). The three common failure types are dependent on the bank material: cohesive soil, cohesionless soil, and stratified or interbedded banks.

Noncohesive banks experience failure when the grain is removed at the toe of the outer bank, which causes sliding of the granular material right when the bank angle exceeds the angle of the repose of the material (Julien, 2002). This is due to a temporary capillary action, which decreases the angle of repose (USDA NRCS, 2009). Cohesive banks undergo rotational failure, especially when they have tension cracks, which accelerates failure (Julien, 2002). However, cohesive soils are more resistant to tension cracks because they are less permeable. Cohesive banks are subject to a rapid drawdown in the water levels due to the increase in soil pore water pressure (USDA NRCS, 2009). The most common type of failure is in stratified banks. Failure is due to the cohesionless soil in a stratified bank, which is usually found at the toe of the bank. Stratified banks are unique because the noncohesive material in the stratified bank leaves the cohesive material unsupported, which can then experience failure once tension cracks become present (Julien, 2002).

Bed Erosion

Bed erosion, on the other hand, occurs slightly differently than bank erosion. Four main reasons for bed erosion are: increase in bed slope, increase in velocity, sediment supply, and increase in discharge (Queensland Government, 2009). Excessive extraction of sand and gravel will increase the height difference between the bank and bed, which makes it more susceptible to collapse causing bed erosion. As a result of bed erosion, channel enlargements cause significant economic and environmental concerns. A lower water level limiting water available for irrigation and pumps can destroy aquatic habitats and destroy neighboring infrastructure.

EROSION PROTECTION

Riverbank erosion is an ongoing concern in many countries and some of the methods used to strengthen riverbanks are hard engineering and bioengineering techniques. With an increase in urbanization, which results in high peak flow rates and volume of water, the natural ecosystem can be disturbed. To protect streams from erosion, it is essential to find a balance between the forces that affect riverbank erosion and alter the bed slope. Bioengineering techniques use natural conditions to stabilize a river. Meanwhile, hard engineering techniques incorporate the use of concrete and manmade structures to strengthen a river.

How can both hard engineering and bioengineering be implemented together to increase riverbank strength? It is ideal to implement these measures when noticeable signs of failure are present and before bank and bed erosion occurs. Some hard engineered solutions are the use of riprap, gabions, concrete cinder blocks, and rock-fill trenches (Julien 2002). On the other hand, bioengineered solutions include vegetation, nutrient retention, and bacterial decomposition that can be beneficial to the overall ecosystem (Vianna et al. 2020). Bioengineered solutions use natural conditions to protect rivers against riverbank erosion. However, if the appropriate solution for the river is not selected, then it can result in continued erosion. Engineered designs used to protect streams depend on economic factors, resources, and design constraints.

Hard Engineering

Hard engineering, such as riprap and gabions can be more expensive initially because of the material, transportation, and labor costs, yet when economically feasible, it is a useful method since it often requires less maintenance. Rock riprap blankets are flexible and are not impaired nor weakened by small movements (Julien 2002). The channel should be stable, meaning that it is in dynamic equilibrium with the sediment load (Copeland et. al, 2001). Riprap is a durable, recoverable, and cost-effective alternative (Julien 2002). Riprap is often used to make shorelines more suitable for agriculture, transportation, and buildings (Strayer et.al 2015). It not only provides stability for rivers, but it supports fish communities as well, making it an environmentally friendly technique. In combination with riprap, filters are used under riprap to allow water to drain into the bank (Julien 2002). Riprap and filters are useful engineered techniques because they allow water to drain instead of causing saturation, which leads to erosion. Allowing water to accumulate is a simple and important

approach. However, riprap does have drawbacks such as particle erosion, slides, slide slope failure, and slump (Julien 2002). Riprap is not the only hard engineering technique widely used, but it is a more cost-effective one.

Gabions, patented rectangular boxes filled with small stone, are stacked on steep slopes forming a massive structure that resists the forces of river flows and unstable material (Julien 2002). Gabions are flexible structures used to resist the high velocities in streams from reaching the sediments, which is a leading cause of bank erosion. However, it is not always the most cost-effective technique, so bioengineered methods are implemented to mitigate bank erosion. Riprap and gabions are just a few of the many hard engineering techniques used to stabilize rivers and protect them against erosion. Although hard engineering has been a long-term solution against bank and bed erosion, it has climate change implications that must be considered when determining the most effective and efficient solution.

Bioengineering

The most widely suggested bioengineered technique to protect against bank erosion is the use of vegetation. Bioengineering can sometimes include hard engineering with biological components of plants (Mondal & Patel 2020). The river's stability can be restored by implementing a vegetated wall along the riverbank surface for surface protection (Mondal & Patel 2020). Different plants are chosen in the design depending on the degree of erosion the river is facing (Mondal & Patel). Fascines are another bioengineered technique, which help to restore habitat quality (Martin et al. 2020). Bioengineered methods are often beneficial because they are found to be more of a cost-effective solution and consider both biotic and abiotic components of a river. At times when it is more difficult to choose an option that mimics natural features, bioengineering seeks to strengthen rivers through soil fixation properties (Martin et al. 2020). Bioengineering is often a favorable method used to protect streams. However, just as hard engineering has its drawbacks, bioengineering has limitations because natural vegetation cannot resist such high velocities and storm events, which would still pose an erosion concern.

GUIDANCE TO SOLVE

Every river has its own characteristics that differentiate it from other rivers. The overall goal of bank stabilization is to increase environmental efficiency and sustainability while at the same time reducing bank failure for a stable channel (Baird et al. 2015). However, not all solutions work the same way as there are some that fix the problem, while there are others that compensate for the problem (King County Department of Public Works, 1993). In order to achieve a sustainable yet durable hard engineered and bioengineered combination solution, the design must be compatible with the river and geomorphic processes. The disruption of the riparian habitat and natural environment should be as minimal as possible (Baird et al. 2015). A crucial guideline to selecting the ideal bank stabilization method is to perform a site analysis such as: a geomorphic assessment and a hydraulic and sediment transport assessment (Baird et al. 2015). Streams are classified into zones: toe zone, bank zone, and overbank zone. Each zone has its own design implications that should be followed for a successful project (King County Department of Public Works,

1993). Once assessments have been analyzed, the selection of bank stabilization method occurs while drafting a project design that will preserve the floodplain (Baird et al. 2015).

METHODOLOGY

The primary research method for this project consists of three parts: data mining, data collection, and a final product. Part one consists of data mining where we collect case studies and design guideline reports of past stream stabilization projects in the United States from governmental sites and peer-reviewed publications. Part one should provide a minimum of five past stabilization projects but may need to be increased to analyze more designs and develop a stronger inventory of past projects.

Part two is comprised of data collection. From each project we are to identify the following parameters: types of material, location, stream classification, stream patterns, hydrologic criteria, type of erosion failure, and type of erosion protection. Hard engineering and bioengineering technique identification using a thematic analysis is the first step to compare the effectiveness of both methods and recognize when each technique is most efficient. The data collected from each project must be compared among other stabilization projects to identify which design would work best in Southern California.

Part three is the last stage of the research project which calls for a final product: a GIS database of hard engineered and bioengineered solutions. The database should be an ArcGIS map that pinpoints different sites that have implemented design techniques to control instream erosion in Southern California. Each project location meets different criteria; therefore, each stream stabilization project requires a different design technique, but the goal is to use the design that minimizes climate change impact. Each pin on the map will have a popup with a variety of pictures showcasing the different techniques used at each specific location. The observations and trends discovered from the site visits and pictures will allow practitioners and engineers design future projects with less climate change impact. In the case that the trends are inconclusive, and an ideal design cannot be determined, a design booklet of ideal bioengineered solutions will be created. The design technique, location, and material that should be used with associated cost and design criteria for specific stream stabilization engineering methods will be explained. A procedure of method implementation and overall social, economic, and environmental impacts, both positive and negative will be outlined. The idea is to look broader, outside of Southern California but apply the approach locally and create a solution that can be used in Southern California.

RESULTS

During the past few months, the focus was part one of the methodology which was used to create a poster about different erosion control techniques to present at the Southern California Conference for Undergraduate Research (SCCUR) as seen in Figure 5. To create the poster, an inventory spreadsheet of multiple hard engineered, bioengineered, and a combination of techniques was developed on Excel. The list included the technique type, stream classification, materials it was composed of, pros for the technique, and cons against the technique along with the reference of where the information was found (Figure 4). Although this list was used as data for the poster presentation, it will also be used in

writing the design manual. While presenting the poster, feedback from the public gave insight to determine which techniques would be the most common, cost efficient, time efficient, and how would the groundwater be affected by replacing impermeable areas with pervious solutions. It was concluded that concrete is the most common Southern Californian technique but the one with the highest climate change impact. Riprap is another technique very widely used in Southern California because of the abundance of rock found in the area. However, armor flex seems to be a viable combination solution because although it is a rigid concrete lining, it allows vegetation to grow in which gives it a natural aesthetic over time. A possible solution to reduce climate change impact would be to use alternate materials or use more local materials to reduce the distance these materials are transported. The inventory of erosion control stabilization techniques and the poster presentation are a great first step to develop the design manual.

Stabilization Technique	Purpose of Technique	Material	Type of Erosion Failure	Stream Pattern/Classification	Pros	Cons
Riprap	Riprap is placed in potential erosion sites in an excavated trench. Erosion of the toe causes the riprap to launch down the bank of the channel, protecting the slope to form a new final channel bank line.	Large rock	Bank erosion	meandering stream/ braided stream	Large volume of small sized rock as obtained at low cost. Individual rocks may shift position to reorganize themselves to self heal with changing flow patterns. Can be implemented quickly in response to emergent flood events.	Monitoring and maintenance is required to replace eroded bar channels. It prevents bank slumping due to increased velocities and reduced habitat. Rock with dislodged vegetation has lower hydraulic resistance.
Gravel Riprap	Bank slope protection to fill the voids with concrete gravel to form a monolithic armor.	Rock & Portland cement mortar	Bank Erosion	all streams	The use of gravel rock reduces the amount of rock required, gravel eliminates the need for filter material. Ability to use smaller rock and thinner stone layer offers some of the cost of the gravel.	Gravel riprap is rigid but not as extremely strong, support by the embankment must still be maintained. Bank slopes should not exceed 1.5:1. will not conform to changes in bank geometry due to settlement.
Armor Flex	Rigid lining to resist erosion.	Concrete and mesh	Bank erosion	all streams	Lightweight blanket and mesh that encourages diversity, flexibility, vegetation, and habitat enhancement, nice aesthetic, heavy duty.	Use of pre-cast concrete with uniform shape and size.
A-jacks	Dissipate energy and resist erosion forces of flowing water.	Concrete armor units like checker block	Bank erosion	all streams	Reduce velocity less costly than cast in place; prevents undermining of stream toe and protects armor slope.	Concrete with high climate change impact.
Cobles	Box structures are aligned along the streambank toe to form a retaining wall or continuous blanket of protection diverting flow away from the bank.	Woven baskets filled with rock	Bank erosion	small streams with low velocities	Flexibility of mesh and filter stone allows them to maintain their structural integrity even after some degree of displacement.	It has limited recommended max velocities due to small stones becoming unstable. More expensive method of cobblebank erosion protection. Must be periodically inspected and require proper maintenance. Cores of PVC coating expose wire to corrosive elements.
Vegetated Wall	Prevents mass movement and shallow sliding in bank.	woody plants	Vertical erosion	all streams	Root establishment, soil erosion depletion, and increasing enhance bank stability. Fine stems increase surface roughness, create mechanically produce soil.	Windblowing along with destabilize bank, upland of root mass, weight of vegetation create downward slope.

Figure 4: Erosion Control Stabilization Techniques Inventory



Figure 5: Poster Presentation for Southern California Conference for Undergraduate Research

During Spring Semester, the focus was shifted to part 2 of the methodology, the site visits. We completed a total of twelve site visits. The sites visited were the following: Agua Chinon Creek, Buck Gully, Santa Ana River, Aliso Creek, Santiago Creek, Serrano Creek, Brea Creek, Diamond Bar Creek, Chino Creek, Cucamonga Creek, Mill Creek, and Little Chino Creek. Pictures were taken of the hydraulic structures used and uploaded to create a GIS database map on ArcGIS Online. Site coordinates were pinpointed, and notes were added to each point on the GIS map. See Figure 6: GIS Database for a preview of the GIS database of the project sites that have implemented hard engineering and bioengineering solutions. The four common techniques noticed during the site visits were riprap, gabions, vegetation, and coir logs. Based on observations and further investigation, table 1 below was developed to show our findings about each technique. These pros and cons were concluded based on images such as those in Appendix A.

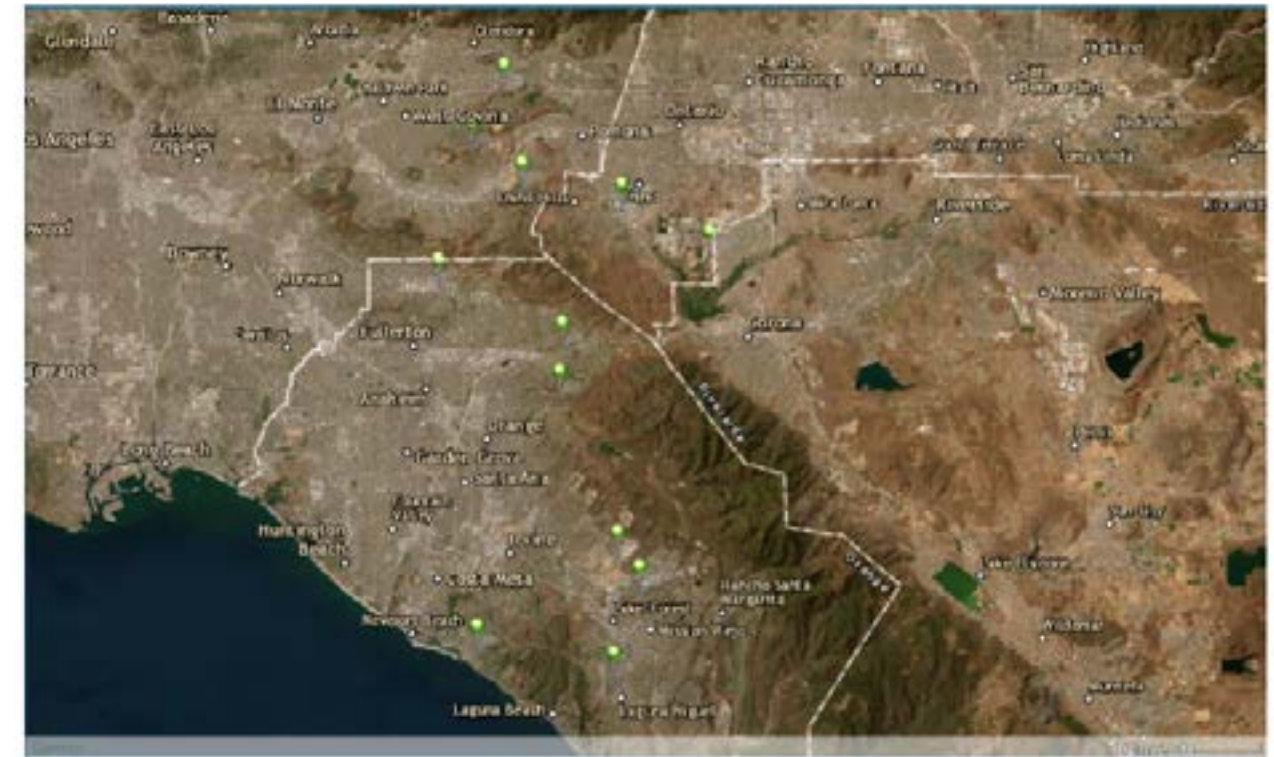


Figure 6: ArcGIS Online Database

Table 1: Erosion Control Technique Comparisons

	Pros	Cons	Replacement/Maintenance
Riprap	Can be implemented quickly in response to emergency floods	Monitoring required; Promotes bank steepening	Every 5 years replacement
Gabions	Flexibility of mesh & filler stone	More expensive and has limited maximum velocities	Every 50-100 years replacement
Vegetation	Root reinforcement, low soil moisture	High flow velocities destabilize bank, requires high maintenance	Every 2-year maintenance
Coir logs	Biodegradable, provide nutrients to the soil	Doesn't work in high velocity streams	Every 2-year replacement

DISCUSSION

Unfortunately, the research project has not advanced as planned. Based on the original timeline, it was expected that data collected from each site would have been documented to create a GIS database. However, the focus of Fall semester was to prepare for the Southern California Conference for Undergraduate Research (SCCUR). With this in mind, the detailed spreadsheet was created to describe as many erosion stabilization techniques that could be encountered throughout the research phase. Based on the research collected, there is an extensive list of different hard engineered and bioengineered techniques that were investigated. The goal from here was to visit sites that have already implemented these techniques and document more data such as type of stream, stream pattern, channel size and shape, and different hydrologic criteria gathered from original design and construction plans.

A meeting was set up on October 11, 2022 with professionals from Riverside County Flood Control and different engineering consultants to discuss different projects that have implemented bioengineering techniques or a combination of both hard engineered and bioengineered solutions. From this meeting, it was determined that not many projects have used bioengineered solutions alone because of the time it takes to gain in size and strength in the streams to protect against erosion, so by the time a storm hits there is not much protection. However, a combination of both hard engineering and bioengineering is more widely used. A date was set up during winter break to visit Buck Gulley in Newport, Agua Chinon Creek in Irvine, and a few more sites in Orange County. This will be an ongoing effort that will be added to over the years, but the goal is to get started by documenting the most well-known techniques that will work in Southern California.

Based on current findings from table 1, riprap is the technique most widely used and requires less maintenance/replacement compared to the other techniques. It only requires replacement about every 5 years while vegetation takes longer to gather the strength required to support the bank of the river and requires maintenance every two years. However, for better aesthetic, maintenance is most likely expected twice a year. Gabions on the other hand last at least 50 years which are a very viable solution, but they are more expensive compared to riprap. For further investigation, cost analysis is a variable to consider. Designing a combination technique that includes riprap, gabions, and vegetation or coir logs is ideal here in Southern California. Suggestions for further research are to design a combination technique solution which can be implemented in a river, maintained for a few years and observed even during natural disasters. This will guide engineers and allow them to discover if a combination technique works in Southern California. This type of research requires years of observations and will continue on with the future generation of students.

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APPENDIX A



Figures 6 & 7: Walnut Creek



Figures 8 & 9: Brea Creek



Figure 10: Cucamonga Creek



Figures 13 & 14: Santiago Creek



Figures 11 & 12: Santa Ana River



Figures 15 & 16: Serrano Creek



Figures 17 & 18: Buck Gully

Iglesias
Oona

The Effectiveness of the McNair Scholars Program at Cal Poly Pomona

Abstract

The McNair Program, or the Ronald E. McNair Postbaccalaureate Achievement Program, is a higher education program designed to prepare eligible participants for doctoral programs through research, academic assistance, and mentorship. The McNair program was introduced to Cal Poly Pomona in 1999 with the aim to diversify faculty in higher education and admits about twenty-six students per year. During the academic year, McNair Scholars have the opportunity to conduct and present research, as well as attend graduate school preparation activities. Most scholarly journals aim their focus on a certain area of the academic pipeline; high school to entrance of postsecondary school. These studies fail to explain efficacy of the secondary retention and graduation rates of the McNair program. My study will focus on measuring the effectiveness of the McNair Program by scholar's feelings and attitudes towards the program. Research conducted will include a mixed methods approach to gather both qualitative and quantitative data. Data will be collected through semi-structured interviews, surveys, and questionnaires from current McNair scholars at Cal Poly Pomona's McNair Scholars program. My quantitative method will consist of numerical data stemming from the McNair class evaluations. Qualitative data will consist of semi-structured interviews of current McNair scholars at Cal Poly Pomona as well as data collected from the class evaluations. Expected results from the study will expand further knowledge on how the program can better assist future cohorts in both their research and plans after their degree.

Major objective(s)

My study will focus on measuring the effectiveness of the McNair Program by scholar's feelings and attitudes towards the program.

Background research with analysis and summary of literature review

My background literature consists of six themes that include: Academic and Transitional Adjustment Support, Social Strains in First-generation Students, Underrepresentation of First-generation Students in College, and Inequalities in Higher Education. To further my background, I have analyzed the federal statistical data on the McNair Program. These themes create the foundation of understanding the issue the McNair Scholars Program is trying to address. The program is to aid underrepresented undergraduate students through promotion in social mobility by means of graduate school. The theme Academic and Transitional Adjustment Support mainly discussed how underrepresented students benefit from transitional adjustment support programs by learning more about the campus and its resources and connecting to faculty, staff, and other students on campus (Childs, Poynton, Schuyler 2021). The literature identified lack of knowledge and preparedness for college in first-generation college students can lead to imposter feelings which can cause them to be discouraged in continuing higher education (Canning, Kroeper, LaCosse, Murphy 2019). Data of student persistence points out how

invisible first-generation students feel in college, causing them to hide in social and academic interactions (Babineau 2018). The literature calls to action how knowledge in higher education is an important way to be more inclusive to underrepresented students in academia.

Data collected for the Department of Education in a report shares national statistical information on the McNair program. The data provided is a straightforward analysis, with complex mathematics involved. Although the complexity is valuable and impressive, it is limited in its pursuit of concrete, statistical relationships, which can lead to researchers overlooking broader themes and relationships. The federal quantitative reports examined how the McNair Scholars Program has impacted students through multiple years after their completion of the McNair Scholars Program. However, it remains unclear how the program affects students through their entire graduate degree process. The quantitative findings provide some longitudinal results regarding students' attainment, but it is not clear that it is only the programs involvement that affected these students' ability to find success in graduate school.

Methods (Experimental procedure/design)

For my methods, I will be conducting my data collection with a mixed methods approach. I will be gathering data from interviews and surveys from current scholars, past scholars, and graduated scholars. The quantitative portion of my data will be from the survey the McNair program assigns scholars at the end of each semester and the course evaluation assigned from the university. The qualitative portion of my data will be gathered from the survey and the semi-structured in-depth interviews. The interviews will be with current scholars, past scholars, and graduated scholars. The areas of focus will include their knowledge, attitudes, and feelings towards the program in its role in their research, degree, and future plans. To recruit these individuals, I will be using the method of convenience/ snowball/ purposive sampling. I will rely on my role as a McNair scholar to recruit other scholars. Given my late admittance into the program, I will be using the snowball/ convenience/purposive sampling method to recruit to past scholars. Overall, I expect results from the study to expand further knowledge on how the program can better assist future cohorts in both their research and plans after their degree to better adhere to the students' needs.

Please describe progress made this period towards your project's stated goals and objectives (This section is a summary of what you have found out in your experiment so far. Your data/result and discussion should be included here)

I have begun a literature review as well as developing my interview questions. The director of the McNair Scholars program has given me verbal consent for obtaining the end of the semester evaluations of the program and overall class. Since my admission, I have been able to incorporate more into my literature review, find possible factors I can interview on, create interview questions, begin the IRB application, and connect with other individuals connected to the McNair Scholars Program. At this time, I will complete and submit my IRB application by the end of May and hope to start conducting interviews by the end of June.

If your project has not advanced the way you had planned, identify the impediments to progress you encountered during this period? What steps have you taken to move your project forward?

There is a level of security and access I need to go through to obtain a PR code to access the recent reports of the McNair program. I am currently trying to communicate with the Department of Education in order to receive access to the recent reports of 2021-2022. While trying to gain access, I will continue to work on my ongoing literature review, refining interview questions and implementing specific theories to my research to continue to move my project forward. I am refining my questions to be more personable in making sure the connections made in the interviews are meaningful. This is important in separating their role as a statistic, something I am trying to stay away from given the federal data collected.

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Lee Yaelle **Medicinal Mushrooms for Cognition and Mood: A review of human clinical trials**

ABSTRACT

Medicinal mushrooms have been used since ancient times to treat disease and promote general health and well-being. Various health-promoting properties have since been confirmed with studies demonstrating immunomodulatory, anti-cancer, anti-viral, anti-bacterial, anti-inflammatory, neuroprotective, and cardioprotective activity among other properties. An additional interest in the use of mushroom nutraceuticals for mental health and cognition enhancement has also developed with various dietary supplement companies advertising their mushroom products with claims of improved memory, focus, and mood. However, research is still in its early stages with few human clinical trials to support these claims. The purpose of this review is to compile and examine the evidence for beneficial effects on the mind by medicinal mushrooms, specifically regarding the domains of cognition and mood, by reviewing human clinical trials. This review reveals trends of improvement in well-being by *G. lucidum* in the context of taxing disease states, improvement in cognitive function *H. erinaceus* in the context of cognitive decline, and general improvement in depression and anxiety by *H. erinaceus*. Potential mechanisms and limitations due to research design are also discussed. This review provides further clarity on the validity of health claims made by supplement companies and calls for future research in these areas.

INTRODUCTION

Medicinal mushrooms have been used to promote health and to treat a variety of ailments for thousands of years. Documentation of therapeutic mushroom use is present in many cultures throughout history, including the ancient Greeks, Chinese, and first peoples of North America.¹ These mushrooms were valued for their pharmaceutical properties rather than nutritional value alone. Certain mushrooms are known as functional foods, foods which may promote optimal health and reduce disease risk. They can be found in supplement form as liquid or powdered extracts known as nutraceuticals. Mycotherapy describes the use of these mushroom extracts to treat illness or support general health. A growing interest has developed in the potential medical applications of these nutraceuticals with modern research identifying and testing the activity of various bioactive compounds from these mushrooms. In vitro studies have shown immunomodulatory,^{2,3} anticancer,^{4–6} cardioprotective,⁷ neuroprotective,^{8–10} and other health-promoting activity¹¹ from a variety of mushroom species.

Ophiocordyceps sinensis, previously known as *Cordyceps sinensis*, is a well-known medicinal mushroom in traditional Chinese medicine where it is called DongChongXiaCao. It is also nicknamed caterpillar fungus due to its parasitic relationship with caterpillars. Within traditional medicine, this mushroom is thought to benefit the kidneys, lungs, liver, circulation, cardiovascular system, and to reduce fatigue.¹² Modern research indicate antitumor, immunomodulatory, antioxidant, anti fatigue, hepatoprotective, and renal protective activity of *Cordyceps*,¹³ though there is a need for more research in humans. *Cordyceps militaris* is a commonly used substitute for *O. sinensis* due to the rarity and costly cultivation process of

O. sinensis. Additionally, a key bioactive compound of *O. sinensis*, cordycepin, is also found in *C. militaris* and in greater concentrations, making it a suitable alternative.¹³

Trametes versicolor was traditionally used for general health promotion, increasing strength and vitality, and promoting longevity.¹⁴ It was previously known as *Coriolus versicolor* and is known as turkey tail in North America, YunZhi in China, and Kawaratake in Japan. Evidence for its immunomodulatory, antimicrobial, antiviral, and anticancer properties has contributed to its approved and routine clinical use in China and Japan as a complementary cancer therapy.^{11,14,15} The health effects are largely attributed to the bioactive polysaccharopeptides (PSPs) from two different strains of the mushroom. The COV-1 strain produces PSP and CM101 produces polysaccharide krestin (PSK).¹⁴

Ganoderma lucidum, called LingZhi in China and Reishi in Japan, is thought to promote longevity according to traditional medicine. Documentation of traditional Chinese medicine practices note beneficial effects regarding cardiac function, memory, antiaging, replenishing Qi, easing the mind, insomnia, and relieving cough, asthma, and shortness of breath.¹⁶ There are hundreds of bioactive compounds found in the spores, mycelia, and fruiting bodies of *G. lucidum*. These include triterpenoids, polysaccharides, nucleotides, steroids, and peptides among other compounds.¹⁷ Properties of *G. lucidum* demonstrated by preclinical studies include antiaging, immunomodulatory, anticancer, cardioprotective, anti-inflammatory, antiviral, antifungal, and antibacterial activity.^{11,18–20}

Hericium erinaceus also has a history of use in traditional Chinese medicine and is known for its bioactive hericenones, erinacines, and polysaccharides. Alternative names for this mushroom include lion's mane mushroom and monkey head mushroom, named after its voluminous, fur-like appearance. In addition to its antioxidant, antibacterial, and anticancer potential,^{21,22} *H. erinaceus* has been shown to stimulate nerve-growth factor (NGF), promote oligodendrocyte maturation, and display neuroprotective activity in animal models.^{23–25} In vivo studies have also shown improvements and protective activity in animal models of ischemic stroke, Parkinson's disease, Alzheimer's disease, and depression.²³

A growing interest in both the therapeutic and everyday use of medicinal mushrooms has developed with the excitement surrounding the implications of recent research and the increasing accessibility of mushroom nutraceuticals. Common health claims from dietary supplement companies, such as Swanson, Fungi Perfecti, MUD\WTR, Om Mushrooms, and Fresh Cap, include immune support from *T. versicolor* ^{26–29}; energy, endurance, and cardiovascular benefits from *Cordyceps* ^{30–32}; stress relief, immune support, and mood support from *G. lucidum* ^{33–36}; and improved memory, focus, clarity, mood balance, and nervous system health from *H. erinaceus*.^{37–40} Other claims such as increased mental clarity,⁴¹ cognitive functioning,⁴² and mental sharpness⁴³ are advertised for various blends of mushroom supplements.

However, with few human clinical trials measuring the cognitive impact of medicinal mushrooms, there is limited evidence supporting these claims. While evidence from in vitro and animal studies is valuable, the applicability in humans does not directly translate. This is why evidence from human studies is so vital for the evaluation of the efficacy of medicinal

mushrooms for different applications and contexts.

While the literature for the use of medicinal mushrooms in an immunological context is more developed,^{6,44} no reviews on the cognitive effects of mushroom supplementation in humans were found upon a search of the literature. This article reviews the human clinical trials measuring cognition-related outcomes to provide clarity on the current evidence.

METHODS

A search was conducted through the PubMed database. Only available, full-text, human clinical trials on the selected mushrooms which also measured at least one cognition-related outcome were included. The following mushrooms and their common names were searched: *Herichium erinaceus*, lion's mane, and monkey head mushroom; *Ganoderma lucidum*, reishi, and lingzhi; *Ophiocordyceps sinensis*, *Cordyceps sinensis*, *Cordyceps militaris*, and caterpillar fungus; *Inonotus obliquus*, and chaga; *Trametes versicolor*, *Coriolus versicolor*, *Polyporus versicolor*, and turkey tail. The following terms were used to search for cognition-related outcome measures: cognit*, mind, mental, memory, attention, focus, executive function, brain, mood, anxiety, depression, dementia, Alzheimer's, psych*, and well-being. Additional available studies referenced in other articles that met the inclusion criteria were also included.

RESULTS

The search yielded 11 studies on 4 mushrooms species. One study was found for *Cordyceps militaris*, one for *Coriolus versicolor*, 4 for *Ganoderma lucidum*, and 5 for *Herichium erinaceus*. Population, sample size, duration, dosage, and cognitive outcomes of the studies are outlined in table 1.

Cordyceps militaris

No evidence was found supporting the efficacy of *C. militaris* for improving insomnia or depression in patients with depression taking duloxetine.⁴⁵ Depression, evaluated by the 17-item Hamilton Depression Scale (HAMD-17), reduced over time in both groups, but this change was attributed to duloxetine and the difference was nonsignificant from baseline and between groups. Results from the Athens Insomnia Scale (AIS), a questionnaire assessing sleep difficulty, reflected a significantly lesser improvement in insomnia in the *C. militaris* group compared to the placebo group. Additionally, "well-being," measured as a subscale on the AIS, saw no significant change within or between groups. Furthermore, the AIS subscale of "functional capacity during the day" revealed a significantly greater improvement favoring the placebo group by the end of the intervention.

O. sinensis. Additionally, a key bioactive compound of *O. sinensis*, cordycepin, is also found in *C. militaris* and in greater concentrations, making it a suitable alternative.¹³

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Herichium erinaceus also has a history of use in traditional Chinese medicine and is known for its bioactive hericenones, erinacines, and polysaccharides. Alternative names for this mushroom include lion's mane mushroom and monkey head mushroom, named after its voluminous, fur-like appearance. In addition to its antioxidant, antibacterial, and anticancer potential,^{21,22} *H. erinaceus* has been shown to stimulate nerve-growth factor (NGF), promote oligodendrocyte maturation, and display neuroprotective activity in animal models.^{23–25} In vivo studies have also shown improvements and protective activity in animal models of ischemic stroke, Parkinson's disease, Alzheimer's disease, and depression.²³

A growing interest in both the therapeutic and everyday use of medicinal mushrooms has developed with the excitement surrounding the implications of recent research and the increasing accessibility of mushroom nutraceuticals. Common health claims from dietary supplement companies, such as Swanson, Fungi Perfecti, MUD\WTR, Om Mushrooms, and Fresh Cap, include immune support from *T. versicolor* ^{26–29}; energy, endurance, and cardiovascular benefits from *Cordyceps* ^{30–32}; stress relief, immune support, and mood support from *G. lucidum* ^{33–36}; and improved memory, focus, clarity, mood balance, and nervous system health from *H. erinaceus*.^{37–40} Other claims such as increased mental clarity,⁴¹ cognitive functioning,⁴² and mental sharpness⁴³ are advertised for various blends of mushroom supplements.

However, with few human clinical trials measuring the cognitive impact of medicinal mushrooms, there is limited evidence supporting these claims. While evidence from in vitro and animal studies is valuable, the applicability in humans does not directly translate. This is why evidence from human studies is so vital for the evaluation of the efficacy of medicinal

<i>Ganoderma lucidum</i>	Zhao et al. (2012) ⁴⁷	Adult females with breast cancer	Treatment: 25 Control: 23	4 weeks	3 g spore powder	Significant improvement in "emotional well-being" and "emotional functioning" (measured by FACT-F and EORTC QLQ-C30 respectively) in treatment group only, and significant difference between groups favoring the treatment group. Significant improvement in anxiety and depression (measured by HADS) in treatment group only, and significant difference between groups favoring the treatment group. No significant change in "social/family well-being" or "social functioning" (measured by FACT-F and EORTC QLQ-30 respectively) in either group, nor significant difference between groups. Significant improvement in "cognitive functioning" (measured by EORTC QLQ-C30) in treatment group only and significant difference between groups favoring the treatment group.
	Wang et al. (2018) ⁴⁸	Adults with Alzheimer's disease	Treatment: 21 Control: 21	6 weeks	3 g spore powder	No significant difference between groups in cognition, dementia-related neuropsychiatric symptoms, and quality of life (measured by the ADAS-Cog, NPI, and WHOQOL-BREF respectively).
	Liu et al. (2020) ⁴⁹	Adults with non-small cell lung cancer undergoing chemotherapy	Treatment: 61 Control: 21	6 weeks	0.45 g spore powder ^b	Greater improvements in "social/family well-being," "emotional well-being," and "functional well-being" contributing to a higher quality of life (measured by FACT-G) in treatment group, but no significant difference between groups.

Table 1. Summary of human clinical trials

Mushroom	Citation	Study Population	Sample Size ^a	Duration of Supplementation	Dosage (per day)	Cognitive Outcomes
<i>Cordyceps militaris</i>	Zhou et al. (2021) ⁴⁵	Adults with major depressive disorder with insomnia	Treatment (<i>C. militaris</i> + duloxetine): 28 Control (placebo + duloxetine): 31	6 weeks	3 g	No significant change nor difference between groups in "well-being" related to insomnia (measured by AIS). Significant improvement in "functioning capacity during the day" related to insomnia from baseline in both groups, but significantly greater improvement in placebo group (measured by AIS). Significantly greater improvement in insomnia (measured by AIS) in placebo group. No significantly greater reduction in depression (measured by HAMD-17) in treatment group.
<i>Coriolus versicolor</i> (<i>Trametes versicolor</i>)	Scuto et al. (2019) ⁴⁶	Adults with Meniere's disease	Treatment: 22 Control: 18	8 weeks	3 g biomass	Notable improvement in total mood disturbance, including "anger," "confusion," "depression," and "tension" (measured by POMS) in treatment group but not in control group. Significant improvement in tinnitus severity (measured by THI) in treatment group compared to control group, and significant improvements in frequency range, average loss in dB, and intellection threshold related to auditory function from baseline in the treatment group, but not control group.

Saitsu et al. (2019) ⁵³	Healthy adults over 50 years old	Treatment: 16 Control: 15	12 weeks	3.2 g fruiting body powder	Significant improvement in cognitive function (measured by MMSE) from baseline in only the treatment group with a significant difference between groups favoring the treatment group. No significant difference in visual cognitions (measured by Benton Visual Retention Test) between groups. No significant difference in short-term memory (measured by S-PA) between groups.
Vigna et al. (2019) ⁵⁴	Adults with overweight/obesity and at least one mood/sleep disorder or with binge eating behavior	Treatment (low-calorie diet + <i>H. erinaceus</i>): 35 Control (low-calorie diet): 35	8 weeks	1.2 g mycelium + 0.3 g fruiting body	No significant improvement in depression (measured by Zung's Depression Scale) from baseline in either group nor difference between groups, but in patients selected for depression symptomatology, only the treatment group showed significant improvements from baseline. Significant improvement in anxiety (measured by Zung's Anxiety Scale) from baseline in only the treatment group with even greater significance in patients selected for anxiety symptomatology in the treatment group but not control group. Significant improvement in "depression" and "anxiety" domains (measured by SCL-90) from baseline in the treatment group test with greater significance in patients selected for symptomatology.

	Pazzi et al. (2020) ⁵⁰	Adult females with fibromyalgia	Treatment: 26 Control: 24	6 weeks	6 g fruiting body powder	Significant improvements in happiness, satisfaction with life, and depression (measured by SHS, SWLS, and GDS respectively) from baseline in treatment group but not placebo group with a significant difference between groups favoring the treatment group in happiness. Significant improvement in "social functioning," "emotional role" of health and "mental health" (measured by the SF-12) from baseline in treatment group and an improvement in only "mental health" in placebo, but no significant difference between groups.
<i>Hericium erinaceus</i>	Mori et al. (2009) ⁵¹	Japanese adults ages 50 to 80 years old with mild cognitive impairment	Treatment: 14 Control: 15	16 weeks	1 g fruiting body powder	Significant improvement in cognitive function (measured by modified HDS-R) from baseline in treatment group and compared to placebo group.
	Nagano et al. (2010) ⁵²	Adult females	Treatment: 12 Control: 14	4 weeks	2 g fruiting body powder	Significant improvement in depressive symptomatology (measured by CES-D) from baseline in treatment group, but no significant difference between group outcomes. Significant improvements in "incentive" and "concentration" subscores relevant to depression (measured by ICI) from baseline in treatment group with improvement in "incentive" significantly greater compared to placebo. Significant improvement in subscore of "irritating" (measured by ICI) from baseline in the treatment group, but no significant difference between groups. Significant improvement in "anxious" subscore (measured by ICI) from baseline in the treatment group, but no significant difference between groups.

Li et al. (2020) ⁵⁵	Adults over 50 years old with Mild Alzheimer's Disease	Treatment: 20 Control: 21	49 weeks	1.05 g mycelia (enriched with 5 mg/g erinacine A)	No significant improvement in dementia-related neuropsychiatric symptoms (measured by NPI) in either group nor difference between groups. Trend of improvement in cognitive abilities (measured by CASI) from baseline in treatment group with a trend of deterioration in placebo group reaching significance at week 25, but no significant difference between groups. Significant improvement in cognitive function (measured by MMSE) from baseline in treatment group only, but no significant difference between groups. Significant difference in ability to perform instrumental activities of daily living (measured by IADL) between groups at the end of the intervention favoring the treatment group. No change in monocular or binocular BCVA (measured by Snellen eye chart) from baseline in either group. No change in monocular or binocular CS (measured by Pelli-Robson chart) from baseline in either group with the exception of a significant change in binocular CS in placebo from baseline and a significant difference in left-eye CS between groups favoring the treatment group.
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AIS, Athens Insomnia Scale; HAMD-17, 17-item Hamilton Depression Scale; POMS, Profile of Mood States; THI, Tinnitus Handicap Inventory; FACT-F, Functional Assessment of Cancer Therapy- Fatigue; EORTC QLQ-C30, European Organization for Research and Treatment of Cancer Core Quality of Life Questionnaire C30; HADS, The Hospital Anxiety and Depression Scale; ADAS-cog, Alzheimer's disease Assessment Scale-Cognitive; NPI, Neuropsychiatric Index; WHOQOL-BREF, World Health Org QoL questionnaire; FACT-G, Functional Assessment of Cancer Therapy - General; SHS, Subjective Happiness Scale; SWLS, Satisfaction with Life Scale; GDS, Geriatric Depression Scale; SF-12, Medical Outcomes Study Short Form-12 questionnaire; HDS-R, Revised Hasagawa Dementia Scale; CES-D, Center for Epidemiologic Studies Depression scale; ICI, Indefinite Complaints Index; MMSE, Mini-Mental State Examination; S-PA, Standard verbal paired-associate learning test; SCL-90, Symptom Checklist-90; CASI, Cognitive Abilities Screening Instrument; IADL, Instrumental Activities of Daily Living; BCVA, best-corrected visual acuity; CS, contrast sensitivity
^aNumber included in final analysis
^bPart of a Reishi & Privet Formula containing 0.45 g dried sporederm-broken Ganoderma lucidum spores + 0.33 g glossy Privet fruit extract (3.36g total weight, standardized for >1% polysaccharide and > 2.0 mg oleanolic acid)

Coriolus versicolor (Trametes versicolor)

Changes in systemic oxidative stress, auditory function, and mood were measured in a population of patients with Meniere's disease (MD),⁴⁶ a chronic disorder of the ear, characterized by vertigo, tinnitus, and hearing loss related to oxidative stress⁵⁶ and subsequent cellular damage and cochleovestibular dysfunction.^{57,58} In addition to significant favorable changes in markers of oxidative stress by *C. versicolor*, significant improvements in tinnitus, measured by the Tinnitus Handicap Inventory (THI), and improvements in the areas of frequency range, average loss in dB, and intellection threshold related to auditory function were observed in the treatment group but not the control group. Notable improvements in the categories of "anger," "confusion," "depression," "fatigue," and "tension" in relation to MD from the Profile of Mood States (POMS) questionnaire were observed in the treatment group only. However, significance was not discussed.

Ganoderma lucidum

A significant improvement in "cognitive functioning" measured by the European Organisation for Research and Treatment of Cancer Core Quality of Life Questionnaire C30 (EORTC QLQ-C30) was observed in a population of patients with breast cancer following *G. lucidum* supplementation.⁴⁷ However, in a population of patients with Alzheimer's disease (AD), *G. lucidum* supplementation did not significantly improve cognitive function compared to the control group measured by the Alzheimer's Disease Assessment Scale-Cognitive (ADAS-cog),⁴⁸ which includes assessment of memory, language, and praxis domains. Additionally, no significant improvement compared to the control group was observed in dementia-related symptoms measured by the Neuropsychiatric Index (NPI) in the same population with AD.

In females with fibromyalgia, happiness and satisfaction with life, measured by the Subjective Happiness Scale (SHS) and Satisfaction with Life Scale (SWLS), improved significantly with *G. lucidum* intake, but not in the placebo group with a difference reaching significance between groups for happiness.⁵⁰ A significant improvement in depression measured by the Geriatric Depression Scale (GDS) was also observed in the *G. lucidum* group, which is consistent with the significant improvement in depression and anxiety, measured by the Hospital Anxiety and Depression Scale (HADS) in an earlier study on females with breast cancer.⁴⁷ However, despite both studies revealing significant improvements in the treatment groups but not control groups, a significant difference between groups was found only in the depression and anxiety of females with breast cancer⁴⁷ but not in the depression of females with fibromyalgia.⁵⁰ Furthermore, in the population of females with fibromyalgia, "mental health," measured by the Medical Outcomes Study Short Form-12 Questionnaire (SF-12), did not differ significantly between groups by the end of treatment.⁵⁰ There was also no significant difference in the "psychological" domain of quality of life measured by the World Health Organization Quality of Life (WHOQOL-BREF) questionnaire in patients with AD.⁴⁸

Greater improvements in "emotional well-being" compared to controls were observed following *G. lucidum* intake in a population of adults with lung cancer⁴⁹ and with breast cancer⁴⁷ measured by Functional Assessment of Cancer Therapy: General (FACT-G)

and Functional Assessment of CA Therapy: Fatigue (FACT-F) assessments respectively. "Emotional functioning" measured by the EORTC QLQ-C30 also improved significantly in the treatment group, but not control group, in females with breast cancer with a significant difference between groups.⁴⁷ In females with fibromyalgia, the "emotional role" of health, measured by the SF-12, improved significantly from baseline in the treatment group only, but the difference between groups was not significant.⁵⁰

In patients with AD, the "social relationship" domain of quality of life, measured by the WHOQOL-BREF, did not improve significantly compared to the control.⁴⁸ Similarly, in females with breast cancer, *G. lucidum* did not result in any significant changes in "social/family well-being" or "social functioning," measured by FACT-F and EORTC QLQ-30 respectively.⁴⁷ Greater improvements in "social/family well-being" were observed in patients with lung cancer following intake of a *G. lucidum*-based formula compared to the control,⁴⁹ and significant improvements in "social functioning" were observed in females with fibromyalgia in the treatment group only.⁵⁰ However, neither study found significant differences between groups in these measures.

Hericium erinaceus

In a population of adults with mild cognitive impairment, cognitive function improved, measured by a modified Revised Hasegawa Dementia Scale (HDS-R), following *H. erinaceus* intake.⁵¹ This change was significant from baseline and when compared to the placebo group. Similarly, in a population of adults with mild AD, significant improvements in cognitive function from baseline were observed following *H. erinaceus* intake measured by the Mini Mental State Examination (MMSE), which includes assessment of attention, orientation, memory, calculation, and language, though the difference was not significant when compared to the placebo.⁵⁵ MMSE scores also showed a significant improvement in a population of healthy adults over 50 years old following *H. erinaceus* intake with no change in the control group and a significant difference between groups.⁵³ However, although the change from baseline and difference between groups were statistically significant, the point-differences were miniscule with a change from baseline (treatment baseline: 29.19 vs. treatment end: 30.00) and difference between groups (treatment end: 30.00 vs. placebo end: 29.53) of less than one point out of total score of 30. Additionally, no significant change in short-term memory of words measured by the Standard Verbal Paired-associate Learning test (S-PA) was observed.

In the adults with mild AD, a trend of improvement in cognitive abilities was also observed in the treatment group with a corresponding decline in the placebo group which reached significance mid-way through the intervention.⁵⁵ This was measured by the Cognitive Abilities Screening Instrument (CASI), a tool used to screen for dementia which assesses attention, concentration, orientation, memory, language abilities, visual construction, list-generating fluency, abstraction, and judgment.⁵⁹ However, NPI scores in this population showed no significant improvement in frequency or magnitude of dementia-related neuropsychiatric symptoms which include delusions, hallucinations, dysphoria, anxiety, agitation and aggression, euphoria, disinhibition, irritability and lability, apathy, and aberrant motor activity.⁶⁰ Still, a significant difference in ability to perform instrumental activities of daily living (IADL), which indicates competence related to daily activities requiring thinking and organizational skills and a lower level of dependence, was observed

between groups, favoring the treatment group. Also of note, though the difference did not reach significance, the treatment group showed greater retention of total neuronal fibers than the placebo group shown by magnetic resonance imaging (MRI).

In healthy adults over 50, visual cognitions measured by the Benton Visual Retention test, which includes measures of visual recognition, memorization, and construction, did not change following treatment.⁵³ In adults with mild AD, a significant difference was observed between groups in left-eye contrast sensitivity favoring the treatment group, but no other significant difference was found in any other measure of monocular or binocular visual acuity or contrast sensitivity measured by the Snellen eye chart and Pelli-Robson chart respectively.⁵⁵

Trends of improvement in depression and anxiety were observed following *H. erinaceus* intake in females⁵² and adults with overweight or obesity with at least one mood or sleep disorder or with binge eating behavior.⁵⁴ In adult females, depressive symptomatology, measured by the Center for Epidemiologic Studies Depression Scale (CES-D), improved significantly from baseline following *H. erinaceus* intake, but the difference was not significant between groups. Subscores of "incentive" and "concentration" relevant to depression and of "irritating" measured by the Indefinite Complaints Index (ICI) also improved significantly in the treatment group from baseline with a difference reaching significance for "incentive" compared to the placebo.⁵² Similarly, in adults with overweight or obesity, depression, measured by Zung's Depression Scale, improved significantly in treatment group patients selected for depression symptomatology. However, when not selected for symptomatology, there was no significant change in depression from baseline in either group nor significant difference between groups. Still, depression measured by the Symptom Checklist-90 (SCL-90) showed significant improvements in all treatment group participants with greater significance when selected for symptomatology. This was the same for the domain of anxiety measured by the SCL-90. Additionally, anxiety measured by Zung's Anxiety Scale showed significant improvement from baseline with greater significance when selected for anxiety symptomatology. No significant change was seen in the control group.⁵⁴ Similarly, in adult females, a significant improvement in the "anxious" subscale of the ICI was shown following *H. erinaceus* intake. However, no significant difference was found between groups.⁵²

DISCUSSION

The evidence of the beneficial impact of medicinal mushrooms on human cognition and mood is very limited with the lack of large human clinical trials with standardized procedures and methodologies. Still, from these studies, trends of improvement in cognition from *H. erinaceus* and in mood from *H. erinaceus* and *G. lucidum* appear. Following *H. erinaceus* intake, measures of cognitive function improved in adults with mild cognitive impairment⁵¹ and with mild AD.⁵⁵ Measures of depression and anxiety improved significantly in adult females⁵² and in adults with overweight or obesity with depression and anxiety symptomatology⁵⁴ following *H. erinaceus* intake. *G. lucidum* intake also appeared to produce significant improvements in emotional well-being or emotion-related health from baseline in adult females with fibromyalgia,⁵⁰ breast cancer,⁴⁷ and adults with lung cancer.⁴⁹ Additionally, improvements in emotional well-being, emotional functioning, and

depression reached significance in a between-group comparison, favoring the treatment group, in the women with fibromyalgia.⁵⁰ Because the studies on *C. militaris* and *T. versicolor* were limited, with one human clinical trial each, no trends were identified nor the potential underlying mechanisms explored.

Nerve growth factor (NGF) is a type of neuropeptide in the neurotrophin family involved in the growth, maintenance, and protection of nerve cells. Brain-derived neurotrophic factor (BDNF), another neurotrophin, has a similar function in addition to its roles in facilitating neuroplasticity and memory. The reduced levels of neurotrophins present in neurodegenerative diseases and psychiatric disorders,^{61,62} including Alzheimer's and depression, point to the potential of neurotrophin-based therapies to address these conditions. The neuroprotective activity and cognition-enhancing effects of NGF in animal models of cognitive dysfunction^{63–65} further support this potential for the treatment of AD. The efficacy of neurotrophin-based therapies can be understood through its protective and regenerative activity on cholinergic neurons demonstrated in animal models and in living patients which would counter the neuronal degeneration and loss leading to cognitive decline in AD.⁶⁶ Evidence for antidepressant-like effects by NGF administration in rats⁶⁷ also points to the potential for neurotrophin-based therapies in mood disorders. The "neurotrophic hypothesis of depression" directly relates decreased neurotrophin activity to depression with the neuronal atrophy, decreased neurogenesis, and loss of glia, and supports the key role of BDNF in antidepressant activity.^{68,69} Neuroinflammation is also a prominent factor in the development and susceptibility to depression, with BDNF acting to mitigate neuroinflammation and high inflammation reducing the expression of BDNF.⁷⁰ While inflammation alone may not be enough cause for depression, its key role in the development or exacerbation of depression is supported by the reduced efficacy of conventional antidepressants in patients with high inflammation⁷⁰ and the greater efficacy of inflammation-reducing treatments, such as TNF- α inhibition⁷¹ and antidepressants with secondary anti-inflammatory properties,⁷² in depressed patients with high baseline inflammation.

H. erinaceus contains bioactive compounds shown to stimulate NGF-synthesis and subsequent neurite outgrowth in vitro.^{73–77} Furthermore, *H. erinaceus* was shown to increase NGF levels in the locus coeruleus and hippocampi of rats⁷⁸ and to increase NGF mRNA expression in the hippocampi of mice,⁷³ suggesting the possibility that these compounds are capable of being absorbed into the blood and crossing the blood-brain barrier (BBB). These compounds include hericenones and erinacines among other unidentified bioactive compounds. In mice, oral administration of an *H. erinaceus* fruiting body powder resulted in an increased level of NGF mRNA expression in the hippocampus.⁷³ In this same study, Mori et al., found that the stimulation of NGF production by an ethanol extract of the *H. erinaceus* fruiting body in 1321N1 human astrocytoma cells appears to occur via activation of the c-Jun N-terminal kinase (JNK) signaling pathway, a mitogen-activated protein kinase (MAPK) signaling pathway involved in a variety of functions including cell proliferation, development and apoptosis. It is also a target for AD treatment due to its involvement in apoptosis regulation.⁷⁹ In another experiment, hericenone E appears to potentiate NGF-mediated neurogenesis via the MEK/ERK and PI3K-Akt signaling pathways in rat pheochromocytoma (PC12) cells.⁷⁷ These pathways are also involved in regulating normal cell proliferation, development, and survival.

Erinacines also appear to act on NGF and BDNF by increasing the expression of these neurotrophins demonstrated in vitro⁸⁰ with further evidence of neuroprotective activity in animal models of ischemic stroke⁸¹ and Alzheimer's disease.⁸² Antidepressant-like effects were also observed in several mouse models^{83–85} with one study indicating antidepressant activity by the modulation of BDNF/PI3K/Akt/GSK-3 β signaling by erinacine A-enriched mycelium⁸³ and another indicating antidepressant activity related to hippocampal neurogenesis.⁸⁴ Anti-inflammatory activity was also observed with decreased levels of IL-6 and TNF- α ⁸³ and decreased TNF- α with an increase in IL-10 by amygenone,⁸⁵ another bioactive compound found in *H. erinaceus*. These compounds provide a solution to the limitations of direct neurotrophin administration such as the poor pharmacokinetic profile and inability of NGF to cross the BBB⁸⁶ as compounds that may cross the BBB^{87,88} and stimulate neurotrophin synthesis.

Although the precise mechanisms are unknown, the outcomes of the studies included in this review are consistent with the theory that neurotrophin production stimulated by the bioactive compounds in *H. erinaceus* are protective against cognitive decline and may improve cognitive outcomes in the context of cognitive dysfunction. This is reflected by the improvements in cognitive function in populations with mild AD⁵⁵ and mild cognitive impairment⁵¹ paired with the lack of improvement in a healthy population.⁵³ The mechanism behind effects of *H. erinaceus* on mood is also unclear, but may be related to the role of neurotrophins or other anti-inflammatory compounds in neuronal protection, regeneration, and the reduction of inflammation, which is implicated in pathophysiology of psychiatric disorders.

There is little information available on the potential mechanisms of action of *G. lucidum* on mood. In one study, *G. lucidum* demonstrates benzodiazepine-like activity via GABAergic mechanisms in rats.⁸⁹ This GABAergic activity may be related to the potential effects of *G. lucidum* on mood and anxiety as benzodiazepines, a class of drug used to treat anxiety and insomnia, work by facilitating the binding of GABA, a primary inhibitory neurotransmitter, to its receptors. *G. lucidum* triterpenoids also appear to act as neurotrophin mimetics, displaying neuronal survival-promoting activities⁹⁰ and inducing neuronal cell differentiation by MAPK activation⁹¹ in vitro. Additional neuroprotective activity⁹² and the down-regulation of mRNA expression of inflammatory mediators including tumor necrosis factor- α (TNF- α) and interleukin 1 β (IL-1 β) by *G. lucidum*^{93,94} may also be related to its effects on mood through the mitigation of neuroinflammation, similar to the potential activity of *H. erinaceus*. However, more research is needed to pinpoint the precise mechanisms of action.

While the outcomes of the studies may appear very promising, study design must be taken into account and caution used when attempting to extend application. All but 2 of the 11 studies reviewed had less than 30 participants in the treatment group. 5 of the 11 studies reviewed had intervention durations of 2 months or longer. Several features of the studies also produce some ambiguity in the interpretation of the outcomes and conclusions. For one, the repeated administration of cognitive function tests may contribute to the learning effect which describes a pattern of an increasing score over time due to a familiarity with the test, skewing the results. For example, one study on adults with mild cognitive impairment supplementing with *H. erinaceus* showed gradual improvement in cognitive function scale

scores in the placebo group in addition to the treatment group,⁵¹ indicating that the seeming improvement may be due, at least in part, to the learning effect. Another consideration is the subjectivity of questionnaires. Affect and mood are difficult to quantify, and high variability between the reported results and the felt experiences of subjects are likely to be present due to the subjective nature of emotion.⁹⁵ The context of supplementation must also be considered as debilitating conditions such as cancer or fibromyalgia will impact mood as well. Improvements in one's physical condition may lead to improvements in mood, so it is difficult to isolate mood outcomes in disease states. In part, this is the nature of illness, but this also means that the studies on these sick populations do not have evidence to support claims, such as those of supplement companies, of generalized improvement in mood by medicinal mushrooms apart from these conditions.

The existing studies also vary greatly in the measurement tools used, duration of intervention, and form and dosage of mushroom used. Despite the common function of quantifying subjective measures such as "well-being" or "depression," the differences between the questionnaires will contribute to the variability between studies and study outcomes. The chosen components of mushrooms used in the studies also contribute to the variability despite the use of a common mushroom. These include the fruiting body, mycelium spores, or combinations of these. These components contain various types and amounts of bioactive compounds. For example, the hericenones of *H. erinaceus* are primarily found in the fruiting body and the erinacines in the mycelium,⁸⁷ so it is possible that the effect of *H. erinaceus* supplementation in a population of AD patients would differ if provided with a fruiting body-based supplement versus a mycelium-based supplement.

Dosages also varied between studies. The typical dosages based on the studies reviewed are 3 g for *G. lucidum* spore powder and 1-3.2 g for *H. erinaceus* fruiting body powder. The other forms and combinations were less frequently used and therefore do not have ranges. The amounts and forms are also detailed in Table 1. The dosing of *H. erinaceus* had a broader range, contributing to more variability. It is also notable that these studies demonstrated safety and a general tolerability of these mushrooms with few and minor side effects observed.

Future research may benefit from greater consistency in the measurement tools used between studies and consideration of frequency of cognitive function test administration to avoid the learning effect. Greater consistencies in the form, dose, and duration of supplementation would also reduce the variables between studies, allowing for more insightful comparisons and stronger evidence for use.

CONCLUSION

Modern research on functional mushrooms increasingly supports their therapeutic utility. This review reveals trends of improvement in well-being by *G. lucidum* in the context of taxing disease states, improvement in cognitive function by *H. erinaceus* in the context of cognitive decline, and general improvement in depression and anxiety by *H. erinaceus*. Medicinal mushrooms hold great potential as complements to limited conventional treatments. This is also supported by the low-risk and general safety of consumption. The evidence is still scarce with limitations in the size and number of studies, but this does

not discount the potential efficacy. These studies show promising therapeutic application, general safety of mushroom consumption, and provide a foundation for the methods and procedures of future studies. This points to the need for larger human clinical trials to be conducted and further research to pinpoint the mechanisms behind the effects.

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Temporal Activity, Habitat Association, and Seasonality of a Large Ungulate on an Isolated Fragment within the Urban Matrix

Abstract

Rapid urbanization has had a negative effect on wildlife populations, and there is a gap of knowledge on urban Mule deer (*Odocoileus hemionus*). Sustainability and habitat management is critical for the future of wildlife and observing the temporal activity of Mule deer living in an urban matrix will allow us to see the difference in their behaviors compared to rural Mule deer. This project includes analyzing the temporal activity of Mule deer on the Voorhis Ecological Preserve in Pomona, California, which is part of an isolated habitat within the urban matrix. The goal is to assess when Mule deer are most active, if the temperature influences their activity, if their activity changes seasonally, and if this influences their habitat association. I will be using time of day, day of week, temperature, and seasonality data from photos collected from 18 camera traps in a grid design throughout the preserve during the fall 2021 and winter 2022 seasons. Overall, temperature and habitat association varied more in the fall season and temporal activity and day of the week activity varied more in the winter season. I found that habitat, season, or temperature statistically had no significant impact on the activity of Mule deer in this area, likely due to the small sample size. Several interesting patterns were that they did exclusively associate with the western part of the preserve during the winter season, there was no detected activity on Monday in either season, no detected activity during the late afternoon (3:00pm-5:59pm) in either season, and Mule deer were much more active when the temperature was in the 51° to 60° Fahrenheit range. Current literature is often conducted in rural areas where Mule deer have expansive ranges. This study contributes to the gap of knowledge on the activity of urban Mule deer that are present in an isolated environment surrounded by human development.

Introduction

The world is being urbanized at a rapid rate and, with that, comes an increase in the presence of urban wildlife (Dearborn and Kark, 2010). One such animal is *Odocoileus hemionus*, a native to western North America better known as Mule deer (Bauer, 1995). The National Wildlife Federation states that the Mule deer population has been on the decline for years due to shrinking habitat from development and a growing human population. As urbanization continues to expand into rural areas and further into urban areas, it is important to understand the consequences this may have on the current and future population of this species. What can be affecting Mule deer's activity in a space surrounded by humans? Existing literature does cover temporal activity (e.g., hours active, rural versus urban activity, seasonal activity) but such activity of Mule deer is often written with other animals involved in the study, overshadowing the Mule deer's results.

Odocoileus hemionus, or Mule deer, are large ungulates that are native to Western North America and can be found in a variety of habitats anywhere from coastal sage to alpine woods, commonly in areas near human development (Pease et al., 2009). The Mule deer native to California is *O.h. californicus*, but Black-tailed deer, *O.h. columbianus*, are also found in Northern California. Mule deer have an herbivorous diet, though they are

considered intermediate since they both browse and graze (Bauer, 1995). The most common causes of mortality in Mule deer are predominantly predation, followed by human-induced, and then malnutrition (Bleich and Taylor, 1998). Regardless if a Mule deer is in an urban or rural area, they require vegetation to sustain their dietary requirements. Mule deer are known to be crepuscular (Nix et al., 2018), early morning and late evenings, however the current literature on urban Mule Deer contradicts this (Patten and Burger, 2018; George and Crooks, 2006).

Several studies have been conducted on Mule deer in urban settings that supply insight on their temporal activity. While in an urban setting, Mule deer display avoidance behavior in response to disturbances such as human activity on a popular hiking trail that can include hikers, bicyclists, domestic dogs, vehicles, and equestrians (Patten and Burger, 2018). The study by Patten and Burger (2018) was performed using 50 camera traps in Orange County, California in urban and urban-adjacent reserves. Single-day patterns in their study showed that mammals were nearly four times more likely to be recorded on a day no humans were, indicating that humans reduced animal occurrence. Same day co-occurrence of wildlife and domestic animals were below 90%. While there is sufficient same-day data, they were unable to observe an overall effect of human activity on wildlife. The study described explored how same-day human presence affects wildlife presence in an urban-adjacent wildland that is similar in human proximity as the Voorhis Preserve, but with much more foot traffic since it is also a popular trail.

Another study, performed at the Nature Reserve of Orange County in Southern California, assessed bobcats, coyotes, and Mule deer in the coastal sub-region and the central sub-region that is separated by the city of Irvine, California and major freeways with no corridors (George and Crooks, 2006). The methods were predominantly camera trapping, but also included sign surveys using tracks and scat. Results were least conclusive for Mule deer and they did not find a clear, consistent pattern of human avoidance, though probability of detecting deer during the day was significantly lower. Human temporal activity in the area was between 6:00am to 6:00pm and all three animals studied were primarily nocturnal. Mule deer are typically not considered nocturnal animals, suggesting that the Mule deer on the preserve are shifting their temporal habits in areas of high human activity (George and Crooks, 2006).

Both studies suggest that Mule deer in an urban setting have adjusted their temporal activity to avoid disturbances, more so than any other reason such as predation, competition for habitat, or foraging availability. Suitable access to other habitats via corridors, natural or otherwise, were not available in either urban Mule Deer study, suggesting that adjusting their temporal activity is necessary for survival. Both study locations can also suggest that the current populations of urban Mule deer have already adapted their temporal activity in response to activity resulted by urbanization, so there would not be much change to observe. Despite the suggestions, neither study supplied significant conclusions and indicated that there is more opportunity for research into the temporal activity of deer in an urban setting.

Methodologies that are commonly used to study Mule deer are camera trapping, fecal pellet collection, radio collars, ground vehicle spotlight, and aerial direct counts (Forsyth et al., 2022). Ground vehicle spotlight is more accurate when done at night. Fecal pellet collection is more effective when combined with transect sampling. Camera trapping is one of the most popular methods in recent studies (Frey et al., 2017). Radio collars appears to be the most successful and accurate in terms of tracking their movement, but is costly and requires the deer to be disturbed so collars can be placed on them. Another up-and-coming method is aerial imagery with thermal-sensing drones, particularly in citizen science research (Kim et al., 2019). The methodology focus for this study will primarily highlight the temporal, seasonal, and temperature data on time-stamped camera trap images. In other studies, the temporal data from camera trap images has been valuable from an ecological perspective and has helped provide insight into human-driven changes in a species' behavior (Frey et al., 2017). Camera trap images are also a consistent, cost-effective, and non-invasive way to quantify the activity level of a species in a particular area (Rowcliffe et al., 2014).

The existing literature provides a wide range of data of spatial habits of Mule deer and especially how they occupy space with other animals, though there is a lot of opportunity for further research in the temporal activity of Mule deer in an urban setting. Another gap in the literature is that studies of Mule deer in urban areas typically include other wildlife occupying the same space and those results generally overshadow the elusive Mule deer. Studies focused on Mule deer are often done in more rural areas such as large, forested areas not close to heavily human inhabited areas. While there are many suggested hypotheses on how urbanization has come to affect the temporal habits of Mule deer, there is potential for further research to be done.

The goal of this study is to supply more information on how the species' activity is influenced in an urban space based on various factors such as time, season, and habitat. I predicted that the Mule deer activity on this urban matrix would peak during the times and days that there was a reduction in human activity and that they would associate in habitats further from human activity. The study area is within an urban matrix that is surrounded by a university and other human development and by comparing two seasons with different amounts of human activity, I anticipated seeing an uptick in Mule deer occurrences during the winter season when human activity on the campus was reduced. Within each season, I also anticipated seeing more Mule deer activity during times of day and days of week where human activity was lower (i.e., weekends and outside normal business hours). Since the literature supports that Mule deer have crepuscular habits and a preference for cooler temperatures, I expected more frequency during evening to early morning hours.

Materials and Methods

Study Area—The area used for this study was the Voorhis Ecological Preserve, located at the northwest part of Cal Poly Pomona's (CPP) campus in the city of Pomona in Los Angeles County. The preserve is approximately 77 acres of coastal sage scrub, oak woodland, riparian, and disturbed habitats. The area has been designated as a Significant Ecological Area by Los Angeles County due to its irreplaceable biological resources. It is also considered an isolated habitat within the urban matrix since it is surrounded by human development on all four sides with the 10 Freeway, Forest Lawn Cemetery, residential

neighborhood in Walnut, and Cal Poly's campus.



Figure 1—Voorhis Ecological Preserve at Cal Poly Pomona in Pomona, California with habitat associations and 18 camera locations depicted.

Camera Trapping—To capture mule deer activity across the preserve, 18 Browning Recon Force Elite (Model BTE-7E-HP4) trail cameras were set up in a grid design. The cam had long range motion detection and would trigger to capture an image when motion occurred. The camera settings included a 30-second photo delay, 12-megapixel photo quality, and a two-shot standard multi-shot mode. Information stamped on the image data strip was camera name, time, date, and temperature in Fahrenheit. Using the camera name stamped on the image helped establish habitat association based on the camera's location within the preserve. Cameras were set up seasonally for 30-day periods to monitor wildlife and the seasons used for this study were Fall 2021 and Winter 2022, November and January respectively. The raw data (i.e., photos) was organized by students in the Ortiz Research Lab to separate photos that did successfully capture wildlife and information was verified by members of the lab, as well as the BIO 1110L students. I then verified the images confirmed by the lab students to contain mule deer images by directly checking the photos. I deleted photos that had repeat occurrences within a time period of approximately 5 minutes to avoid capturing the same animal back-to-back.

Data Analysis—Graphs were created to visualize the patterns of mule deer activity on the preserve for temporal activity, habitat association, day of the week, and temperature. A multi-factor ANOVA was used with the independent variables season, habitat association, and temperature. Day of the week and time of day were removed as variables since the sample size was relatively small and they were not providing any significance. The dependent variable was frequency of occurrence. If the null hypothesis was rejected, a post hoc Tukey's test was performed. Statistical analysis was conducted using RStudio (RStudio Team, 2020).

Results

Mule deer were captured 19 times during the Fall 2021 season and 23 times during the Winter 2022 season. There are five habitat types across the preserve, though predominantly disturbed. Mule deer occurrences were exclusively on the western side of the preserve during the Winter 2022 season, while the Fall 2021 season had Mule deer occurrences at more camera locations throughout the preserve and therefore, habitats (Fig 2).

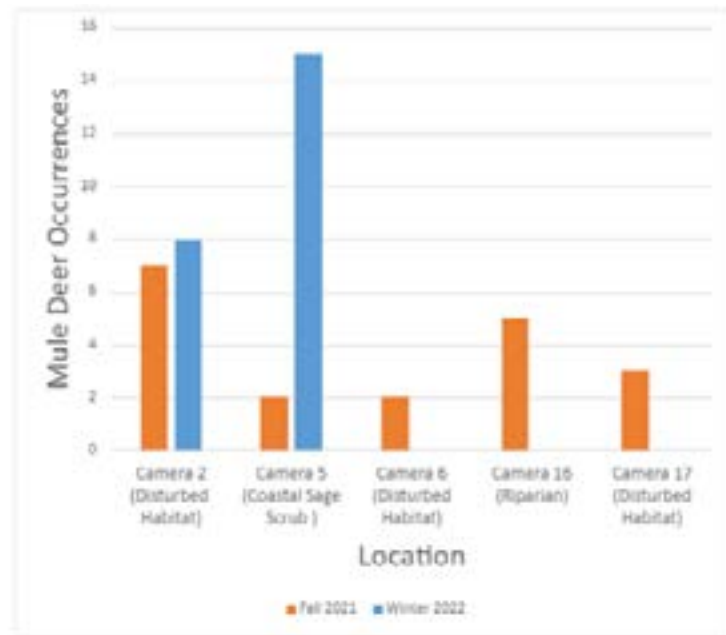


Figure 2– Number of mule deer occurrences at each camera and its associated habitat in Fall 2021 and Winter 2022 at Cal Poly Pomona’s Voorhis Preserve.

Mule deer occurrences were more common at colder temperatures, particularly during the winter season since the temperature is naturally cooler (Fig. 3). Mule deer activity ranged across more times of day during the winter season than in the fall season, and their activity did not follow crepuscular patterns in either season (Fig. 4). Their activity also occurred on more days of the week in the winter season, though Monday had no occurrences in both seasons (Fig. 5). Overall, temperature and habitat association varied more in the fall season while time of day and days of week active varied more in the winter season.

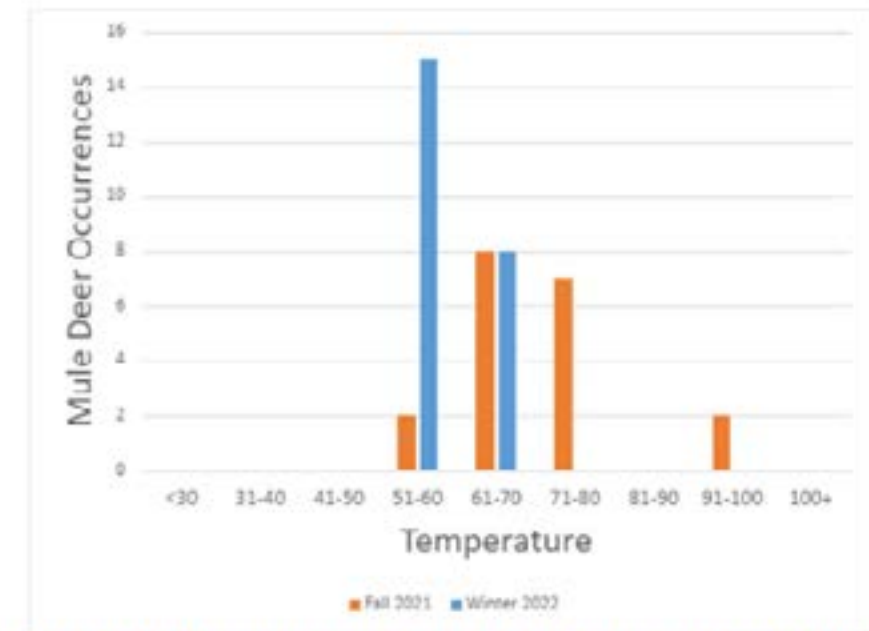


Figure 3– Number of mule deer occurrences at various temperature ranges in Fall 2021 and Winter 2022 at Cal Poly Pomona’s Voorhis Preserve.

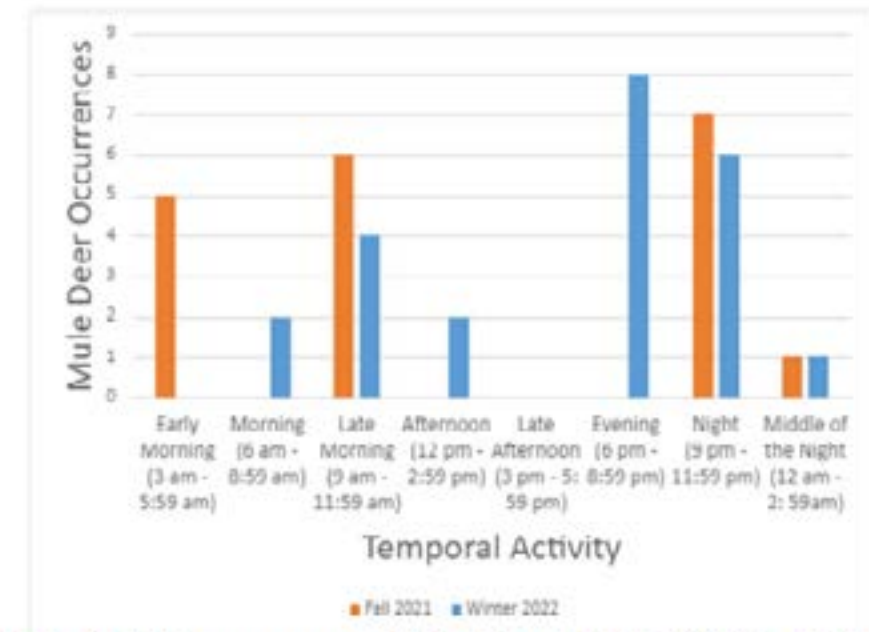


Figure 4– Number of mule deer occurrences at different times of day in Fall 2021 and Winter 2022 at Cal Poly Pomona’s Voorhis Preserve.

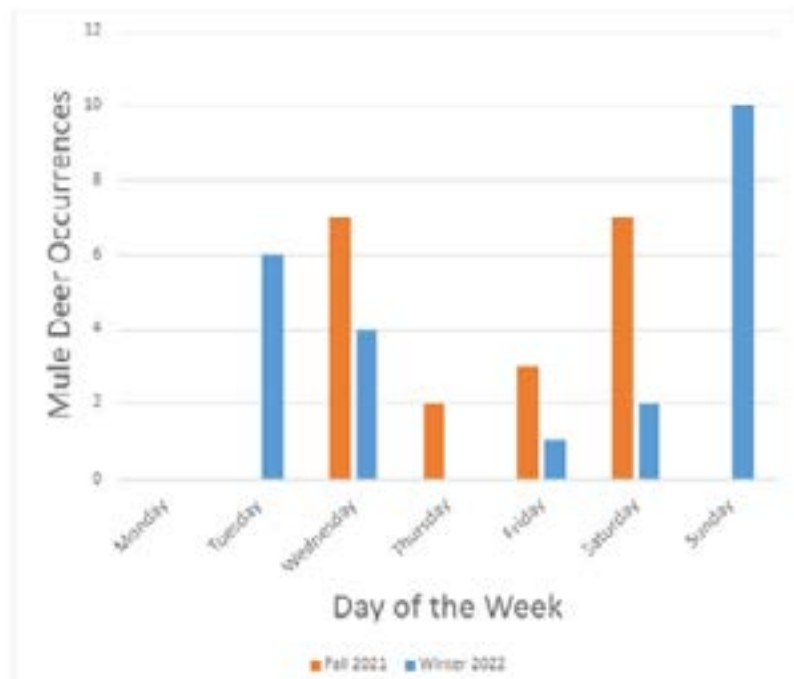


Figure 5– Number of mule deer occurrences on different days of the week in Fall 2021 and Winter 2022 at Cal Poly Pomona’s Voorhis Preserve.

Due to the small sample size (i.e., number of occurrences), day of the week and time of day were removed as they were providing false significance in the statistical analysis. The independent variables used for the multi-factor ANOVA were season, habitat association, and temperature, and the dependent value was frequency of occurrence (Table 1). The p-value was not less than .05 for any group, so we fail to reject the null hypothesis and conclude that there is no sufficient evidence to say that there is any statistical difference in the frequency of occurrences between the three variables.

Table 1– Multi-factor ANOVA output with independent variables season, habitat, and temperature on dependent variable frequency of occurrence of Mule deer on Cal Poly Pomona’s Voorhis Preserve, Pomona, CA in Fall 2021 and Winter 2022.

Summary	Df	Sum	Mean Sq	F value	Pr(>F)
Season	1	6.1	6.095	1.128	0.323
Habitat	2	9.61	4.807	0.890	0.453
Temperature	3	15.41	5.136	0.951	0.466
Residuals	7	37.81	5.402		

Discussion

While the study did not identify any significant results in terms of how Mule deer adjust daily and temporal activity within an urban matrix surrounded by human development, there was still interesting insight that helped contribute to the current knowledge of urban Mule deer behavior and habits, such as being more active in winter compared to fall. Overall, more Mule deer occurrences were detected on the cameras during the winter season than the fall season in terms of frequency. The Voorhis Ecological Preserve

sees less human activity during the winter season than fall due to winter intersession on the CPP campus, so that data appears to be in line with what is commonly known for Mule deer as being avoidant of human activity in urban spaces (Patten and Burger, 2018). Mule deer did exhibit higher activity from 6:00pm-11:59pm in both seasons, which is in line with their usual crepuscular habits of being more active at these times of day (Nix et al., 2018). However, the frequency of Mule deer captured during late morning during both seasons contradicts their crepuscular habits (Nix et al., 2018). Mule deer on the preserve covered a larger amount of ground in the fall season based on the cameras they were captured on, which follows what is known for their seasonality movements, with winter being when they are least active since forage quality and quantity is reduced, and thus their energy levels (Garrott et al., 1987; Pease et al., 2009). Their activity did occur on more days of the week during the winter, with Monday being the sole day that no Mule deer activity was captured during either season. Urban mule deer activity on the Voorhis Ecological Preserve appears to vary more than other Mule deer in Southern Californian urban spaces (Patten and Burger, 2018; George and Crooks, 2006.)

Limitations

There were several limitations within this study. The study area, Voorhis Ecological Preserve, is only the eastern portion of the hillside and it is possible that not all Mule deer activity and movement is being captured. The study also included only two seasons of data, though more data is still being processed that may be able to contribute to future work. There is the limitation of the camera trapping only being set up for one month at a time, not allowing for a full scope on their activity for the full duration of a season. The other biggest issue was not being able to differentiate the Mule deer using the space to get an accurate population count, making it entirely possible that the population could be as few as two.

I cannot confirm that season, habitat, or temperature affect their behavior within this space. The lack of significant results can likely be attributed to the small sample size, since only 42 occurrences were used for the dependent variable across both seasons. Though there were no significant results within the statistical analysis, it can be assumed that this isolated population of Mule deer have already adjusted their habits to urban activity leaving nothing within these two observed seasons to be detected as unusual, especially since it is likely that there is only a small population of deer in this patch of land.

Conclusion

While the results did not strongly suggest human activity had an effect on the activity of the observed population of Mule deer, that does not mean there is no effect. The surrounding area of the Voorhis Ecological Preserve has long since been urbanized and it is entirely possible the Mule deer in this area have already adjusted their habits to be avoidant of human activity, such as with other urban areas (Patten and Burger, 2018). There is still a lot of opportunity for further research in the activity of Mule Deer occupying an urban space surrounded by human development. While camera trapping is an effective and non-invasive way to study the habits of urban wildlife, future studies involving Mule deer might benefit from employing different methods such as radio collars, scat collection, sign surveys, and thermal-sensing drones to get a better sense of the population number of Mule deer within an area and to be better document their individual movements.

An emphasis for future work involving urban Mule deer should be striving to improve connectivity to other suitable habitats, since habitat fragmentation is a threat to biodiversity and can affect population demographics and have genetic consequences (Fraser et al., 2019). The work should not only be studying to understand their habits and why they behave that way, but to improve future genetic diversity, population declines, and avoid inbreeding depression (Dearborn and Kark, 2010; Mittelberg and Vandergast, 2016; Fraser et al., 2019). Understanding how human development affects urban wildlife such as Mule deer can help make conditions better in the future as urbanization continues to grow, requiring us to allow space for urban wildlife to thrive as well. This study and other current literature does help supply a better understanding of Mule deer's current activity and behaviors when in close proximity to urban development, and that research can help build a future where both human and wildlife coexist in better equilibrium.

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**Are Foreign Citations a Threat to Courts? Judicial Globalization
and its Effect on Court Legitimacy**

Abstract

Courts in the United States lack the power of the sword or the purse; instead, they must persuade their audience on the validity of their decisions with the power of the pen. To achieve that goal, the United States Supreme Court increases the persuasiveness of their published opinions by utilizing various types of legal arguments, including citations of international law. The purpose of this paper is to assess the effect of international law citations on the persuasiveness of a decision, and on the overall institutional legitimacy of the Court. We utilize a survey experiment to show that international law citations do not have a uniform effect on legitimacy, but are highly dependent on public attitudes, especially with regards to the cosmopolitan values of the American public.

The United States Supreme Court has traditionally been one of the most trusted institutions in the United States, especially when compared to Congress and the Executive Branch. However, this degree of public support has not remained constant across time. Variations in support, and the recent backlash against the Supreme Court after the overturning of *Roe v. Wade*, have prompted scholars to evaluate the factors that affect the institution's legitimacy. Despite the numerous studies in the area, scholars have reached contradictory results on which factors affect institutional legitimacy, or even if institutional legitimacy can be threatened at any point.

On the one hand, part of the literature suggests that institutional support for the Court remains steady and is not threatened by single decisions or the composition of the Court. In a 2016 study, Gibson and Nelson investigate whether support for the court weakens based on the decisions it makes. The focus is on the role that judicial symbols play in undermining the relationship between specific and diffuse support for the court. The results are consistent with two theories. The first is conventional legitimacy theory which states that legitimacy is maintained even if people are dissatisfied with specific decisions. The second is positivity theory which states that the more people "know" the court, are exposed to the court, the more the court is presented to people, and the more awareness of the court people have, the more they tend to respect the court despite unpopular decisions (Gibson and Nelson 2016).

The same authors investigate whether people's satisfaction with the court's ideology and performance affects their support for the court (Gibson and Nelson 2015). This study builds on prior studies that suggest that when the court's decisions are not aligned with the public's political beliefs, public support for the court goes down. The results are based on a "survey of a representative sample of the American people, conducted in 2011." The results of the survey are compared to the results of a different study from 2005 and a statistical comparative analysis is presented. The results of this study suggest that "dissatisfaction with a single Court decision substantially diminishes the institution's legitimacy" (Gibson and Nelson 2015).

On the other hand, scholars have begun to unveil factors that could threaten the legitimacy of the Supreme Court. In the book, "The Rights Paradox: How Group Attitudes Shape US Supreme Court Legitimacy" (2022), Zilis asks "whether the Court does experience public backlash when it rules in favor of disliked political groups." Zilis touches on the distinction between specific support and diffuse support arguing that while people may support a political ideology in general (for example, free speech), when such an idea is applied in specific rulings, supporters of that political idea don't always agree with the court's application. The study finds that public support for the court is based on whether judicial rulings are consistent with how the public in question feels about the political groups involved in the ruling. According to Zilis, "citizens evaluate [the Supreme Court] based on the extent that they perceive it as an ally of groups they dislike." (Zilis 2022:7) This is the "group antipathy model" and it takes into account groups such as immigrants, Christian fundamentalists, LGBTQ+, and racial groups. Moreover, Zilis argues that these "group-based" reactions apply to other groups beyond bipartisan groups (Zilis 2022).

Another factor that has been assessed as a threat to institutional legitimacy is that of polarization. Armaly and Enders (2022) study the role that affective polarization plays when it comes to the Court's legitimacy and find a significant negative relationship between affective polarization and both diffuse and specific support for the Supreme Court. Bartels and Johnston (2013) reach a similar conclusion. They argue that there should be an acknowledgement of ideological disagreement when it comes to institutional legitimacy. Because of this disagreement, Bartel and Johnston explain that the relationship between Americans and the court fails to maintain a relationship with trust that can be seen within other countries justice systems. The reasoning for this being that the American court system is most believed to have a democratic moral, as well as a left leaning bias. Bartels and Johnston more accurately describe this bias as "positivity bias" (2013). However, they later go on to explain that this belief does not hold itself accurately, as they further explain how the court system contains a conservative perspective. Even with this conservative perspective, it still does not explain the conservatives showing less support for the contemporary court than the left. These findings reveal that the reasoning for this misconception of the court having a left leaning policymaking due to the lack of coverage from media, which is due to most citizens not having enough information to challenge or even analyze the decisions of the court. In other words, according to Bartel and Johnston, "The evidence challenges conventional wisdom and suggests an effect opposite to what would be expected if citizens were rationally mapping their ideological preferences onto the contemporary court's purportedly conservative tenor (2013:185)".

Considering that the Supreme Court's legitimacy is not as steady as some would think, others have attempted to uncover tools that justices may use to uphold the Court's legitimacy in specific cases. For example, Donnelly (2022) argues that coalition building, action by elected branches, incrementalism, charity for the opposing side, triangulating between constitutional extremes and promoting a vision of institutional humility can help maintain legitimacy. Similarly, Farganis (2012) discusses the link between legitimacy and case outcomes, but also addresses the importance of opinion content. Farganis argues that while court legitimacy is strong, there are more efficient ways to strengthen the justice system and have support from the public, as the average citizen can tend to be drawn away from the court due to the political nature of it. In order to create stronger judicial arguments

for the court to get support from the public, research suggests that involving justices in their opinions can have a positive effect, but only if done properly. In which case boils down to justices understanding which arguments would be more accepting in the public's eye, and which ones will draw the average citizen away. Farganis argues that "Written opinions that rely on factors such as constitutional text and precedent are thought to help secure the court's legitimacy; personal beliefs, political ideology, and a host of other 'extraconstitutional' justifications, most observers contend, do not" (2012) This again falls into the first article's argument that the court needs to be seen as fair to the average citizen in order to secure its legitimacy, due to the stigma that Americans tend to believe that the court needs from separate politics and stick to the constitution. There is a common counterargument that the average American are known for being inattentive to judicial reasoning, but Farganis tackles that notion with the accessibility of modern technology. Because of widely available information, granted from websites devoted to the court with proper sources, citizens can now educate themselves and have access to law libraries that were not readily available previously.

Concerns over institutional legitimacy are not unique to the United States. Baird (2001) assesses the effect of procedural justice leading to judicial legitimacy, ultimately discovering that the viewpoint of the matter is mixed. In her article, she presents the possibility of both sides of the argument, with one being how if judicial procedures are fair (as seen from the public), it will gain more support for courts. Whereas the other side of the argument explains that if judicial procedures focus on being legalistic as opposed to being fair, there will be gradual support as time goes on. Baird addresses the first half of the argument when discussing the FCC, the German court short for Federal Constitutional Court, where they are dependent on public support for their policymaking, thus creating a system where citizens form a trust with their courts. Baird supports this conclusion by drawing evidence to court rulings in 1993, where she states that "it had ruled 198 federal laws unconstitutional, over 5 percent of all laws passed since 1951. This is staggering compared to the 174 federal laws ruled unconstitutional in the entire U.S. history. Furthermore, 25 percent of the justices perceive their primary role as policy making. Because of its active role in public policy in highly salient issues, such as abortion, reunification, and the relationship between church and state, popular support is essential for the FCC in order to ensure utmost compliance with its rulings" (2001:336). From this point on, we can also see the counter to this when Baird explains that there is also this perception that legitimacy is developed with procedures already being seen as fair. It is the belief underlying the issue that certain decisions and laws may be seen as complicated, and therefore would not receive support from the public. In this scenario, rather than basing laws on popular support, rulings are factored based on the trust that the justice system will abide by the rule of law. Baird explores this opposing thesis further by breaking down the conception of American justice system in which certain laws that might be deemed unwanted with a different perception. She states that utilizing legalistic arguments to support unpopular decisions, along with raising levels of awareness of the Court, can assist in shielding institutional legitimacy from threats (2001).

We are adding to this literature on Supreme Court legitimacy by considering a specific type of legal argumentation, that of international law citations, and the effect it can have on public support for the Court. This practice of utilizing international law

in Supreme Court citations has been the topic of a normative debate in recent years. For example, Calabresi and Zimdahl (2005) present the notion that the question at hand is not whether foreign law should be practiced, but how and when these laws should be cited. When it comes to practicing foreign law, there is prone to be more cultural differences that can affect decisions that can be seen as morally correct and/or incorrect. An example of this can be seen in the discussion of abortion, where Calabresi and Zimdahl cite how the United States is vastly subjective on the matter when compared worldwide, as it can conflict with political, ideological and ethical attitudes of the American public. Based on the evidence presented, while citing foreign law has benefits of creating a system with diverse perspectives, it can also conflict with the current political standing of American citizens and its court. Calabresi and Zimdahl argue that with this issue in mind, it can be noted that the court typically cites foreign law when it most conveniently fits into their narrative, i.e. liberal results as opposed to conservative ones (2005).

This is not the only instance where foreign practice is often used morally, or when questioning the judgement call made amongst other countries. Jackson (2001) explains this when discussing how the court rejected the death sentence of a juvenile due to existing rules in other countries-Jackson even goes as far as to say how the court are open minded to foreign practices especially in regards to punishment challenges that may be considered "cruel and unusual", in order to see other countries perspectives on the matter. Further on this, Jackson is also on the notion that there is no debate as to whether foreign law should be used and is on the argument that it'll only strengthen the perspective of our justice system. Jackson goes on to mention the history of the U.S. Supreme Court once being connected with the concept of change, as it was one of the only constitutional courts worldwide, to now remaining stagnant in its growth. As the world goes on to develop their courts and constitutional laws, it is now up to the court to follow through as well, in order to develop their process of decision making. In fact, Jackson follows up with this claim by proving that in other countries, they also follow through with looking at foreign laws in order to aid their courts. One of the examples she uses is with South Africa, in which she explains that "The South African Constitution explicitly requires that international law be taken into account when interpreting constitutional rights and specifically authorizes its courts to consider foreign law, manifesting a vision of the constitution as a site for possible convergence with transnational constitutional, or international, norms" (2001). With this requirement of South Africa, Jackson goes on to then explain that even interpreting other international laws does not necessarily equate to adopting the same laws. Rather, it is necessary as a comparison in other to see how distinct laws can vary from country to country, as other constitutional courts at times also take U.S. laws into consideration.

Furthermore, Law and Chang (2011) suggest that various scholars are on the argument that foreign law is seen as "dialogue" by the constitutional courts, and therefore reflects as "the emergence of a common global enterprise of constitutional adjudication" This can be seen with the Taiwanese Constitutional Court, as they are always extensively engaging in foreign law and comparative analysis when making decisions. This dialogue can also be seen when comparing the Taiwanese Constitutional Courts and the U.S. Supreme Court, granted Law and Chang do admit that their "global judicial dialogue" plays a small role when it comes to shaping the courts use of foreign law. The reason for this being that judges are incentivized to possess foreign law expertise. Moreover, Law and

Chang appear to be on the argument that while foreign law can be used, it should only be referenced very loosely due to the drastic changes that take place depending on the origin of the court (2011).

Despite the lively debate on the appropriateness of international law citations in domestic court decisions, empirical studies on their effect are hard to find. One exception is Curry and Miller's study (2008) on the controversy behind foreign law as well as the public's opinion regarding it. The authors find that there is a debate on how closely foreign law should be referenced when it comes to decision making, and the double-sided nature of it. On one side there is the argument that the Supreme Court should follow the Constitution strictly, and not strive away from our origins when it comes to decision making. This is an argument presented by a conservative audience and comes from the belief that courts should not make decisions based on what is currently popular or seen as morally correct/ or incorrect. Additionally, they also go to address that by following foreign law, it does create a relationship of distrust between the public and the court due to it (some may argue) being "unconstitutional". However, the counterargument for this debate follows that America and its justice system cannot grow if we do not use other sources (in this case foreign laws) in order to see how they also faced similar issues we have. The core belief here is that if we fail to see beyond our borders and roots, then we fail as a country to progress forward and open our minds to different perspectives. To limit our decision making to domestic resources only creates arrogance, and further problems down the line. This debate on foreign law is not new, according to Curry and Miller, who go on to explain how this will continue to be an ongoing debate. Ultimately, their paper does not present a clear answer, as there is no easy way to approach or find a correct way to solve this matter (Curry and Miller 2011).

To address the scarce and contradictory findings on the effect of international law citations on the institutional legitimacy of the Supreme Court, we are conducting a survey experiment. In our study, we additionally take into account a factor missing from the current literature, that of the public's attitudes. Specifically, we argue that the effect of international law citations on court legitimacy will be conditional to the public's cosmopolitan values, that is, the public's openness to foreign influences.

Experimental Design

The experiment was conducted in May 2016 on Amazon's Mechanical Turk platform. Mechanical Turk workers were recruited to respond to survey questions regarding their opinions about the U.S. Supreme Court and they received \$0.50 each as compensation for their participation. 2500 participants responded to the questionnaire.

Participants first responded to a pre-test questionnaire that included demographic questions. They were then randomly assigned to one out of twelve experimental conditions, depending on the interaction between issue area, the ideological direction of the decision, and the citation of domestic law or a combination of domestic and foreign or international law.

The experiment utilizes two dependent variables, *Diffuse Support* and *Acquiescence*. To construct a measurement of diffuse support, we used four questions aimed to assess support for the court as an institution independent from any specific court outcome (Gibson, Lodge, and Woodson 2014). The responses to these four questions were rescaled in order for higher values to correspond to higher institutional loyalty and were then averaged to create a single variable (minimum value=1, maximum value=5). The four questions used to measure acquiescence focused on people's attitudes toward the court as a reaction to the specific decision they were asked to read for the purpose of this experiment (Gibson, Lodge, and Woodson 2014). Responses were again rescaled, with higher values corresponding to higher levels of acquiescence, and averaged to a single variable (minimum value=1, maximum value=5).

One of the main variables of interest, *Cosmopolitanism*, was measured based on six indicators that differ significantly from the internationalism measurement of the replication study.¹ While the internationalism measurement focuses on what people feel the position of the

¹ For these measurements we relied on Saran and Kalliny (2012): 1) I think it is good to spend time with people who are willing to talk and learn about other cultures; 2) I think I respect others' culture the way I respect mine; 3) I think if people have a positive attitude toward other communities, there would be less conflict in the world; 4) I think, to be successful, one needs to be able to use materials, information,

United States should be in the world, the cosmopolitanism questions are formulated so as to capture people's personal stance toward foreign influences. The latter approach was chosen because it resembles the logic behind foreign and international law citations by U.S. federal judges. Cosmopolitanism indicators randomly appeared before the treatment for half the subjects and after the treatment for the other half, to ensure that neither the questions nor the treatment affect each other.² Responses to the cosmopolitanism indicators were averaged to create a single variable (minimum value=1, maximum value=5). The second independent variable of interest, *Agreement*, was constructed based on a question asking respondents to rate their level of agreement with the court decision, ranging from strong disagreement to strong agreement (minimum value=1, maximum value=5).

The main independent variable, *Treatment*, was coded 1 for subjects assigned to either the international law treatment or the foreign treatment groups and 0 for the ones who read the domestic law court decision. To be able to assess the conditional effects of the treatment on diffuse support and acquiescence, we also constructed two interaction variables. *Treatment x Cosmopolitanism* is the interaction between the *Treatment* and *Cosmopolitanism* variables, while *Treatment x Agreement* is the multiplication product of the *Treatment* and *Agreement* variables.

Additional to the independent variables, we control for several factors that have been found to affect diffuse support for a court, as well as levels of acquiescence to its outputs. The variable *Knowledge* is included so as to control for the previous finding that a court enjoys higher levels

knowledge etc. from other cultures; 5) I am ready to learn about other cultures through listening, observation, thinking and reflecting; 6) I think reading about world events is worthwhile.

² A ttest confirmed that there is no statistically significant difference of means for cosmopolitanism depending on whether the relevant questions appeared before or after the treatment.

of institutional loyalty and acquiescence among knowledgeable individuals. *Liberalism* was based on the respondents' self-assessment and is measured on a six-point scale, from very conservative to very liberal. Finally, we included two dummy variables, *Issue Area* (0=Patent case, 1=Search and Seizure case) and *Decision Direction* (0=Conservative, 1=Liberal), to control for any effect the different types of vignettes had on subjects.

Results

In our results section, we are focusing first on a factor that has been traditionally found to correlate with high levels of support for the Supreme Court, namely knowledge.

The domestic political knowledge assessment includes (but is not limited to) questions regarding the names of the current VP, the speaker of the house, the majority leader of the US senate, the number of supreme court justices, which political party is more conservative, which party currently holds the majority in the House of Representatives, the number of supreme court justices and their length of appointments.

In general, participants showed a high level of knowledge. Out of 13 questions, 9 were answered correctly by more than 80% of respondents. More than 90% of respondents (per question) answered correctly the name of the vice-president in office, which party is the most conservative, and recognized the chief justice of the US supreme court by name.

Participants demonstrated a moderate level of knowledge regarding the number of supreme court justices (59%) and the name of the speaker of the house (64%). The lowest level of knowledge (below 50%) was in naming the majority leader and the minority leader.

Ambiguity due to typos can be reduced in some of the questions that have a single correct answer by implementing multiple choice into the survey. For example, in Q1 a couple surveyors answered *Joel Biden* and *Jon Biden* instead of *Joe Biden*. The response is similar enough to

assume a correct answer but the lack in accuracy may leave room to question the extent of the individual's knowledge. If we can predict that this person would have selected "*Joe Biden*" in a multiple-choice survey. Then, in application, both methods yield the same result in the data (in this case, it is that the person answered *correctly*). This shows that some short answer responses can be strategically replaced by a multiple-choice format. The most popular wrong answer for the current vice-president of the United States was *Barack Obama* (the *current president* at the time). It's considerably possible for some surveyors to have read the question wrong since the words *vice-president* and *president* look similar; but we don't know whether that was the case.

When asked to state the majority required for the U.S. Senate and House to override a presidential veto, popular wrong answers include $3/5$, $4/5$, $3/4$, $1/3$, $1/2$, and some of their respective decimal and percentage equivalents (i.e. 0.6, 60, 0.8, 0.75, 75, 0.3, 0.5, 50).

When considering percentages, it's important to note a commonly premature cutoff in the decimal portion of the number. Fractions such as $1/3$ and $2/3$ (the correct answer) result in a repeating decimal. Some calculators show this as $0.\bar{3}$ and $0.\bar{6}$, respectively. The horizontal line on top of the last number means that the number repeats forever (e.g. $0.\bar{3}$ and $0.\bar{6}$ are the same as $\frac{0.333}{0.333}$ and $\frac{0.666}{0.666}$, where 3 and 6 repeat forever). This ambiguity is problematic because another popular answer, $3/5$, is exactly equivalent to 0.6 (*without* the horizontal bar on top). This means that the number after the decimal (6) does *not* repeat and is represented to *two* decimal places as 0.60. In the case of $2/3$ (the correct answer), 0.6 is represented to *two* decimal places as 0.66. The decimal values 0.60 and 0.66 represent different percentage values (60% and 66% respectively). The 6% difference between these values is equal to 26 votes in the House of Representatives and 6 votes in the Senate. Without these 32 total votes, the House and the Senate cannot override a veto. For this question, answers of 60% or 0.6 were considered incorrect.

Table 1: Domestic Knowledge Answers

Q-ID	Topic	Correct Answers	N-Participants	% Correct	Level of Knowledge
1	Current VP	336	344	97.67	high
2	Veto	252	309	81.55	high
3	House	295	333	88.59	high
4	Conservative	330	343	96.21	high
5	Constitutionality	305	342	89.18	high
6	Speaker	177	275	64.36	moderate
7	Roberts	211	223	94.62	high
8	Majority Leader	110	223	49.33	low
9	Minority Leader	104	218	47.71	low
14	SC	183	309	59.22	moderate
16	Nomination	283	333	84.98	high
17	Length	250	304	82.24	high
18	Members	205	247	83.00	high

When it comes to international knowledge related questions, there appears to be a noticeable pattern regarding the participants' knowledge. Examples of this can be seen with question 10, "*Who is Kofi Annan?*", where the majority either didn't know the answer or refused to put an answer down. The number of participants who did correctly answer were extremely limited, and some guesses for answers included unique answers such as "Black UN guy", "Arab leader", and "A person".

Another instance of this happening can be seen similarly with question 20, "*What does NATO stand for?*", in which the majority did not know the answer, but if they did know, they would mistake "Treaty" for "Trade". Additionally, there was also a good number of participants who put "American" rather than "Atlantic". There were questions such as 11, "*Who is the British Prime Minister?*" and 12, "*What does NAFTA stand for?*", where the answers were fairly half and half. Participants who answered 11 correctly also managed to get 12 correct, opposing the

other participants who left both blank or answered “I don’t know”. For every three correct answers, there would be three answers not knowing for both 11 and 12.

The only consistent answer that was correct even by participants who have incorrectly answered was for question 15, “*What nation’s leader is Castro?*”. This question was consistently right by participants who previously answered correctly, and incorrectly. The participants who have consistently been leaving questions blank were still blank for this one. There also was a consistency of people answering question 21 correctly, “*Which of these three nations has the best relationship with the United States?*”, but it was still only answered correctly by those who have previously gotten the answers right.

Overall, the consensus amongst participants was that there appeared to either be a lack of knowledge regarding international knowledge- naming leaders or groups- whereas knowledge regarding Cuba and Israel appeared to be more common. This may be due to the fact that Castro is a common headliner for American media, as well as Israel as a whole. Which cannot be said for people such as Kofi Annan and David Cameron. It is also worth mentioning that for instances like question 10, there was still a negative connotation associated with answers such as “An Arab leader” and “A black guy”.

When comparing the international answers with the domestic ones, there appears to be a distinction of participants being more knowledgeable on domestic questions rather than the international questions. Examples of this can be seen with almost every participant answering correctly for the question “Who was the vice president of the United States?”, with the percentage of correct answers standing at 97%. Those who answered correctly for this question consistently answered the Kofi Annan question either incorrectly, or refusing to answer.

Additionally, this same occurrence can also be seen with the question “What job is currently held by John Roberts?” where a high majority were able to answer correctly, the percentage being 94%. However, when answering the NATO question, there are common inconsistencies or wrong answers. This pattern of correctly answering domestic questions while being consistently wrong with international questions draws a theory that the average American might not be as educated on the international court due to modern media focusing primarily on American court issues.

Further results also show that majority of applicants identified as Republican, with an extremely small number identifying as Democratic. Those same participants also unanimously agreed that Republicans tend to be the most conservative political party. Furthermore, studies show that the Republican party participants are stronger in the domestic knowledge rather than international knowledge, possibly due to their conservative beliefs. Not enough evidence has been gathered on the Democratic party to draw conclusions as to how knowledgeable they are on domestic and international knowledge. With the few that did identify as Democratic, they also showed patterns of struggling in the international questions as well, and striving in the domestic questions.

Moving on to the statistical analysis of the results, Table 2 presents the effects of the treatment, conditional to values of cosmopolitanism and levels of agreement with the court decision on diffuse support.

Table 2: Effect of Treatment on Diffuse Support, conditional to Cosmopolitanism and Agreement.

VARIABLES	(1) Diffuse Support	(2) Diffuse Support
Treatment	-0.786** (0.354)	-0.782** (0.359)
Cosmopolitanism	0.00817	-0.101

	(0.0673)	(0.0706)
Agreement	0.0574*	0.0664**
	(0.0319)	(0.0323)
Treatment x Cosmopolitanism	0.140*	0.145*
	(0.0814)	(0.0818)
Treatment x Agreement	0.0724*	0.0659*
	(0.0386)	(0.0370)
Issue Area	-----	-0.0507
		(0.0386)
Decision Direction	-----	-0.0584
		(0.0456)
Liberalism	-----	0.0295***
		(0.0114)
Knowledge	-----	1.427***
		(0.0842)
Constant	3.151***	2.613***
	(0.294)	(0.310)
Observations	2,170	2,170
R-squared	0.027	0.135

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

The treatment effect is statistically significant and moves in different directions depending on cosmopolitanism and agreement. The treatment variable moves in a negative direction and is statistically significant at the .05 level in both models. This finding confirms that the citation of foreign and international law materials in a court opinion results in lower levels of diffuse support when the levels of both cosmopolitanism and agreement with the decision outcome are at their lowest value. On the other hand, the two interaction variables are statistically significant and have a positive relationship with the dependent variable. Thus, the court's inclusion of foreign and international law arguments is correlated with an increase in the levels of institutional support as cosmopolitanism and agreement with the decision increase. These findings hold even after controlling for other factors, out of which both knowledge and liberalism have a positive and statistically significant relationship with diffuse support for the Court, and do not depend on the issue area of the case or the direction of the decision.

Table 3: Effect of Treatment on Acquiescence, conditional to Cosmopolitanism and

Agreement

VARIABLES	(1) Acquiescence	(2) Acquiescence
Treatment	-0.0151 (0.260)	0.0519 (0.259)
Cosmopolitanism	-0.0127 (0.0465)	-0.0478 (0.0485)
Agreement	0.416*** (0.0239)	0.379*** (0.0249)
Treatment x Cosmopolitanism	0.0119 (0.0592)	-0.00169 (0.0592)
Treatment x Agreement	-0.00514 (0.0304)	-0.00515 (0.0294)
Issue Area		-0.288*** (0.0289)
Decision Direction		0.147*** (0.0363)
Liberalism		0.0173* (0.00888)
Knowledge		0.432*** (0.0668)
Constant	1.972*** (0.204)	1.957*** (0.203)
Observations	2,170	2,170
R-squared	0.344	0.390

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table 3 assesses the effect of foreign and international law citations on acquiescence. As expected, there is no statistically significant relationship between the treatment and levels of acquiescence with the court decision. This result holds true for different values of cosmopolitanism and agreement, as well as when we control for other factors that affect acquiescence. Following previous literature on court legitimacy, we find that acquiescence increases as agreement with the court decision increases and is higher among high knowledge

individuals. Additionally, acquiescence depends on the characteristics of a case, such as the issue area of the case and the ideological direction of the court decision.

Conclusion

As discussed in the beginning of this study, the inclusion of foreign or international law arguments in court opinions, and especially in high-profile, constitutional law cases, has resulted in a heated debate regarding the appropriateness of such behavior. With this paper, we join the debate, but from a different angle, as this project is, to our knowledge, one of two studies that empirically test the relationship between court legitimacy and foreign and international law citations. Furthermore, this study is the first that utilizes a large sample and connects the effect of these types of legal argumentation on court legitimacy to factors external to the judiciary.

The use of international law and foreign citations provides an additional reservoir of potential legal solutions. Common law dictates that judges have a legal duty to honor case law within their jurisdiction. When a legal question is presented and a case with similar facts has previously been ruled within the same jurisdiction, judges must rule in accordance with the previous ruling. Judges are expected to apply the same standard in determining the similarities between the facts of two cases regardless of whether the case being cited is domestic or international. However, the legal basis of case law only applies to domestic citations. When considering international and foreign citations, judges are *not* legally bound by the principle of common law. International and foreign citations are considered as mere *ideas*. This consideration is not based on placing a higher value or any ranking value on the geographical location where the idea of a legal ruling came to be. At every point in this process, judges have a duty to apply their impartial discretion and legal expertise in accordance with the bounds of our domestic system of justice. The discretion of the impartial judge brings about a variable of *trust* because

judges are not required to present the full thought process of their discretion, but they have the final word in the court room.

Before giving participants the main treatment for international citations, we assessed their knowledge of government as a control for the idea that higher levels of knowledge correlate with higher support for the court. We aim to control this variable in order to minimize ambiguity in correlations to the court's legitimacy that may involve both high levels of knowledge and international citations. In general, the participants' knowledge of government can be one reflection of their political involvement and may affect whether they are coming in with a previously established political stance or instantly concluding a stance for the purposes of completing the survey. We can further this part of the study by considering the extent to which the knowledge questions capture the scope of the avenues of involvement and expertise that members of society may have in government and politics.

In addition, the practice of using international and foreign citations is one moving part of a larger system of justice and may be considered specialized knowledge. We can further our study by considering whether the inclusion of foreign and international law citations is a commonly known practice. If a person doesn't know that this practice exists in the first place, they can't form an opinion about it. This can give us further insight into the numbers and/or the groups of people who possess the background knowledge required to lead an individual to opine on the matter. Considering the views of individuals with different levels of knowledge may reveal what we can expect from certain groups. Using data of the participants' *lack* of knowledge in specific areas, we can isolate their view from one potential variable in the equation and explore the dynamics of other factors that influence that individual's support for the court. For example, if we can determine that somebody *doesn't* know who the members of the court are, we

can better gauge the influence of the other factors that affect that individual's level of support for the court. We can then use the data attained at the individual level to make observations about larger populations and to explore correlations between different knowledge groups.

Going back to the main question addressed in this paper, are foreign and international law citations a threat to court legitimacy? The findings indicate that, first of all, the reliance of a court on foreign and international law arguments does not have a uniform effect on diffuse support for the citing court. As the normative arguments against these citations suggested, foreign and international law citations result in a decrease in institutional loyalty only for non-cosmopolitan individuals who disagree with the outcome of the decision. On the contrary, the inclusion of such citations in a court opinion increases diffuse support for cosmopolitan individuals, as well as for those who agree with the court decision. Furthermore, foreign and international law arguments appear to help the court persuade the public that a correct decision was reached and have no effect on levels of acquiescence to the court decision.

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Attorney-Client Privilege Across The Globe

Abstract

Attorney-Client Privilege is an essential component in our justice system, as it ensures that the client will receive proper counsel, without fearing that their information will be shared. This concept differs across the globe, and the varying legal systems may have accounted for these differences. This thesis assesses how attorney-client privilege in the U.S. compares to similar ethic rules in various countries, and why such rules differ. Using case studies, I find that a relationship exists between legal systems and the right of confidentiality.

Introduction

Legal privilege is one of the most sacred principles in the United States legal system, as it helps foster frank discussions between a client and their attorney. There are two justifications for the existence of legal privilege. The first justification for attorney-client privilege is that the best administration of justice cannot happen without legal privilege. Without attorney-client privilege, the accused would not be able to reveal information to their lawyer without it being revealed to the prosecution. (Hill, 1995) The attorney becomes a medium of confession. This threatens the accused's right to counsel and the privilege against self-incrimination. Clients need to have candid conversations, in order to receive proper legal advice.

The other justification for attorney-client privilege is based on the idea of privacy. Clients should be able to decide who has access to their information. Attorneys and non-attorneys benefit from attorney-client privilege as individuals will be more inclined to seek legal assistance if they are certain their information will not be revealed. Individuals who are not attorneys cannot effectively live in an adversary system without counsel. Seeking legal advice and knowing the complexities to be able to survive in this system and have legally correct behavior, which helps society flow.

As we are governed by complex laws, expert legal advice is essential. Attorney-client privilege influences clients to communicate with legal experts, and the privilege to prevent their later disclosure is said by courts and commentators to be a necessity. The social good derived from the proper performance of the functions of lawyers acting for their clients is believed to outweigh the harm that may come from the suppression of the evidence in specific cases. (Sisk & Abbate, 2008)

Every body of laws, with its supporting institutions, national or part of a federal or pluralistic system, can be called a legal system. There are three elements in every legal system that influences laws, which are structural, cultural, and substantive. Substantive refers to laws, doctrines, statutes, etc. Structure refers to the type of courts, presence or absence of a constitution, division of powers between political representatives, etc. The values and attitudes which bind the system together are the cultural components of legal systems. The diverse values of people around the world create varying legal systems. (Friedman,1969)

The two most dynamic legal systems are the Romano/Germanic system and the Anglo/American system. The legal system, civil law, represents most of the world's jurisdictions, and common law is the second most prevalent in the world.

Attorney-client privilege has been practiced in common law for a very long time and is also practiced in many other jurisdictions around the world. However, the concept of legal privilege may differ, and the diverse legal systems representing countries may be the reason for these differences. The law of privilege has origins in the Roman Republic and developed in Great Britain. Since the theory was established early, it has been reformed over the years. At the early common law, attorney-client privilege belonged to the attorney, and not the client. In 1873, the clients began to receive full protection. (Utz,2019) The U.S. adopted the common law system after gaining independence from Great Britain. France has a civil law system that traces its origins to the Roman system of law. (Lee et al. 2012) Canada is a bijural country, which incorporates both common and civil law.

In this paper I show what accounts for the differences in attorney client privilege, while comparing these legal systems. My research question is how does attorney-client privilege in the United States compare to similar ethic rules in various countries, and why such rules differ. I uncover these differences by finding similar legal rules and the reasoning behind the varying approaches. My analysis is centered around the legal systems of the United States, France, Canada, and Saudi Arabia, which an Islamic law country. After analyzing these legal systems, I show whether their differences might have correlation to the possible imbalance of attorney-client privilege across the globe.

My non-directional hypothesis is that there is a relationship between attorney-client privilege and legal systems. To find the relationship between attorney client privilege in the United States, France, Canada, Saudi Arabia, and the various legal systems these countries adopted, we must use a qualitative approach. The case study model will be utilized, an in-depth view of a specific ethic rule is needed. Case studies focus on collecting information about a specific object or activity, such as a particular organization. I must examine real-life situations from many perspectives in order to find valuable data.

I believe that the United States, being a common law nation, has the strongest attorney-client privilege. The United States, France and Canada all seem to have similar ethic rules regarding legal privilege, but Saudi Arabia has many legal complexities. Although all countries have varying legal systems, Islamic law differs from these legal systems drastically, which is the rationale behind choosing Saudi Arabia for my research. When analyzing the differences between legal systems, and their history, it is expected that Islamic law will differ the most, which will help us discover how legal systems cause

inconsistencies in ethic rules. I expected the common law jurisdictions, like the United States and Canada, to have the strongest attorney-client privilege because the concept of legal privilege was developed in common law. Additionally, the United States and Canada provides their in-house counsel with legal privilege, unlike most jurisdictions. In-house counsel helps with legal issues in the corporation they are hired in, and legal systems also might be a factor in the decision to provide legal privilege to in-house counsel or not.

Lit Review

Importance of privilege

The prehistory of legal privilege can be traced back to the Roman Republic and Empire, where it originated, and in the common law of England, where it further became developed. “The roots of the privilege extend back to Roman law and the notion that the loyalty a lawyer owes to a client disqualifies the lawyer from serving as a witness in the client's case. In English common law the rule of confidentiality for attorney testimony came to be grounded in the client's right to have his secrets protected, rather than the lawyer's right not to be compelled to testify. It was under English common law that attorney-client privilege bloomed, and we can still see the important role of legal privilege in the criminal justice system.” (Cole, 2003)

Attorney-client privilege fosters frank discussions between an attorney and a client, and because of these frank discussions, the attorneys are able to provide effective counsel, avoiding self-incrimination. Individuals being represented by attorneys would be hesitant to provide relevant information if they believe that the attorney might be required to reveal their information. Non-lawyers cannot function efficiently or effectively in the

adversary system without counsel and because individuals need to seek advice on the law and its complexities to properly function within the system. If individuals do seek legal assistance and conform with the laws, the benefits of this legally correct behavior will help society flow. (Hill,1995)

Legal Systems

There are three components in every working legal system that influences laws. The three elements are: structural, cultural, and substantive. Substantive is the output side of the legal system. These are the laws themselves-the rules, doctrines, statutes, and decrees, to the extent they are used by the rulers and the ruled. The institutions themselves, the forms they take, the processes that they perform: these are structure. Structure includes the type of courts, presence or absence of a constitution, division of powers between political representatives, and the procedures of various institutions. The values and attitudes which bind the system together are the cultural components of legal systems. The diverse values of people around the world create varying legal systems. People's respect for law and tradition or lack thereof, the training of lawyers and judges, political participation (do individuals willingly go to court and what purposes do they turn to government officials) all reflect the legal system. (Friedman, 1969)

Legal culture is the term we apply to those values and attitudes in society which determine what structures are used and why, which rules work, and which do not, and why. Legal cultures obviously differ in ways that cut across the conventional similarities and differences of legal systems, classified by historical evolution; so, therefore, do legal systems differ. (Friedman, 1969)

Common Law

The Norman Conquest of England in 1066 started the development of common law in Royal Courts, which looked to standardize the law. Common law derives from the activity of the courts, as it is the work of judges. The discovery of common law was not planned. The Normans were successful in conquering people, then later realized that they were around foreigners and needed a new legal system that would appeal to the Normans' interests. From these circumstances, common law was born. In this legal system, unwritten law is based on judicial precedent applicable without relevant statutory provisions. (Lee et al., 2012) "As the courts of Henry II developed, those appearing before them would make notes of the decisions and repeat them to judges in other cases. Glanvill's treatise is believed to be the first organized presentation of England's laws and customs. In 1215, the Magna Carta created the Court of Common Pleas in England. The average citizen then had a resort for personal disputes that did not concern the monarchy. Soon, "year-books" and "law reports" appeared, providing a record or precedent of prior opinions of common law issued seriatim by each judge. By the late 1200s, Bracton had collected hundreds of cases. Unofficial judicial opinions appeared in the late 1530s." (Sandler, 2020)

Common law may be distinguished from civil law by the rule of stare decisis. Stare decisis favors judge-made legal rules and puts reliance on case precedent. (Lee et al., 2012) There are three characteristics of stare decisis. First, there is one sole court that monitors all lower courts, and the lower court judges are bound by previous decisions of higher courts. Second, material facts are legally relevant circumstances to the dispute that determine the case's outcome. Finally, law reports make judgments with precedential value publicly available. (Gonzalez, 2016)

Civil Law

Unlike in common law systems, civil law jurisdictions do not adopt stare decisis. When deciding on legal issues, precedents serve a persuasive role. Civil law jurisdictions adopted jurisprudence constante, which is the doctrine under which a court is required to take past decisions into account when there is a sufficient level of consistency in case law. (Fon & Parisi, 2004)

Civil law got its inspiration from Roman law and its main principles and rules are contained in codes and statutes, which are applied by the court's codes. Codes and statutes prevail, while case law constitutes only a secondary source of law. Napoleon put a provision in the Civil Code that forbade judges from creating any laws, and this is still prevalent in civil law countries. (Henry, 1929)

In the common law system, laws have been primarily created by judicial decisions, while a conceptual structure is often lacking, but civil law judges are using concepts from the common law doctrine of precedent to enforce their own constitutions. The Anglo-American doctrine of precedent is thus migrating to civil law, a context with a more standard approach to judicial justification that has a diverse judicial structure. (Gonzalez, 2016)

Common law is distinguished by its method and inductive reasoning, which consists of generalizing from precedents and observing similarities. Civil law, on the other hand, is characterized by its deductive method, high degree of abstraction and generalization. In short, the method of civil law is rational, that of the common law empirical. (Seguin, 2001)

Bijural Law

Bijuralism is the coexistence of two legal systems within a single state. (Seguin, 2001) The existence of two legal systems together within a state is not common, but can be explained by influences from different countries, which was often caused by colonization. "With civil-law jurisdictions representing forty-six percent of the world's jurisdictions and common-law jurisdictions representing twenty-six percent, the six percent with mixed systems are a distinct minority." (L'Heureux-Dubé, 2002) The combination of civil and common law is one of the rarest forms of bijuralism. (Seguin, 2001)

The interaction between two different legal systems can have different impacts. For example, if a country implements common law, economic development may be achieved as there are differences in systems, such as the property law system in common law jurisdictions, which seem to be working efficiently. When the systems interact, it is important to note which principles have been adopted in the bijural state.

Islamic Law

Jurists classify the sources of Islamic law in two groups. The first group being the chief sources. Which is the Quran, the Sunnah, the Ijma, and the Qiyas. The second group belongs to the supplemental sources, but the two most important sources are the Quran and Sunnah, as every other source has been controversial due to their validity. Islam was born after the angel Gabriel revealed the Quran to the prophet Mohamed. Muslims believe that God revealed his final law to govern all aspects of human life to the Prophet Muhammad between 610 and 632 CE. This became known as the Quran or, the "Book of God." Islam means "submission to the will of God" as shown in the Quran. (Vogel, 2000)

Religion guides Muslims in many aspects of their lives, including their laws. There is no rule of precedent, like *stare decisis*, in Islamic law. (Vogel, 2001) The Quran or the “book of God” is the primary source of Islamic law, and the belief of all Muslims. It has approximately 600 verses with 80 verses regarding legal topics. The secondary source of Islamic law is the Sunnah. The Sunnah is the clarification of the Quran. It is the Arabic term for the prophet Muhammad's way of life and legal precedent. The rules derived from the Quran of the Sunnah cannot be changed. (Hansen, 1987)

The concept of collective interest is fundamental in Islamic legal theory to promote the welfare of human beings and prevent corruption and injustice. There is a prominent legal rule derived from Islamic jurisprudence confirms the application of “public interest.” It implies that public interest (*Maslahah*) comes before personal interest. Collective interest is one of the main principles of the Islamic doctrine, and legal actors, are obligated to promote the common interest in their community. Usually, lawyers practicing in other legal systems are only expected to promote their client’s interest.

Research Methodology

To find the differences in attorney client privilege in the United States, France, Canada, and Saudi Arabia we must use a qualitative approach. This method is most appropriate because the data I need is nonnumerical. The qualitative method generates data that characterizes and approximates. It is a comparative case study based on characterizing ethic rules from each of the countries. The qualitative approach has observations with a large number of cases that confirm the argument by statistically proving patterns from data analysis, survey research etc. Therefore, qualitative

methodology does come with its drawback of low external validity, but it has high internal validity. My data is not opinion based and avoids bias.

The United States, France, Canada, and Saudi Arabia were chosen because they all have different legal systems. The research will show whether the differences in legal systems cause differences in attorney client privilege in these countries. My research will prove there is a relationship between legal systems and the right of confidentiality. My question is institutional, as it is measuring trends and patterns in France, Canada, Saudi Arabia, and the United States. It is not behavioral because I am not measuring attitudes and opinions of people. I will be utilizing the case study model, as I need an in-depth view of a specific ethic rule. Case studies focus on collecting information about a specific object or activity, such as a particular organization. I must examine real-life situations from many perspectives to find valuable data.

The key concepts are attorney client privilege and its formation in the United States, Canada, France, Saudi Arabia, and their accompanying legal systems. I will collect my data by examining documents and records. I will use the One Search database to find most of my research, and Google Scholar. The One Search database provides reliable sources, as it is a search tool within the Cal Poly Pomona Library website. Some of my search entries are attorney-client privilege United States, France, Canada, Saudi Arabia, common and civil law differences, *bijural law*, Islamic law, and the countries’ Constitutions.

I found in my research many similarities in attorney client privilege in the United States, Canada, Saudi Arabia, and France. Even though all these countries have different legal systems, many aspects of attorney-client privilege are similar in all four countries.

The legal systems are evidently going to play a factor in the minor differences. I found that common law and civil law are fairly different approaches to the legal process, as in civil law, rules are in codes and statutes, while in common law, law is created by judicial systems. Islamic law had the most differences in their legal rules, which was suspected. The concept of privilege seems similar in all the countries in my study, except in-house counsel privilege. In my paper I will also show why there is lack of in-house counsel privilege in most civil law jurisdictions.

Results

Out of all the different legal systems in our world today, the two most dynamic systems are the Romano/Germanic system and the Anglo/American system. The influence of the Anglo/American common law system is limited to the United States, Great Britain, former Commonwealth and African countries. The Roman/Germanic system, championed by the French legal system, has created a wide field of influence throughout Europe, Latin America, Africa, and the Middle East. (Hansen, 1987)

United States

At the early common law, attorney-client privilege belonged to the attorney, and not the client. (Utz, 2019) As in Rome, where legal privilege first originated, English lawyers had the privilege to refuse testimony. The U.S. adopted the common law system after gaining independence from Great Britain. (Sunshine, 2021)

In the United States the lawyer has a sixth amendment duty to provide effective counsel and a fifth amendment duty towards the client to not cause the client to self-incriminate. Attorney-client privilege has been recognized in the United States since the year 1888, and for in-house counsel since the year of 1915. (Hill, 1995) Courts in the

United States consider many factors when deciding whether attorney-client privilege applies to communications between an attorney and a client. (Pratt, 1999)

The concept of confidentiality was created by Wigmore in the first edition of his treatise, and in his fourth treaty Wigmore proposed a balancing test. It tests how important certain communications are. According to Dean Wigmore's classic definition of the attorney-client privilege, the privilege only applies: "1) [w]here legal advice of any kind is sought (2) from a professional legal adviser in his capacity as such, (3) the communications relating to that purpose, (4) are made in confidence (5) by the client, (6) are at his instance permanently protected (7) from disclosure by himself or by the legal adviser, (8) except the protection be waived." Although Dean Wigmore lists eight considerations, courts in the United States often condense these elements into four factors: (1) a communication; (2) made between privileged persons; (3) in confidence; and (4) for the purpose of seeking, obtaining, or providing legal assistance to the client." (Pratt, 1999)

In the United States in-house attorneys have been enjoying confidential communications under attorney client privilege for an exceptionally long time. In-house counsel are hired by a corporation, and they help with legal issues. "The attorney-client privilege for in-house counsel in the United States derives from a much earlier privilege for lawyers in private practice. Dean Wigmore refers to this more general privilege as "the oldest of the privileges for confidentiality known to common law."(Pratt, 1999) In most jurisdictions, individuals need to pass at least one bar exam, but law school graduates in the United States can choose not to pursue apprenticeship and can still serve

as in-house counsel. They are not members of the bar, but legal privilege is granted to these individuals.

The court case that made attorney-client privilege available for in-house counsel, is *Upjohn Co. v. United States* (1981). An investigation of Upjohn began, but Upjohn refused to give the documents that the IRS had asked for, arguing that they were protected by attorney-client privilege. The Court reviewed attorney-client privilege to its entirety to find answers, and they declared that the point of legal privilege is to encourage the communication of relevant information by employees of the client to attorneys seeking to receive legal advice to the client corporation. Allowing privileged communications with attorneys, aids in serving justice and public interest. The Court recognized that, although the communication was protected, the underlying facts were not, but this case gave the Supreme Court the opportunity to explain to what extent the attorney-client privilege should apply to corporations and to in-house counsel specifically. Currently, all jurisdictions within the United States recognize the attorney-client privilege for in-house counsel.

In the United States, there is a debate on whether privilege should be extended to in-house counsel, as there is uncertainty when deciding if communications between an attorney and their client are as significant when the client is a corporation or when the attorney is in-house counsel. (Pratt, 1999) The main issue is in deciding who specifically should get protection in a particular company. Many critics are against attorney-client privilege when the attorney is in-house counsel or when the client is a corporation. Outside of the United States, most jurisdictions do not recognize privilege for in-house

counsel. Many jurisdictions find that in-house counsel lacks the independence to give sound legal advice to their clients. (Hill, 1995)

France

The civil law system traces its origins to the Roman code system, which spread throughout Europe during the highpoint of the Roman Empire but then fell into disuse. European legal scholars revived Roman codes during the eleventh and thirteenth centuries and the revised forms of the codes became incorporated into French law. (Lee et al, 2012)

Under French law, all communications between an attorney and their client are covered by attorney-client privilege. (National Regulation of the Lawyer's Profession, Law No. 71-1130 of 31 December 1971, the Privacy Decree of 20 October 2005 and Preliminary Article of the French Code of Criminal Procedure as amended by Law No. 2021-2129 of 22 December 2021) All communications, whether oral or written, between a lawyer and a client, are protected by professional confidentiality in France. The information protected by professional secrecy cannot be disclosed to the Court. In France a breach of professional secrecy is a criminal offense. A lawyer who testifies in legal proceedings cannot breach his obligation of secrecy even if asked to give testimony about the secret information. (Hill, 1995)

However, in-house counsel privilege is not recognized in France. The European Commission, along with its member states, such as France, also does not recognize Legal Professional Privilege for a wide range of lawyers. "Community law, that is, the treaties and secondary law made according to the different legislative procedures, is directly applied and enforced by EU institutions only exceptionally." (Reinisch, 2012) Legal

privilege is considered a fundamental human right under the European Convention on Human Rights, but there is no privilege for communications with in-house counsel. The communications that are not privileged according to EC investigations are communications between companies in-house counsel, notes prepared by in-house counsel, requests from the company or an in-house lawyer to professional advisors for information or advice, other than an external lawyer qualified to practice in the EEA, and the preparation of internal reports by the company or an in-house lawyer of advice received by professional advisors, other than an external lawyer qualified to practice in the EEA. Under EC law, legal privilege is only available to independent lawyers.

France does not consider company lawyers to be independent enough to qualify for membership in a bar association, so privilege is not extended to in-house counsel. (Pratt) This reduces the amount and quality of legal advice from attorneys to corporations, which may create issues for these businesses.

When the European Court of Justice was deciding whether to allow in-house counsel in the EC to exercise the attorney-client privilege, ECJ, looked at the laws in its Member States and decided that in-house counsel should not be given the privilege that is given to independent attorneys in the EC. The decision was based on the assumption that once attorneys are employed by a corporation, they cannot ever be independent. This assumption was the basis for the decision of several countries of the EC not to permit attorneys who became employees to remain members of the bar.

Attorney-client privilege is not specifically granted by the laws of the EC, but the ECJ decided in the court case, *AM & S v. Commission*, that in certain situations privilege does exist. This case was the first opportunity ECJ had to investigate the attorney-client

privilege for attorneys in the EC. The case was appealed from a decision by the Commission of the European Communities, which demanded AM & S to turn documents over to the Commission. The attorneys for AM & S did not give the Commission the documents they asked for because they argued that the documents are protected. Some of the documents involved in the case were prepared by in-house counsel and some were prepared by attorneys in private practice. Under Article (3) of Regulation 17, the Commission decided that AM & S had to turn over all the documents.

AM & S still refused to turn over the documents to the Commission and brought suit against the Commission to the ECJ. There were different types of documents in question, such as documents requesting advice, documents giving advice and documents which summarized advice. AM & S received support from the government of the UK and the Consultative Committee of the Bars and Laws Societies of the European Community. The French Republic also intervened, but on behalf of the EC. The parties all agreed that legal privilege existed in the EC, so the case will determine what procedure should be used to decide whether a certain document is covered by privilege.

The UK suggested a system that would give the ECJ the authority to make a final determination if the parties could not reach an agreement. The CCBE argued that the EC, just like all member states, already recognize legal privilege, and they claimed that legal privilege was a 'practical guarantee of fundamental, constitutional or human rights.' The EC argued that legal privilege was important, but it was not an existing principle of Community law, and that the evidence needed by AM & S was relevant evidence needed by the court. France argued that Community law did not provide legal privilege for documents between an attorney and a client, whether the attorney is in-house or not, and

that attorney-client privilege was not a common principle to the laws of all the member states, and that making of legal privilege available in community law would frustrate the ability of the EC to exercise Regulation No. 17.

The ECJ realized that legal privilege existed in all Member States, which meant it had to be recognized in EC law. The EC, accepting attorney-client privilege, recognized the significance in the freedom of legal consultation. However, legal privilege for in-house counsel was not included. Many of EC's member states not recognizing in-house counsel as members of the legal profession and not allowing them to be members of the bar was an influential factor when the EC was deciding on the outcome of this case.

The ECJ reviewed the legal systems of the member states to discover which communications between clients and their attorneys were covered by legal privilege. "Since the aim of Community law is to find the best solution having regard to national laws, it is necessary to examine the spirit, orientation and general tendency of the national laws on legal privilege." (Hill, 1995) A two-part test was created to determine if a document could be available for legal privilege. Attorney-client privilege is available only for written communications that would occur after an administrative procedure, and the attorney must be independent. (Hill, 1995)

Canada

Bijuralism is the interaction between different legal traditions. In a Canadian context, we can examine the interaction of civil and common law. The existence of two legal systems may be explained by history and by the colonization of America by the English and the French. The colony was first subjected to French law, then, following the British victory in 1759, to the English common law. (Seguin, 2001)

The preservation of bijuralism continued as the Quebec Act and a division of legislative powers provided for by the Canadian Constitution of 1867. The Quebec Act applied French law to matters of property and civil rights and English law to matters of public and criminal law. The British North America Act divided legislative powers between the federal government and those of the provinces. Subsection 92(13) allowed for continued national legal duality by providing that property and civil rights would be under provincial jurisdiction. Quebec was thus able to preserve its civil law and the other provinces their common law. While having a civil law system, Quebec's private law differs from French law and has original rules that are based on common law. "...Common law thus plays a very great role in Quebec private law in both formal and substantive terms. The form of judgments, for example, reveals a very clear relationship with common law. Case law illustrates the mixed nature of Quebec law—the task of Quebec judges, as civil law judges, is not to restate a rule established by a court based on the facts before them. Like French judges, they apply an abstract rule to specific facts. Unlike French judges, Quebec judges, like common law judges, explain their reasoning. They generally proceed with a detailed analysis of the rule, of previously applied judgments and of the relevant doctrine, then set out the reasons leading them to apply the rule to the facts before them." (Seguin, 2001) In Quebec, courts recognize legal privilege as shown in Article 9 of the Quebec Charter. "Every person has a right to non-disclosure of confidential information. No person bound to professional secrecy by law and no priest or other minister of religion may, even in judicial proceedings, disclose confidential information revealed to him by reason of his position or profession, unless he is authorized to do so by the person who confided such information to him or by an

express provision of law. The tribunal must, *ex officio*, ensure that professional secrecy is respected.” (Article 9, Quebec Chapter)

Similar to Quebec, Louisiana, a state in the United States preserved civil law. Louisiana is the only state in the United States with a civil law system. Louisiana was also subject to French law due to colonization. Spain acquired Louisiana in 1762 and imposed its law a few years later. In 1800, Spain ceded the territory back to France, but the French allowed the continuation of Spanish law in the territory. The French sold Louisiana to the United States in 1803, and Congress did not impose common law in Louisiana. In 1812, Louisiana became a state and Congress lost the power to impose common law. Louisiana’s constitution states how unwritten law is not adopted in the state, excluding common law. (Seguin, 2001)

Louisiana’s legal system is a combination of both civil and common law, as the state’s criminal, administrative, and civil procedure law is consistent with the rest of the United States, but private law is based on Roman/French/Spanish law. Therefore, the United States can also be considered a bijural country, as it is similar to Canada. Quebec, like Louisiana, has civil and common law influences. (Seguin, 2001) The Crimes Act of 1804 allowed application of common law principles in criminal cases in Louisiana and courts have also followed common law in recognizing legal privilege. (Cook, 1957) Both Quebec and Louisiana provide attorney-client privilege.

The Supreme Court of Canada often adopts a comparative method, drawing at times on the civil law in a common law context. In the past few decades, the Supreme Court of Canada has greatly strengthened solicitor-client privilege, making it into a constitutional law. Between 1999 and 2002, Canada decided on five cases regarding

privilege. In Canada, legal privilege applies to communications between a lawyer and their client. In the United States, this is known as attorney client privilege, but in Canada it is called solicitor-client privilege.

Legal privilege in Canada and the United States function similarly as the basic test of solicitor-client privilege in Canada is the same as the test in the United States. In 1927, the Supreme Court of Canada adopted Wigmore’s classic definition of legal privilege, and Wigmore’s formulation is still the working definition of privilege today. Solicitor client privilege applies to all oral and written communications between an attorney and a client, the seeking or giving of legal advice, and are intended to be made in confidence.

In the case *R v Campbell* (1999), the Supreme Court of Canada declared support for in-house counsel having legal privilege, but they cannot use this privilege over non-legal advice, like giving business advice to a client. In-house counsel still must be careful when applying legal privilege because courts often find that in-house counsel provides non-legal business advice to their corporations. Corporations having external counsel when discussing sensitive matters is wise, as Canada does not offer the same legal privilege the United States gives to in-house counsel.

Saudi Arabia

In Saudi Arabia, Islamic law is constitutionally the law of the land. The majority of people in Saudi Arabia value their religion and want Islam to guide them in their legal and social lives. Saudi Arabia accepts only the Quran and Sunnah as legitimate sources of Islamic law, rejecting Ijma and Qiyas. All legislative acts in Saudi Arabia must align with the principles of Islam, the Quran, and the Sunnah. The king does not have the right to

legislate unless he is applying the Sharia. The Sharia is the merging of religious and social duties, matters of ritual and devotion, and legal and moral obligations.

French laws influenced and spread in the Middle East before the emergence of the Kingdom of Saudi Arabia. The Middle East has a history of influence from Roman law, as Napoleon occupied Egypt and as French mandates were created in Syria and Lebanon. The French codified system of law was very adaptable to existing Islamic law, as it spread throughout the Middle East. (Aldarbas, 2015) There is profound French influence in Saudi law, except for personal family law which remains strictly Islamic, and has not been reformed over time.

Much of this influence has come from Egypt, as Egypt has a long history with France and their civil system. Egypt's legal contributions helped unify the Kingdom of Saudi Arabia. Examples of Egypt's legal contributions to Saudi Arabia can be seen in regulations. In 1966, the Kingdom Royal Decree No. M-6 was identical to the Egyptian bid regulations from the year of 1957. Egypt translated this statute from French regulations from 1953.

The separation of administrative functions established in Saudi Arabia is strikingly similar to how French law separates public and private law. Although the rules that come from the Quran and the Sunnah cannot be altered, the King has broad powers of administration under the principle of public interest and rectification of abuse, which are the principles found in French jurisprudence.

Public interest is one of the most important principles of the Islamic doctrine, which is why lawyers especially, are committed to serving this principle and promoting justice in Saudi Arabia. The Code of Law Practice lists the requirements for the practice

of law, and article 11 states "In respect of confidentiality, the provisions of the Basic Law on rights and obligations assert that the state must safeguard human rights in conformity with Islamic law". This is different from the way lawyers in other jurisdictions are expected to work, as they are expected to serve only their client's interest, and they do not have to worry about collective interest.

Code of Law Practice restricts an attorney from divulging any secret information entrusted with others being aware of his profession, even after the ending of his power of attorney, unless or until this violates the principles of Islamic Law. (Article 23) If a client violates the rules of Islamic law, legal privilege would be out of the question, and the attorney must report the actions. The lawyer has the authority to report the client's actions, no matter how ridiculous they are and it is up to the Saudi courts to determine whether the client's actions violated Islamic law or not. This can cause inconsistencies in Saudi Arabia's implementation of the law.

The general jurisdiction in Saudi Arabia is held by traditionally trained judges. They heavily implement Islamic principles in their decision process, as they have undergone traditional Islamic legal learning. Similarly, lawyers in Saudi Arabia must have a degree from a Sharia school or a bachelor's degree in law from a Saudi university or an equivalent degree from abroad. There aren't any exams to practice law in Saudi Arabia, but applicants must have at least one to three years of experience in the legal field. Article 3 of the Code of Law Practice lists more requirements, including the ones just mentioned. Article 3 states that "A person who practices law shall have his name included in the list of practicing lawyers, and shall satisfy the following requirements: (a) He must be a Saudi national. However, a non-Saudi shall be entitled to practice law

subject to the terms of agreements concluded between the Kingdom and other countries.

(b) He must be a holder of a degree from a Shariah college or a Bachelor of Law from one of the Kingdom's universities or an equivalent of any of these degrees obtained from abroad, or a post-graduate diploma of legal studies from the Institute of Public Administration. (c) He must have at least three years of practical legal experience. This period may be reduced to one year for a holder of a Master's degree in Shariah or in law, or an equivalent of any of these degrees, or a post-graduate diploma in law for the graduates of a Shariah college. This requirement shall not apply to a holder of a doctorate in these fields of specialization. (d) He must be of good conduct and not under interdiction. (e) He must not have been subjected to any hadd (Qur'anic prescribed punishment) or any other sentence in connection with a crime that impugns integrity, except where a minimum period of five years has expired since execution of that sentence. (f) He must be a resident of the Kingdom."

Additionally, only Saudi nationals were given the ability to practice law, unless non-Saudis receive permission from the Kingdom, but there has been a recent change. "...The Code of Law Practice has been amended by Royal order no. M\66. in 2021 with a view to enabling non-Saudi attorneys to practice in the Kingdom and provide them with a minimum level of service and professionalism similar to that which they would relish in the common law of the respective jurisdiction." Individuals practicing law in Saudi Arabia must display good conduct and be residents of the Kingdom. It seems like Saudi Arabia only wants traditionally trained individuals to practice law, in order to ensure the implementation of Islam in legal affairs.

In Saudi Arabia, legal privilege does not apply to in-house counsel. However, it is customary duty to keep the secrets of employers. If employees spread information that has been trusted to them by their employer, they may be subject to criminal liability.

Comparison

In-house Counsel

The lack of in-house counsel privilege in all the countries I studied was the main difference in legal privilege when compared to the United States. I expected that community law would have a greater impact on laws in member states, but not the contrary. I did not expect the EC to look to member states when making a decision for the AM & S case. The EC does not have an impact on attorney-client privilege in France, but when further examining in-house counsel we can see that there are many reasons why in-house counsel privilege should and should not be available, and why some countries choose to provide privilege.

One of the reasons why in-house privilege should not be available is because in-house counsel work for corporations where they might be more inclined to be corrupt as there is corporate pressure. The second reason is that it is hard to determine whether a communication is legal or business and whether privilege should apply because in-house counsel is incredibly involved in all the company affairs. Courts in the United States have dealt with this issue before, and it seems like they were successful in the distinction between legal and non-legal advice in order to prevent the availability of legal privilege in erroneous circumstances. (Hill, 1995)

There are also a few advantages of having in-house counsel privilege available.

Since in-house counsel are dependent lawyers, they may be more successful in

encouraging ethical behavior by the client and the administration of justice as they have more influence over who is in charge in the company. In-house counsel is very involved in the affairs of their corporation, and due to this relationship between the corporation, and in-house counsel, the corporation will be more trusting with their own lawyer, rather than an independent lawyer. In-house counsel needs to ensure that their company is as profitable as possible, but an attorney cannot cause their client to act unlawfully, and in-house counsel are in a special position because they have more power to influence lawful behavior. In the United States, we can see that in-house counsel has been trying to influence ethical behavior. This can be proved by the amount of “whistleblower cases” that have been brought in the United States due to in-house counsel being fired for refusing to violate the law. (Hill, 1995)

The EC was made to help member states develop, both socially and economically. However, when making a decision in AM & S, the EC did not show enough concern with the impacts of not having legal privilege available for in-house counsel on relations with foreign countries and their corporations. The United States and Europe have a great relationship, as their markets grow more interdependent. With this level of growth, it is inevitable that lawyers will be needed, and the EC should give their in-house counsel the same privileges the U.S. gives their in-house counsel, as they are treaty partners. This will help avoid conflicts, as other countries will not be suspicious when dealing with EC companies, thinking that their confidentiality will be breached.

Corporations are always trying to find new strategies to cut costs, so they can make a substantial profit. As mentioned, in-house counsel is very involved in the affairs of their corporation, so they are aware of certain policies within the corporations or the

people working there. This is why hiring in-house counsel, who are then helped by outside legal experts, is the most efficient for companies. Hiring in-house counsel often leads to faster and it is financially smart. “These protections for corporations may be less well-developed in other countries, in part, because of an absence of perceived need for such protection by an artificial agency in light of a traditional reluctance to hold corporate entities criminally liable; an approach quite different from America's voracious appetite to prosecute corporations for their employees' misdeeds.” (Anello, 2008) Most foreign jurisdictions do not have privilege available for in-house counsel, but the United States does provide legal privilege for in-house counsel because the U.S. places more significance in the corporate world compared to other countries. Canada offers limited legal privilege to in-house counsel, as courts in Canada do not apply legal privilege to internal counsel when they are not solely giving legal advice.

Saudi Arabia

As Saudi Arabia is the most traditionalist Islamic system in the world, I expected many differences. However, Saudi Arabia’s legal privilege is quite comparable to the legal privilege available in many other jurisdictions across the globe. Although their legal privilege is quite similar to attorney-client privilege in other countries, Saudi Arabia has absurd requirements to practice law that none of the other country in this study possessed.

One of the main examples of this is the requirement to be a Saudi national in order to practice law. Non-Saudi individuals have to be approved by the kingdom, and it seems like the Saudi government only trusts nationals to uphold and apply Islamic principles to law. It was only until 2021, when the Code of Law Practice was amended to include non-Saudis.

Being an attorney or practicing law in Saudi Arabia is quite different as they are obligated to think about the common good of their country, rather than solely being concerned about their client, like in most jurisdictions. This requirement of attorneys and valuing public interests derives from Islamic principles. Attorneys also have the authority to report their clients if they violate the rules of Islamic law. Islamic principles are always going to play a substantial role in Saudi law.

Origins of Legal Privilege

The prehistory of the law of privilege traces its origins back to the Roman Republic and Empire and was later developed in the common law system of England. Since civil law is inspired by the Roman code system and common law has a long history of attorney-client privilege, we can understand why the United States, France, Canada, and Saudi Arabia all have some form of attorney-client privilege. The United States adopted common law from the English shortly after the American Revolution. The Roman code system was altered and was incorporated into French law. Canada's law was influenced by both common and civil law due to occupation by both the French and the English, and Saudi Arabia was influenced by French law with the help of legal contributions from Egypt. All these influences cause similar ethic rules across the globe.

Conclusion

It is surprising how Saudi Arabia was never occupied by Europeans but has been influenced by French law. Saudi Arabia took advantage of its neighboring countries, as Egypt transmitted most of its legal expertise, and filled in the voids left by Islamic law while always conforming to the Sharia. French law has greatly influenced the laws in Saudi Arabia, except for personal family law which remains strictly Islamic. This

influence may be the explanation to why legal privilege in Saudi Arabia is quite similar to the other countries in my study.

However, typically only Saudi nationals, who undergo traditional Islamic training are trusted with legal privilege. It was only until 2021, when the Code of Law Practice was amended to include non-Saudis, and they are allowed to practice law in Saudi Arabia, after approval from the Kingdom. The general jurisdiction in Saudi Arabia is held by traditionally trained judges and they implement Islamic principles in their decision process. Similarly, lawyers in Saudi Arabia must have a degree from a Sharia school or a bachelor's degree in law from a Saudi university.

One of the three components of all legal systems is culture. The varying values and attitudes around the globe create diverse legal systems. The cultural component also entails the training of lawyers and judges. With the majority of Saudis valuing Islam and its principles, it is evident that religion will preserve its force in Saudi law. The cultural component of legal systems has the most impact on attorney-client privilege in Saudi Arabia. Lawyers in Saudi Arabia are also obligated to report their clients if they violate any Islamic law principle. Since lawyers have the ability to report to their clients, it may cause them to charge their clients more, or exploitation.

In most jurisdictions, in-house counsel privilege is not available, but it is available in the United States and loosely in Canada, which is one of the reasons why I believed that the common law jurisdictions would ultimately have stronger attorney-client privilege. The focus is more on the attorney in common law jurisdictions. Although Canada only permits limited legal privilege for in-house counsel, we can still argue that both of the countries that incorporate a common law system, recognize some sort of legal

privilege for in-house counsel. Civil law countries, especially the EU, should reconsider making privilege available for in-house counsel.

The decision to not grant in-house counsel in the case *AM & S v Commission*, was based on the argument that in-house counsel are too involved in their corporations and cannot maintain independence. Some member states allow in-house counsel to be members of the bar, and they are bound by the same rules and responsibilities that independent attorneys have. In-house lawyers that are members of the bar in their countries will face difficulties if their country's court case is handled in national courts, and countries that provide legal privilege for in-house counsel are being asked to exclude this privilege for internal counsel.

Just as the courts of Saudi Arabia are subordinate to the Sharia, in socialist law, the legal system found in Russia and China, the courts do not have a strong role in lawmaking, as they are subordinate to the legislature. Similarly, attorneys in Saudi Arabia, Russia, and China are subordinate to the state. In the 1980's, China enacted the first laws in relation to legal privilege. The new legislation required attorneys to keep state secrets and private matters a secret, and there was nothing regarding the confidentiality between an attorney and their client. It was amended in 1996 to include commercial secrets and confidential client information. However, the most notable change happened between 2007 and 2008 as the new law required attorneys not to disclose information where the client has made known a desire to keep private. (Christensen, 2012)

Even after all these changes, attorney-client privilege in China, is still not strong, and due to this subordination to their state, the likelihood of there being a relationship

between attorney-client and legal systems increases. The legal systems found in these countries do not allow their attorneys to fully commit to their client, so we expect that attorney-client privilege will be much weaker in these jurisdictions. Since these countries have similar goals, they also have similar goals.

Due to the origins of attorney-client privilege tracing back to Rome and the development of legal privilege occurring in English common law, we can understand how many jurisdictions have similar legal privilege principles, as the majority of the jurisdictions across the globe have been influenced by common or civil law. The countries in this study have all been influenced by systems that encouraged attorney-client privilege. As more similarities regarding legal privilege across the globe were found than expected, I can partially confirm my hypothesis/argument.

Partially confirming my null hypothesis, that there is no relationship between attorney-client privilege and legal systems, means that I found some differences in legal privilege that may be caused by the varying legal systems, but the findings did not show a significant correlation. The relationship between attorney-client privilege and legal systems is moderate. The main difference in legal privilege is the lack of in-house counsel privilege in France and Saudi Arabia. The jurisdictions that incorporate common law, Canada and the United States, offer in-house counsel, unlike the other jurisdictions in this study, which incorporate civil law. Common law jurisdictions are more likely to offer in-house counsel. This can also be demonstrated in the court case *AM & S v Commission*, as the UK, being a common law jurisdiction, was in favor of in-house counsel privilege. Besides the different attitudes towards internal counsel, Saudi Arabia

can be considered an anomaly in this study due to its complexities and its Code of Law Practice mirrors the principles of Islamic law.

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Matsumoto
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Introduction to Monodentate and Bidentate N-heterocyclic Carbene Ligands

N-heterocyclic carbenes (NHCs) are five membered rings that have a carbene located between two nitrogen atoms (Figure 1). A carbene contains a sp^2 -hybridized carbon atom which only has 6 valence electrons.¹ NHC ligands were chosen for this project of synthesizing novel cobalt complexes due to the stability from the “push-pull” effect and flexible nature of the ligand. They are stabilized by the negative inductive effect (push) and the positive mesomeric effect (pull). The push effect occurs because of the lone pairs from the nitrogen atoms allowing the delocalization and π -donation into the vacant p-orbital. The pull effect is due to the withdrawal of the electron density at the carbene center, stabilizing the σ orbital. Both nitrogen atoms contribute equally to this effect, enhancing the stability of NHCs. NHCs are also versatile as most substituents can be bound to the nitrogen atoms, leaving much room for experimental design.²

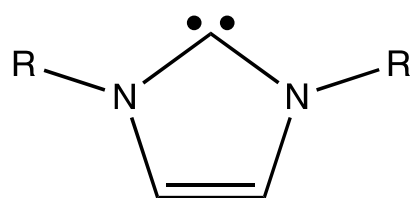


Figure 1. Structure of *N*-heterocyclic carbene

When little was known about NHCs, they were considered to be phosphine ligand alternatives as neutral two-electron ligands and was thought to be significantly less convenient as phosphines are commercially available.³ There has been an increase in preference for NHCs as they exhibit a highly directional sp^2 -type lone pair, allowing the NHCs to form stronger σ bonds with a wider range of transition metals.⁴ This was reflected by the larger proton affinities found in NHCs compared to phosphines.⁵ The strong σ bonds produce a complex that is stable towards air and moisture as it makes it less difficult to degrade.² NHCs are also more reactive compared to phosphines as they have the ability get be involved in ligand modification at the metal

coordination sphere.⁶ NHCs play a key role in palladium catalyzed cross coupling reactions and ruthenium-based olefin metathesis catalyst.^{3,7} The utility of NHC cobalt complexes has expanded to a wide variety of catalytic reactions like cross-coupling and hydrogenation after the first NHC cobalt complex was reported by Lappert and Pye in 1977.^{8,9}

Bidentate NHC ligands have two NHCs that offer additional stability as a result of the chelate effect which is the greater affinity of chelating ligands for a metal ion compared to nonchelating ligands, like monodentate, for the same metal. Bidentate NHCs exhibit unique structural and electronic properties in addition to the high degree of modularity seen with NHC ligands.¹⁰ These characteristics make them ideal candidates for chelate rings, allowing for captivating reactivity with a variety of transition metal-mediated reactions.¹⁰ In a study of synthesizing bidentate NHC palladium complexes for catalysis, theoretical calculations found that specific bidentate chelating ligands could favor oxidative-addition reactions and increase the stability of the catalyst. A preliminary catalytic study showed that palladium complexes were effective for C-N coupling reactions, aligning with the proposed theory of stabilization.¹¹ Wu and coworkers successfully synthesized bidentate NHC iron complexes as a pre-catalyst for homogenous coupling of Grignard reagents.¹² Novel self-isomerized cyclometalated bidentate NHC rhodium complexes were synthesized, characterized, and successfully applied to catalytic hydrosilylation of internal alkynes with exceptional performances, with conversions ranging from 66 to 100%.¹³

Topological and electronic properties such as steric hinderance and solubility of the complex can be altered in NHCs by modifying the wingtip, linkers, and backbone, as seen in Figure 2.¹⁴ By modifying the backbone and wingtip, stereoelectric properties of NHCs can be altered.² Poyatos and coworkers found that depending on the length of the linker and rigidity,

adding bulky ligands to the wingtip forces the ligand axis closer to the sterically crowded plane because the rotation of the metal to NHC bond is more restricted for chelate bidentate NHC complexes.¹⁵ Mata and coworkers concluded that longer linkers resulted in a weaker bonding between the 2 metal centers within the NHC rhodium complexes, resulting in an increased preference of the *meso* diastereomer.¹⁶ The length of the linker can also determine the orientation of the complexes. When synthesizing binuclear NHC ruthenium (II) complexes, Mercks and group found that with a short linker, like a methylene linker, the metal centers were electronically coupled.¹⁷ They were also able to find that increasing the number of CH₂ units in the linker and propylene or butylene linkers decreased the degree of coupling to the point.¹⁷ In this project, a xylyl linker (Figure 3) was utilized as it creates more space between the two carbenes, allowing for an aryl group to be added and generating a possibility for better crystallization.¹⁸



Figure 2. Alterations of topological and electronic properties by R groups

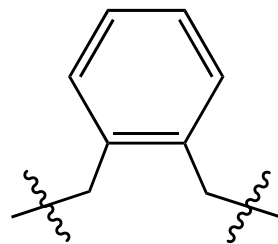


Figure 3. Structure of xylyl linker

In recent years, there have been major advances in the use of first-row transition metals in organic synthesis and catalysis. Most reactions rely on toxic, expensive, and less abundant noble metals like rhodium and iridium.^{13,19} With sustainable organic transformations gaining recognition, first row transition metals have been applied as they are much more abundant, far less expensive, and environmentally friendly. While there are many studies on first row transition metals for catalysis and synthesis utilizing bidentate NHC ligands, they are generally limited to nickel with a few examples of iron.

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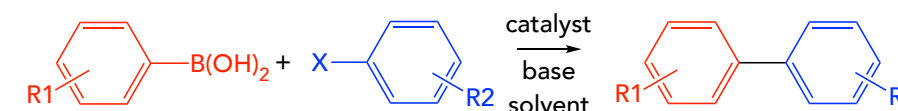
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Mendoza
Enner*Synthesis, Characterization, and Application of Ni(salophen)
Complexes in Suzuki-Miyaura Cross-Coupling

Dr. John

Background

Transition metal-catalyzed cross-coupling has proven to be a powerful tool in the synthesis of organic compounds by joining together complex molecules through the formation of carbon-carbon bonds. These molecular frameworks play an integral role in intermediate and key steps leading to the discovery and development of many novel pharmaceuticals, agrochemicals, and fine chemicals.^{1–4} Of the cross-coupling methods, the Suzuki-Miyaura cross-coupling reaction is the most prominent due to its effectiveness in joining aryl halides and aryl boronic acids to form bi-aryl compounds (Scheme 1).^{3,4} This method is favored for its mild reaction conditions, tolerance for the attached functional groups, and wide selection of boronic acids available for coupling.^{3,5,6}



Scheme 1 Suzuki-Miyaura cross-coupling reaction

The catalytic activity and selectivity of the complex used in this cross-coupling reaction is determined by the steric and electronic properties of the ligand attached to the metal (Figure 1).⁷ Phosphine ligands in combination with palladium are known to be the best ligand/metal system for the Suzuki cross-coupling as their properties are easily tuned by changing the properties of the groups attached to the phosphorous atom.^{6,7} However, the high costs of phosphines coupled with the use of a noble metal, palladium, make this ligand/metal system expensive and economically unviable.^{3,7,8} Furthermore, phosphines are sensitive to moisture and air, environmentally unfriendly, and have high toxicity.^{7,8} Additionally, the use of palladium catalysts in these cross-coupling reactions demands extensive purification to remove trace metal

impurities from the desired chemical product.⁶ Despite its proven success, the design of new ligands complexed with less expensive materials is of paramount importance to achieve sustainable means of production and reduce the environmental impact when implementing these methods in large-scale synthesis.

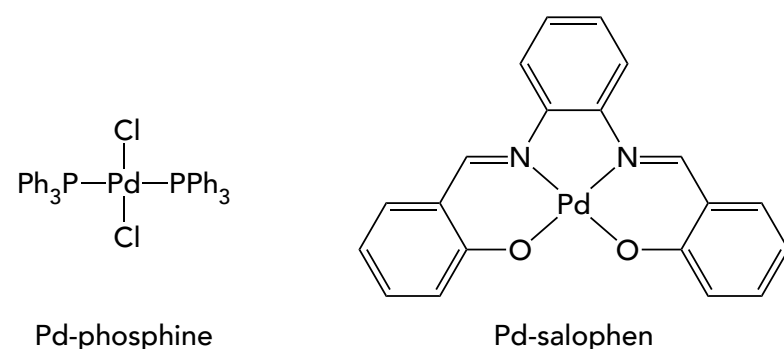


Figure 1 Comparison of a Pd-phosphine vs a Pd-salophen

The design of new efficient catalytic systems that addresses these drawbacks is an important area of research in organic chemistry. The design of efficient phosphine-free ligands toward the formation of carbon-carbon bonds has produced a significant amount of literature as researchers look for viable alternatives to phosphines.^{1,2,7} Schiff bases, which are characterized by an imine group with a carbon-nitrogen double bond, have been shown to have high conversion and selectivity for cross-coupling reactions.^{4,7,8} Similar to phosphines, the steric and electronic properties of Schiff bases can be easily tuned by selecting the appropriate aldehyde and amine to produce the desired characteristics.^{4,7} Unlike phosphines, however, Schiff bases are stable in moisture and air, are much easier to synthesize, and are less expensive due to the commercial availability of the starting materials.^{4,7,8} Furthermore, Schiff bases are able to stabilize metals in various oxidation states, giving them additional advantages over their phosphine counterparts.^{4,9}

Attention has been drawn toward first-row transition metals due to their greater earth abundance, making them cheaper to implement and much more sustainable when compared to noble metals.^{3,7,10} Ligands coordinated with earth-abundant nickel have shown high yields for the formation of bi-aryl products in the Suzuki-Miyaura cross-coupling reaction, and in some cases, perform better than the palladium-coordinated ligands.^{3,11–15} Due to its size, nickel is more nucleophilic than palladium and possesses Ni(0)/Ni(II) and Ni(I)/Ni(III) oxidation states, giving it unique characteristics that influence its catalytic behavior in the cross-coupling reaction.^{3,16} Although nickel ligand systems usually require a higher catalyst loading, their high earth abundance makes them more economical and environmentally friendly when compared to palladium. The challenge involves designing an earth-metal catalyst with high conversion and selectivity (avoids the formation of side products) that outweighs the cost of the additional catalyst loading. Through careful selection of the ligand properties, a balance may be found to achieve more sustainable means of production.^{6,10}

Objective

The goal of the project is to develop nickel complexes supported by salophen ligands for application in the Suzuki-Miyaura cross-coupling reaction. The hypothesis is that sterically and electronically modulated salophen ligands will allow modulation of the steric environment as well as the electron density at the nickel center to control reactivity and selectivity in the cross-coupling reaction. Specific aims include:

1. Synthesis and characterization of sterically and electronically modulated salophen ligands.
2. Synthesis and characterization of nickel salophen complexes.

- Evaluation of the reactivity and selectivity of nickel salophen complexes in the Suzuki-Miyaura cross-coupling reaction.
- Optimization of reaction conditions by testing a combination of different bases, solvents, temperatures, and catalyst loadings.
- Correlation of the reactivity of the nickel salophen complex with the steric and electronic effects of the salophen ligand.

Methodology

To test the hypothesis, various sterically and electronically modulated ligands will be synthesized (Figure 2). Salophen ligands, a class of Schiff bases, are easily synthesized by the reaction of a 1,2-phenylenediamine and a suitable salicylaldehyde (Scheme 2). A successful synthesis can be ascertained by using a variety of spectroscopic methods including IR and NMR spectroscopy. The steric and electronic effects of the ligand can be easily manipulated by selecting the appropriate diamine and salicylaldehyde derivatives, making it easy to tune the ligand properties through the addition of electron-donating and electron-withdrawing groups.^{7,9} These groups determine the activity and selectivity of the ligand system, making it a crucial step in the design of the catalyst.⁷ Nickel complexes will then be synthesized by the reaction of the salophen ligands with $\text{Ni}(\text{OAc})_2 \cdot 4 \text{H}_2\text{O}$ and characterized by NMR spectroscopy.

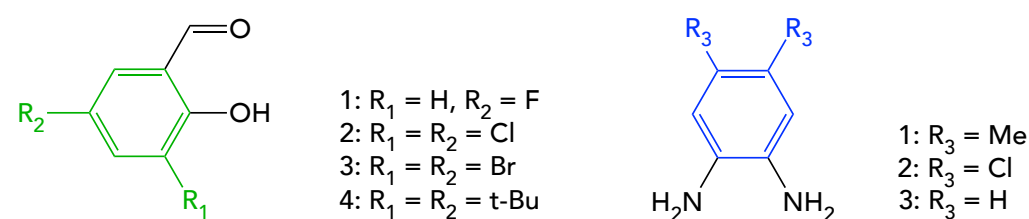
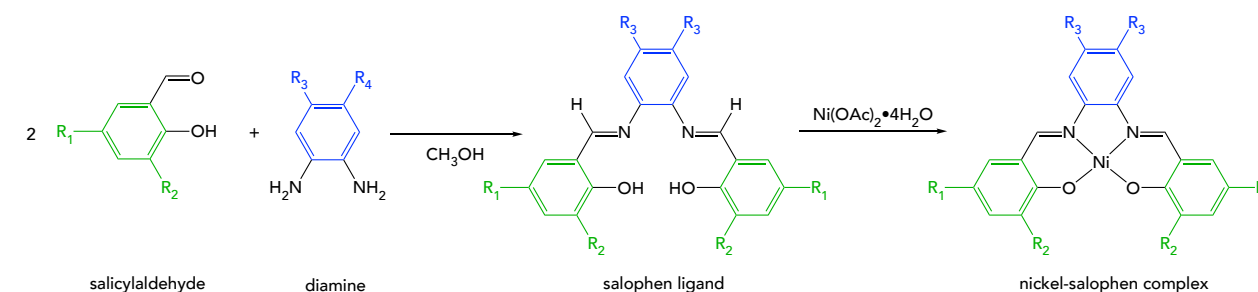
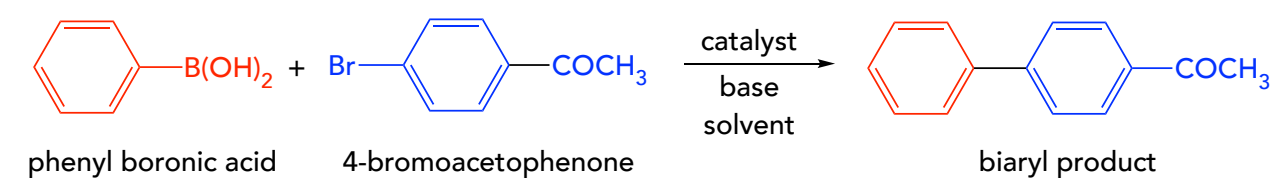


Figure 2 Selection of substituted phenylenediamines and salicylaldehydes



Scheme 2 Reaction scheme for the synthesis of salophen ligand and complexation with nickel

Upon successful synthesis, the nickel salophen complexes will be evaluated for their potential in the Suzuki-Miyaura reaction using phenylboronic acid and 4-bromoacetophenone as a model substrate (Scheme 3). A prominent feature of the Suzuki-Miyaura cross-coupling reaction is the catalyst regeneration at the end of the catalytic cycle.⁷ The pathway involves three steps, beginning with the oxidative addition of the aryl halide to the metal center.⁷ Transmetalation, the second step, is an exchange of the halide for an aryl group and is followed by the reductive elimination of the biaryl product and regeneration of the metal catalyst.⁷ It has been demonstrated that the electronic and steric properties of the ligand dictate the transmetalation and reductive elimination steps.⁷ Although the oxidative addition is governed by electronic factors, steric and electronic properties have been found to speed up both the oxidative addition and reductive elimination steps.^{6,7} The hypothesis is that electron-donating groups on the salicylaldehyde will facilitate oxidative addition while sterically bulky groups will promote reductive elimination.⁴



Scheme 3 Suzuki-Miyaura cross-coupling reaction using $\text{Ni}(\text{salophen})$

Optimization of the reaction conditions include choosing the appropriate solvent and base corresponding to the ligand system as both play a crucial role in the success of the cross-coupling. ^{4,5} In some cases, the base has been found to accelerate the transmetalation step which suggests that the catalyst performance can differ based on the selected base. ⁵ Common bases include Na_2CO_3 , $\text{Ba}(\text{OH})_2$, K_3PO_4 , Cs_2CO_3 , K_2CO_3 , TIOH , KF , and NaOH . ⁵ Where sterically demanding substrates are used, $\text{Ba}(\text{OH})_2$ and K_3PO_4 are used; for non-demanding substrates, Na_2CO_3 is the most common base. ⁵ Once optimal conditions have been identified, correlations will be made to establish structure-activity relationships. Additionally, the substrate scope will be expanded to establish the versatility of the catalytic reaction.

Results & Discussion

$\text{H}_2\text{salophen}$ I was synthesized by a reaction of 3,5-di-terbutyl-salicylaldehyde and 1,2-phenylenediamine with ethanol over reflux for 48 hours and $\text{H}_2\text{salophen}$ II was prepared by a reaction of 4,5-dichloro-*o*-phenylenediamine and 5-fluoro-salicylaldehyde with ethanol over reflux for 9 hours; both ligands were complexed with $\text{Ni}(\text{OAc})_2 \cdot 4\text{H}_2\text{O}$ yielding $\text{Ni}(\text{salophen})$ I and $\text{Ni}(\text{salophen})$ II in yields of 81.52 and 92.75%, respectively (Figure 3). A $\text{Pd}(\text{salophen})$ (Figure 3) was complexed using $\text{H}_2\text{salophen}$ I with $\text{PdCl}_2(\text{NCC}_6\text{H}_5)_2$ to replicate results by Liu in their Suzuki-Miyaura cross-coupling reaction of phenylboronic acid with a 4-bromoacetophenone which reported a 99% yield for the 4-acetyl-biphenyl (Scheme 3).

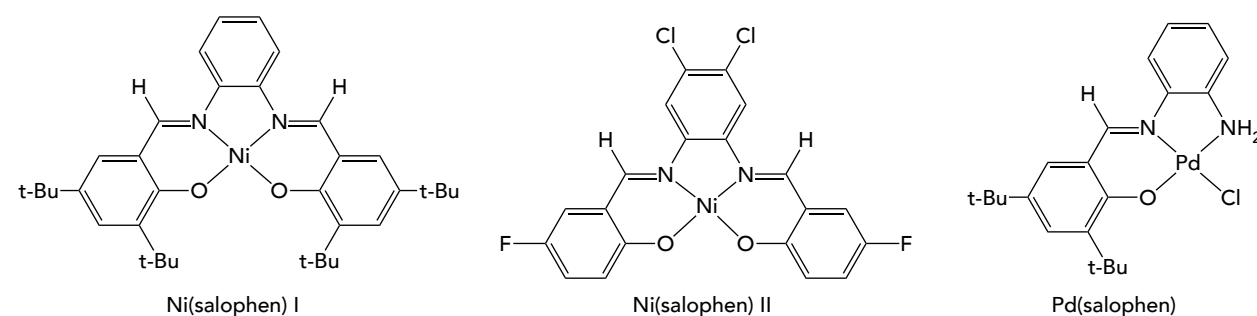


Figure 3 $\text{Ni}(\text{salophen})$ I, $\text{Ni}(\text{salophen})$ II, and $\text{Pd}(\text{salophen})$

$\text{Ni}(\text{salophen})$ II and $\text{Pd}(\text{salophen})$ were used in the Suzuki-Miyaura cross-coupling reaction with an ethanol solvent, K_3PO_4 base, at 60 °C. A 1 mol% catalyst loading was used for the $\text{Pd}(\text{salophen})$ and a 10 mol% for the $\text{Ni}(\text{salophen})$ II. The cross-coupling reactions were run for 24 hours, and the products were characterized by NMR spectroscopy. No internal standard was used as the studies being performed are preliminary. A reference NMR for 4-acetyl-biphenyl was obtained which identified the protons nearest the carbonyl to appear at 8 ppm. The NMR revealed the coupling product was obtained for the $\text{Pd}(\text{salophen})$, while the $\text{Ni}(\text{salophen})$ II showed no catalytic activity under those reaction conditions. Figure 4 displays the peak near 8 ppm for the $\text{Pd}(\text{salophen})$ (top) and the absence of the peak for the $\text{Ni}(\text{salophen})$ II (middle).

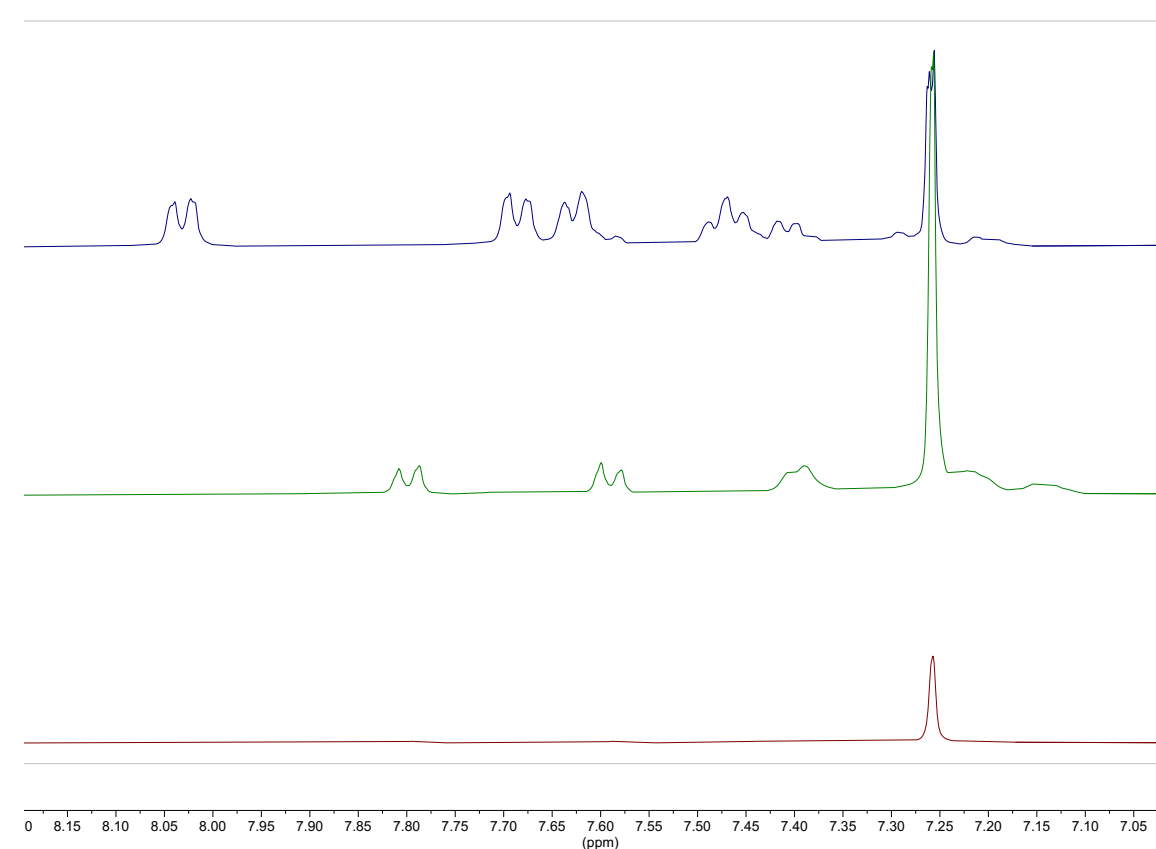


Figure 4 ^1H -NMR of Cross Coupling Products for $\text{Pd}(\text{salophen})$ (top), $\text{Ni}(\text{salophen})$ II at 60°C (middle), and $\text{Ni}(\text{salophen})$ II at 120°C (bottom) with K_3PO_4 base

The reaction time and temperature for the cross-coupling reaction for the Ni(salophen) II were increased to 48 hours and 120°C. The longer reaction time and higher temperature did not affect the catalytic activity of the complex as no peak appeared in the H-NMR (Figure 4, bottom).

Optimization of the complex for the Suzuki-Miyaura reaction began with selecting a solvent with a higher boiling point and lower polarity. DMF was selected as the solvent and a cross-coupling reaction was run at 145°C with a K₃PO₄ base for 24 hours using the Ni(salophen) II complex. H-NMR of the products revealed a peak near 8 ppm, indicating a yield of the 4-acetyl-biphenyl (Figure 5).

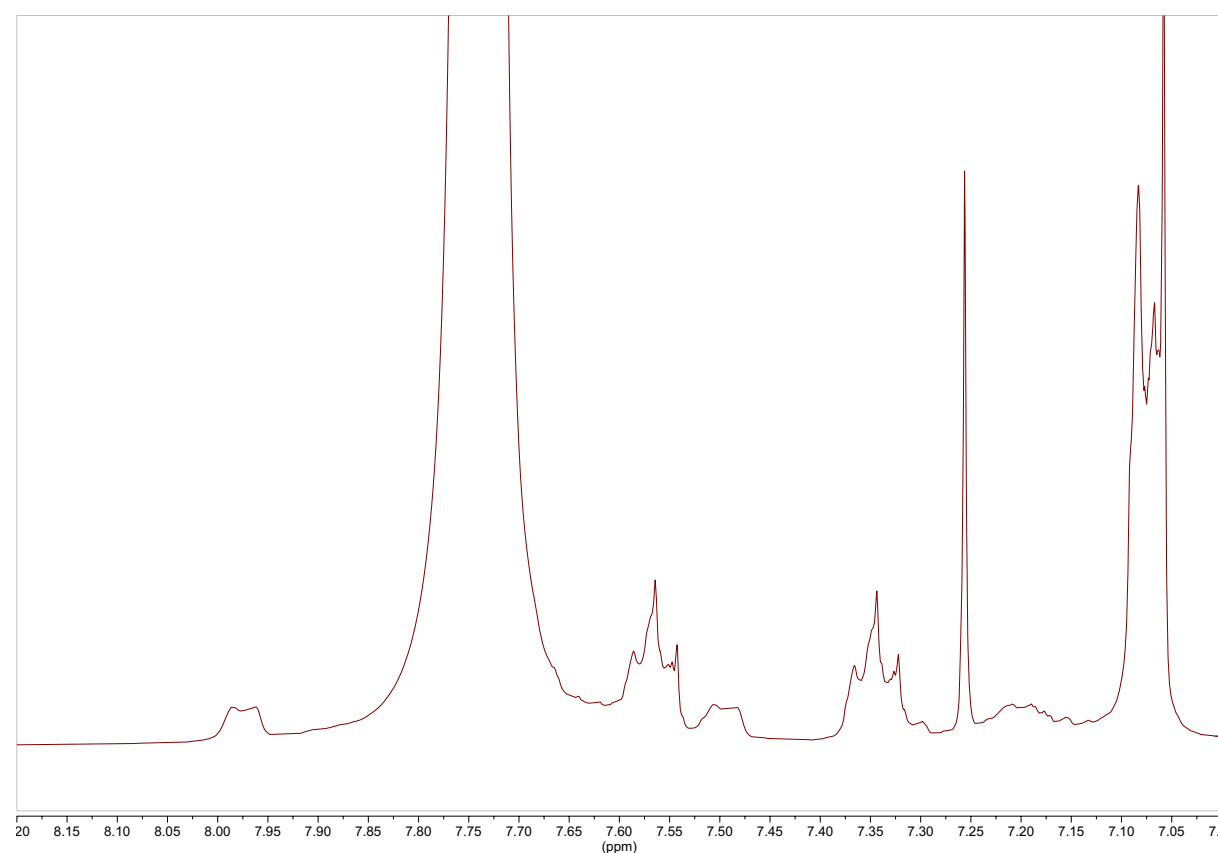


Figure 5 H-NMR of Cross Coupling Products for Ni(salophen) II at 145°C, DMF solvent, and K₃PO₄ base

The catalytic reaction using the Ni(salophen) II was performed again with the same reaction conditions (145°C, K₃PO₄ base, 24 hours) in DMF to confirm the previous findings. A second reaction was also performed in DMF/H₂O. The H-NMR revealed scrambled products and confirmation of a successful cross-coupling reaction could not be ascertained. The obtained products will be analyzed by gas chromatography to determine the components present.

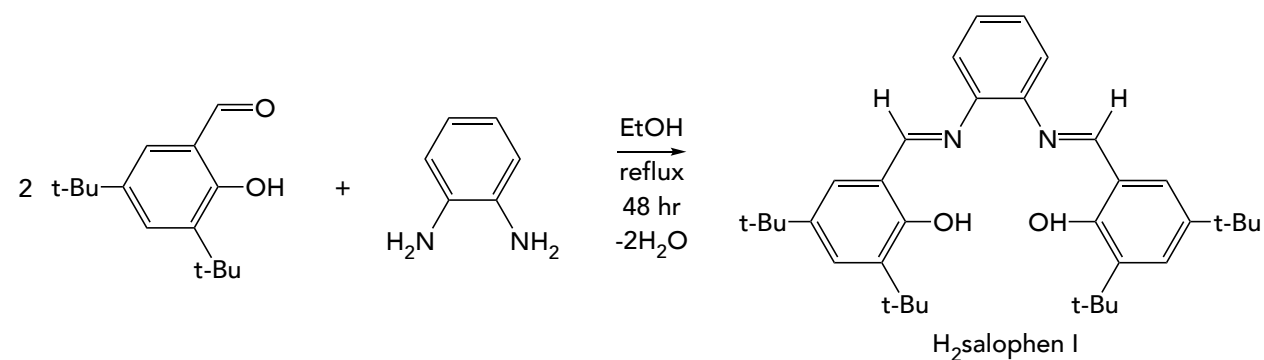
Conclusion

A novel Ni(salophen) complex featuring chloro- and fluoro- substituents was synthesized and characterized by H-NMR spectroscopy. The nickel complex showed some catalytic activity for the Suzuki-Miyaura cross-coupling reaction of a 4-bromoacetophenone and phenylboronic acid in DMF. The reaction conditions for the Suzuki-Miyaura require further optimization to determine the catalytic activity in the presence of different bases, solvents, and temperatures. Further analysis is required to ascertain the exact yields of the cross-coupling products achieved with the nickel catalyst through the addition of an internal standard.

The Ni(salophen) featuring di-tertbutyl-phenols has been characterized by H-NMR but has not been used for the catalytic reaction. Additional ligands and complexes will be synthesized to determine their catalytic activity and corresponding yields for the cross-coupling reaction. All complexes need to be characterized by C-NMR spectroscopy to ascertain the complexes used in the reaction. Upon gathering sufficient data, correlations could be made to determine the effects that electron-donating and electron-withdrawing groups have on both the steric and electronic properties of the ligand and how these affect the selectivity and reactivity of the complex in the Suzuki-Miyaura reaction.

Experimental Section

Synthesis of H₂salophen I



Scheme 4 Preparation of ligand I (H₂salophen I)

3.4734 g of 3,5-ditertbutylsalicylaldehyde (14.822 mmol) was placed in a round-bottom flask containing 0.8140 g (7.527 mmol) of 1,2-phenylenediamine and 25 mL of ethanol at room temperature. A stir bar was added to the flask and the solution was placed on reflux and plugged with N₂. After 48 h of reflux, the solution appeared bright yellow/orange. The solution was allowed to cool to room temperature and was then washed with cold ethanol and dried on a high-vac. A bright yellow solid was collected. Yield: 61.59% (1.96 g). C₃₆H₄₈N₂O₂ (*M* = 540.79). ¹H NMR (3500 MHz, cdcl₃) δ 13.50 (s, 2H), 8.64 (s, 2H), 7.42 (s, 2H), 7.34 – 7.27 (m, 2H), 7.26 – 7.17 (m, 4H), 1.41 (s, 18H), 1.30 (s, 18H) (Figure 2).

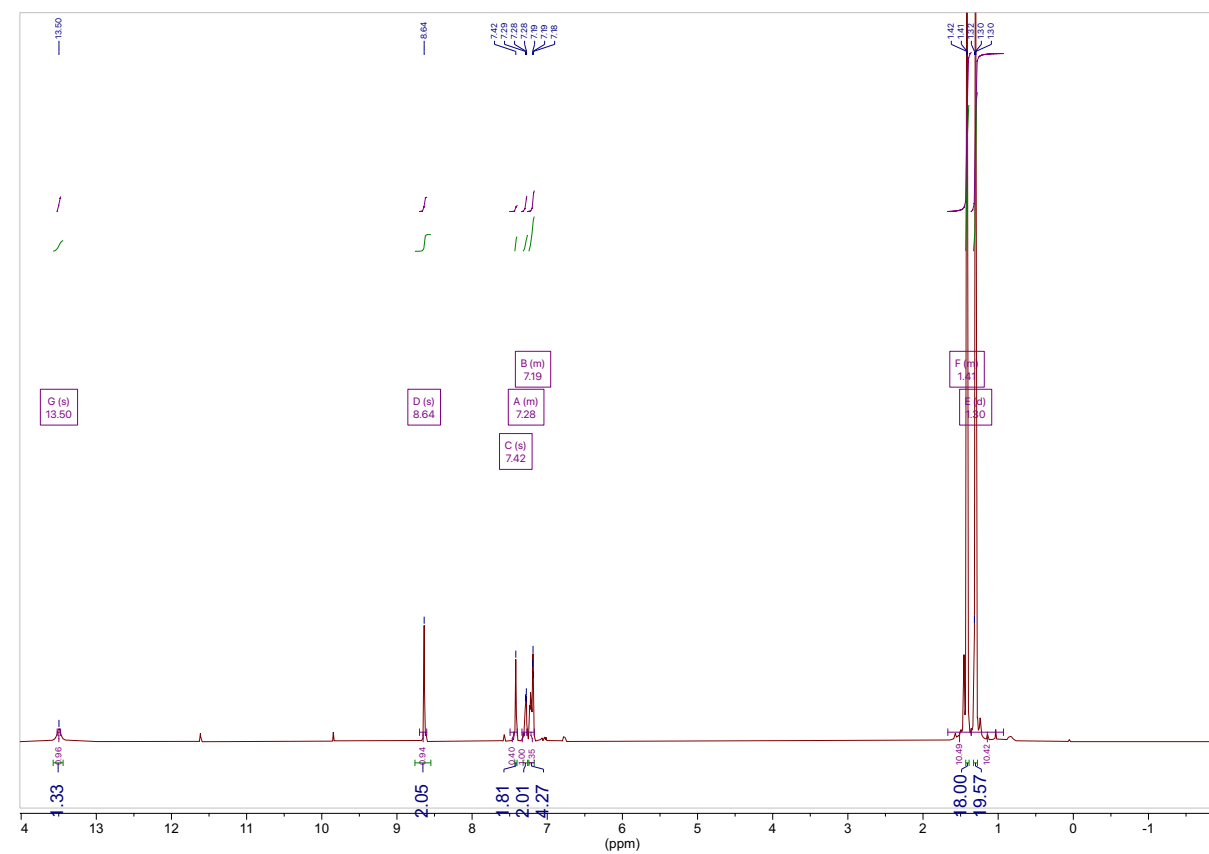


Figure 6 H-NMR of H₂salophen I

Complexation of Ni(salophen) I

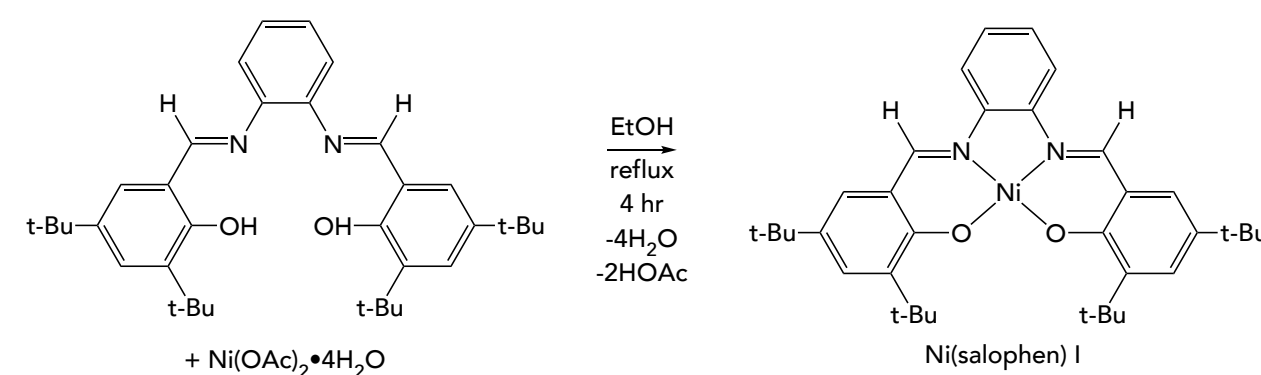


Figure 7 Complexation of nickel salophen I [Ni(salophen) I]

10 mL of ethanol and 0.1014 g (0.1875 mmol) of H₂salophen I ligand was added to a round bottom flask with a stir bar and placed on a heating mantle. An equivalent amount (0.0488g,

0.1961 mmol) of $\text{Ni}(\text{OAc})_2 \cdot 4\text{H}_2\text{O}$ was added to the mildly boiling solution and placed under reflux plugged with N_2 . Upon adding the acetate, the solution instantly turned maroon from dark yellow/orange. After 4 h, the solution was allowed to cool to room temperature, washed with cold ethanol and placed on a high-vac to dry. A dark purple precipitate was collected. Yield: 81.52% (0.0913 g). $\text{C}_{36}\text{H}_{46}\text{N}_2\text{NiO}_2$ ($M = 597.47$). $^1\text{H NMR}$ (300 MHz, cdCl_3) δ 8.23 (s, 2H), 7.70 (d, $J = 5.6$ Hz, 2H), 7.41 (s, 2H), 7.18 (d, $J = 5.4$ Hz, 2H), 7.09 (s, 2H), 1.47 (s, 18H), 1.31 (s, 18H) (Figure 4).

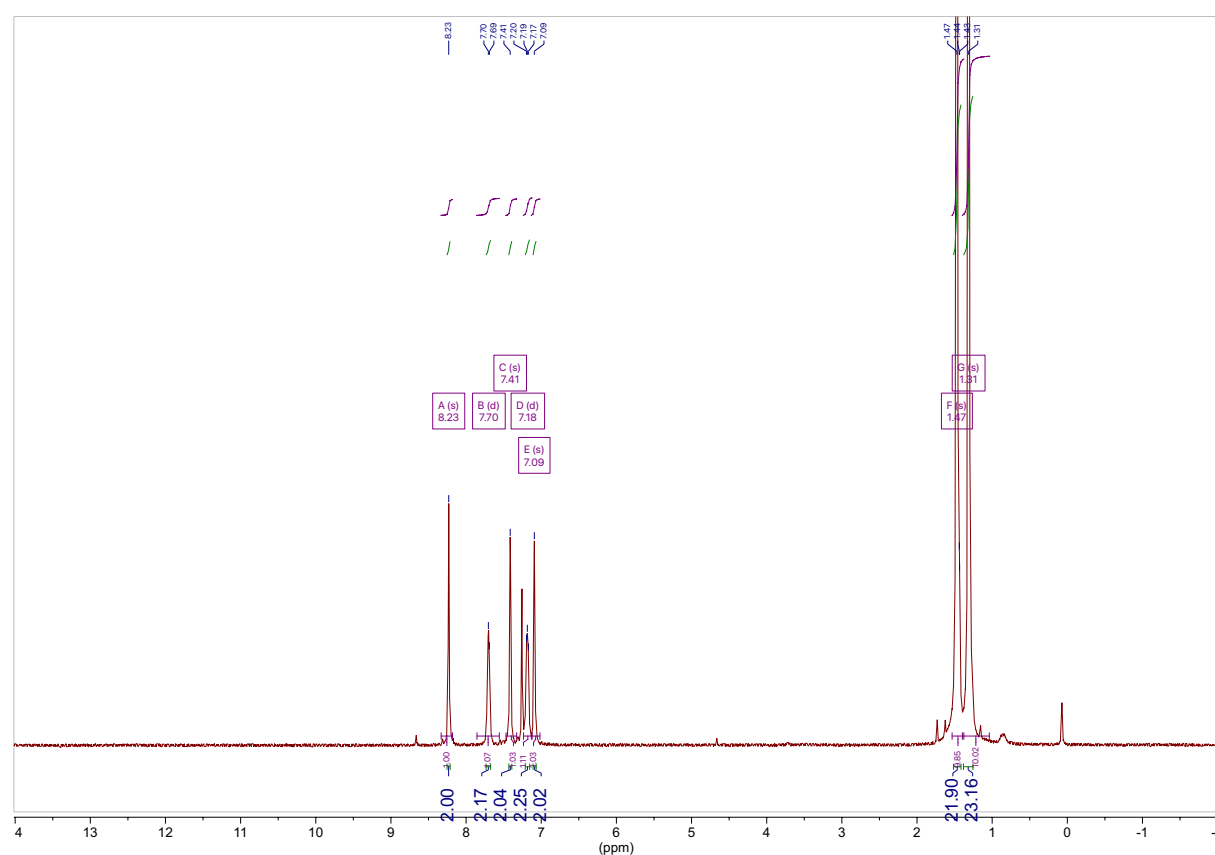


Figure 8 $^1\text{H-NMR}$ of $\text{Ni}(\text{salophen I})$

Synthesis of $\text{H}_2\text{salophen II}$

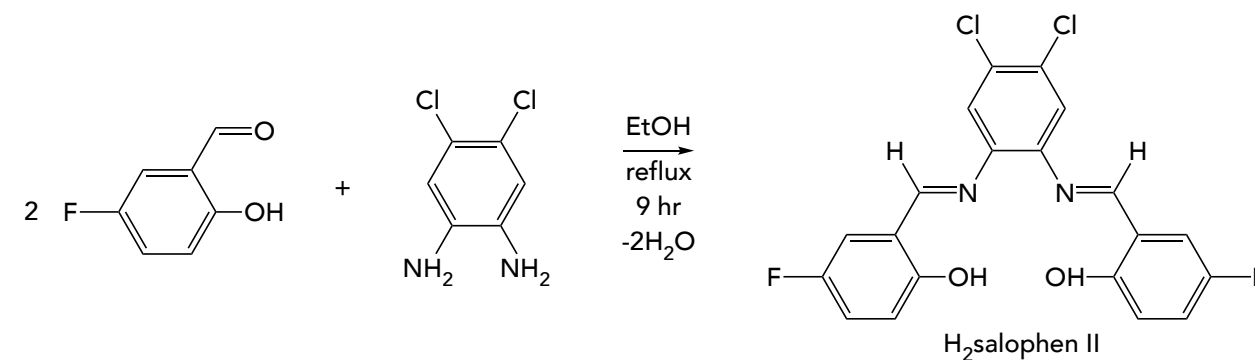
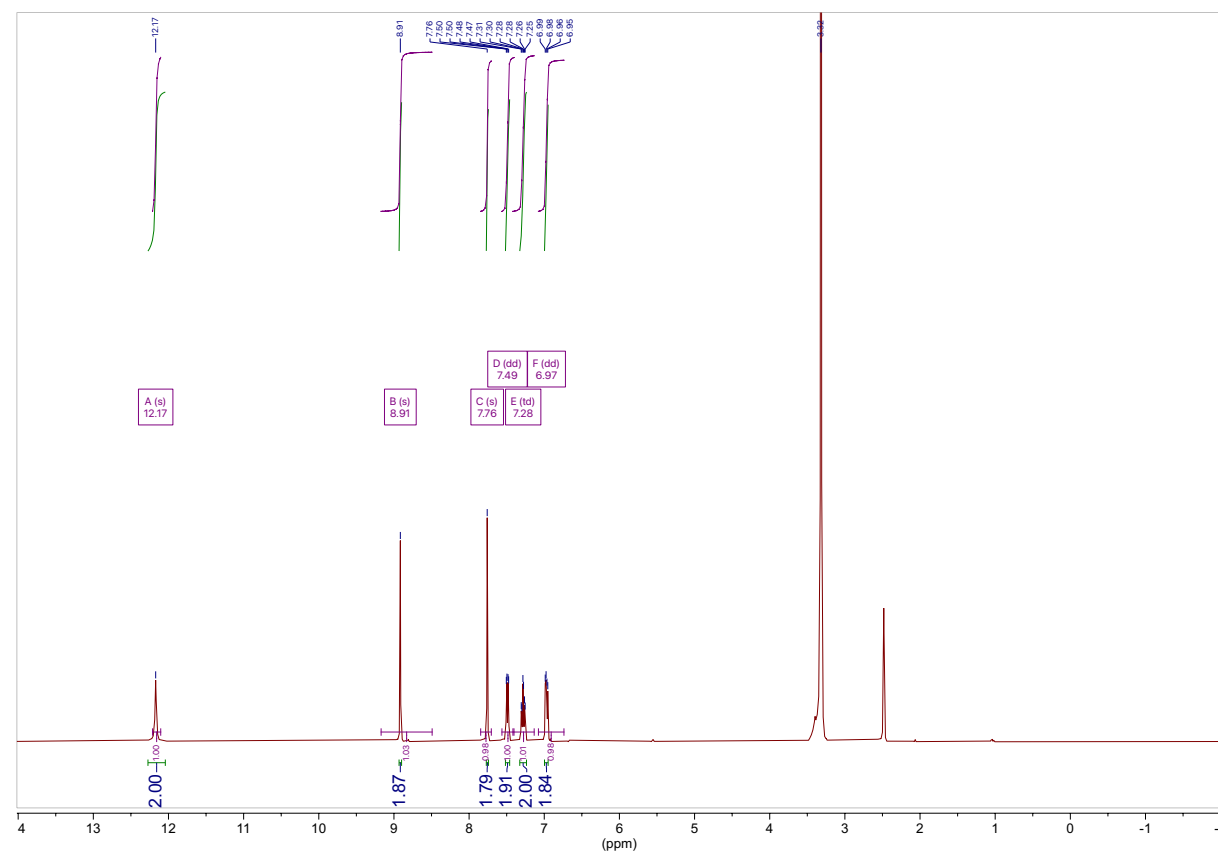


Figure 9 Preparation of ligand II ($\text{H}_2\text{salophen II}$)

0.3141 g (1.7743 mmol) of 4,5-dichloro-*o*-phenylenediamine and 0.4983 g (3.5565 mmol) of 5-fluoro-salicylaldehyde were placed in a round bottom flask with 10 mL of warm ethanol. The contents were placed on reflux with a stir bar and plugged with N_2 . The solution turned light orange/pink with addition of the diamine and then gradually changed to a dark yellow with addition of the salicylaldehyde. After 9 h, the solution was removed from reflux and allowed to cool to room temperature. Cold ethanol was used to wash the solution and then placed on a high-vac. Yield 31.55% (0.3258 g). $\text{C}_{20}\text{H}_{12}\text{Cl}_2\text{F}_2\text{N}_2\text{O}_2$ ($M = 421.22$). $^1\text{H NMR}$ (300 MHz, dmsO) δ 12.17 (s, 2H), 8.91 (s, 2H), 7.76 (s, 2H), 7.49 (dd, $J = 9.0, 3.3$ Hz, 2H), 7.28 (td, $J = 8.7, 3.3$ Hz, 2H), 6.97 (dd, $J = 9.1, 4.5$ Hz, 2H) (Figure 6).

Figure 10 H-NMR of H₂salophen II

Complexation of Ni(salophen) II

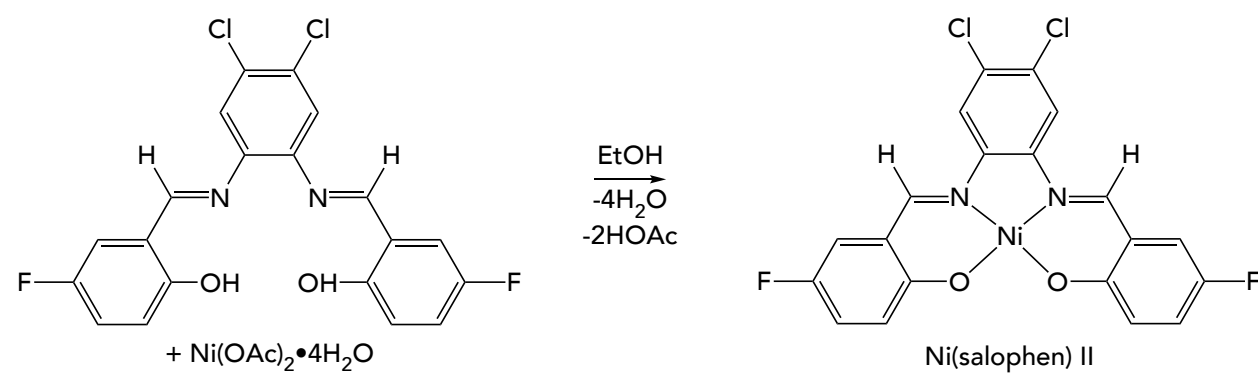


Figure 11 Complexation of nickel salophen II [Ni(salophen) II]

To 10 mL of warm ethanol, 0.997 g (0.2367 mmol) of the H₂salophen II ligand was placed in a round bottom flask with a stir bar for 10 minutes which turned yellow. 0.0597 g (0.2399 mmol) of the Ni(OAc)₂ • 4H₂O was then added to the warm solution instantly changing the color to a

cloudy reddish brown. The solution was allowed to cool to room temperature and washed with cold ethanol before placing on a high-vac. A maroon precipitate was collected. Yield 92.75% (0.1049 g). C₂₀H₁₀Cl₂F₂N₂NiO₂ (*M* = 477.90). ¹H NMR (300 MHz, dms_o) δ 9.13 (s, 2H), 8.24 (s, 2H), 7.12 (dd, *J* = 11.9, 8.2 Hz, 4H), 6.72 (dd, *J* = 9.3, 4.6 Hz, 2H) (Figure 8).

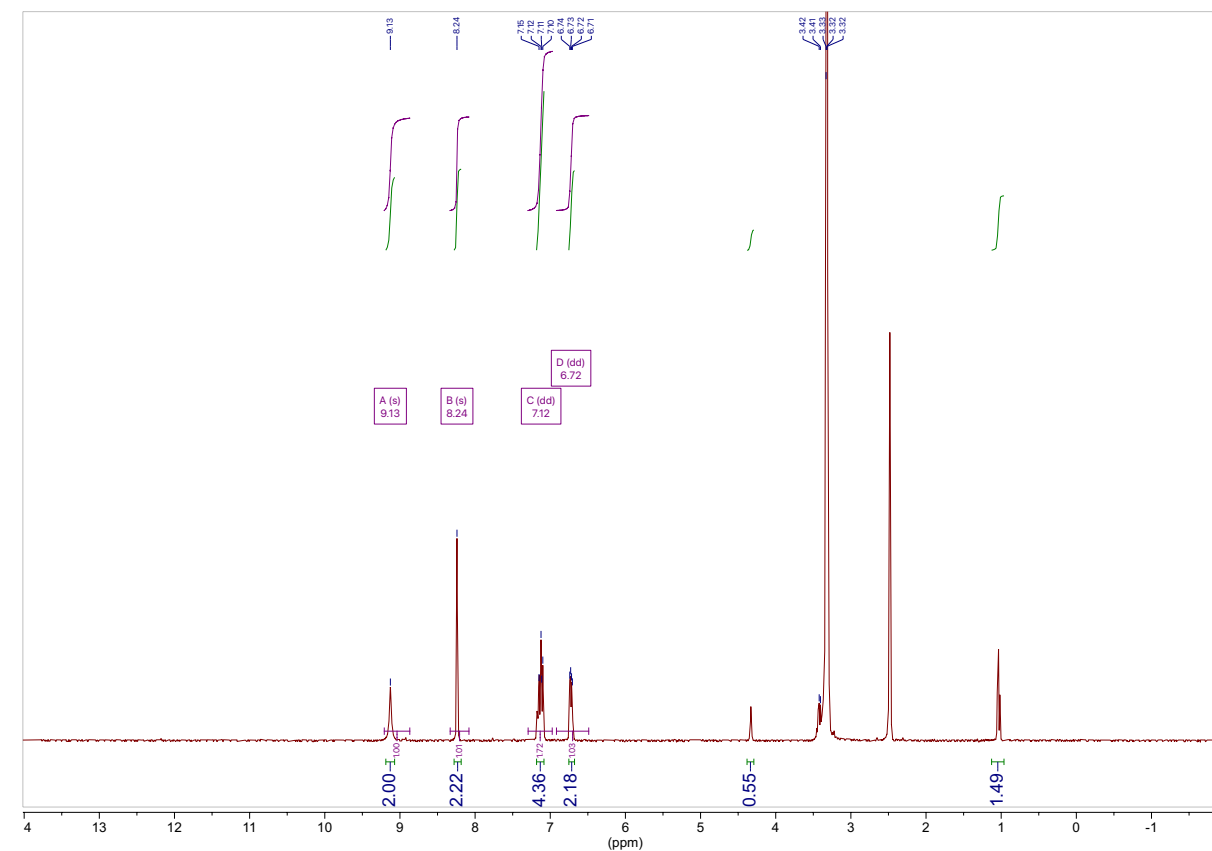


Figure 12 H-NMR of Ni(salophen II)

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Think Sleep, Not Suicide: A Study on the relationship between sleep, suicide, and depression

Suicide has become a huge public health concern. With over 100 million deaths being caused by suicide globally, many studies have been dedicated to aid in preventing suicide (Bilsen, 2018 & WHO, 2017). However understanding why people commit suicide is tricky as researchers are unable to study or ask questions to those who have already committed suicide. Researchers are left to study other behaviors and aspects that are commonly seen with suicide. For example other suicidal behaviors such as suicide attempts and common risk factors such as sociocultural environmental factors and psychopathology (Fleming 2007). Psychopathology can be seen as especially important in regards to psychiatric disorders, like depression. Depression has been noted as the main risk factor associated with suicide and is commonly researched together (Roco 2019).

Depression and other psychological aspects have been proven to be helpful (Fleming 2007). However what isn't commonly looked at is the physiological aspects, such as sleep. Specifically how sleep quality and sleep quantity both affect the likelihood of suicide attempts. The current argument remains to be whether or not sleep is an indirect or direct predictor of suicide. In other words to say whether or not sleep needs another variable added as a mediator to help predict suicide attempts.

The current study looks at sleep quality and sleep quantity on suicide attempts, and examines whether a common psychological predictor like depression is needed to make the relationship stronger. The following paper will address 1) the literature on suicide, sleep, and depression, and how these factors are connected, 2) propose and test a mediation model on how depression is related to both sleep and suicide.

Suicidal behavior

Suicide remains a huge public health concern that affects people across all ages (Soares 2020). Amongst young people, suicide has been found to be one of the leading causes of death and is the second most common cause of death among the ages of 15-29 years worldwide (Bilsen, 2018). In high income countries (e.g. Canada, USA, France, South Korea) suicide has caused 10% of deaths in males and young adults from the ages 20-24 (Lin, 2015). Likewise in low-income and middle-income countries like the Eastern Mediterranean region, suicide was still on of the main causes of death (Lin, 2015). Globally, 1.4% of deaths are caused by suicide globally and affects people of all ages (WHO, 2017).

The study of suicide is complex and has many definitions, which are referred to as suicidal behaviors. Suicidal behaviors includes 1) completed suicide, 2) attempted suicide (act of trying to commit suicide), 3) non-suicidal or suicidal self harm injuries (i.e., inflicting physical harm to oneself that can cause death or any other nonlethal harm) , and 4) suicidal ideation (i.e., making suicide plans and thoughts of harming oneself are commonly known as suicidal ideations; Soares, 2020). (Soares, 2020).

Given these definitions, it's important to understand how these various behaviors connect. Suicidal ideation for example has been shown to have a strong pathway connection to suicide (Miranda, 2014). Suicidal ideation has been found to increase the likelihood of attempted suicide in a 33%people and has been found to be affecting around 15-29% of adolescents and young adults. In Meir's (2019) study it was found that nearly 30% of adolescents reported a lifetime history of suicidal ideation. Whereas in epidemiological studies, it was indicated that intense and frequent suicidal ideation ranged from 7% to 16% and less severe forms (not as frequent thoughts) varied from 36% to 63% (Dubow et al., 1989). Suicide attempts are also a matter of

concern as they happen 10-20 times more frequently than completed suicide (Bilsen, 2018). So with every completed suicide, 20 suicide attempts occur, which makes suicide attempts an even graver issue to be cautious of (World Health Organization, 2014).

Predictors of Suicide

Apart from suicidal ideation and other suicidal behaviors, research has found multiple predictors of suicide. Psychological adjustment variables such as self-esteem and anxiety are important when looking and understanding why suicide occurs. Self-esteem has been defined as the entire range of attitudes, values, and judgments about oneself regarding their perceptions, emotions, thoughts, behavior, abilities, past experiences, physical characteristics and personal values (Coopersmith, 1967). Self-esteem has also been conceptualized as the positive or negative feelings held by an individual about themselves (Swann & Bosson, 2010). Those with negative feelings towards themselves tend to have low and negative self-esteem that is often accompanied by feelings of worthlessness, inferiority, loneliness, depression, anxiety, and guilt, undermining values of achievement and personal abilities and preventing social adjustment and integration (Coopersmith, 1967). According to Borton, unstable self-esteem may contribute to dysfunctional coping and vulnerability to poor mental health outcomes (Borton et al., 2012). These feelings have also been highly associated with suicidal behaviors which could explain how one with low self-esteem can result in an increase of suicidal behaviors like self-harm and/or suicidal ideation. DeMan (2002) also claimed that suicidal ideation occurs more frequently among individuals with low self-esteem, but especially when self-esteem is unstable.

Another prevalent psychological adjustment that has been known to be connected with suicidal behaviors is anxiety. Many studies have suggested that anxious individuals are at heightened risk for suicidal ideation (Meir, 2019). In Bomyea's (2013) study of 1002 individuals

with at least one anxiety disorder, participants were given a Mini International Neuropsychiatric Interview (MINI) which included a suicidal risk module. This module included questions on thoughts of death, intentions of self-harm, and history of suicide attempts. It was found that 26% of patients with anxiety expressed passive suicidal ideation, 16% had thoughts of suicide within the month of assessment, and 18% expressed a previous history with attempted suicide. In another study done by Sareen et al. (2005), it was found that 55% of participants with anxiety endorsed a suicidal attempt and 37% had experienced suicidal ideation. Anxiety disorders have been found to be an independent risk factor for the onset of suicidal ideation and suicide attempts. The data also showed that anxiety increased the risk of suicide attempt in those with mood disorders.

Sleep and Suicidal Behaviors

While psychological aspects are important to look at, the physiological aspects are equally important. Sleep for example is seldom in research that is devoted to preventing suicide. Sleep is commonly referred to a condition of the body and mind that recurs for several hours, typical during the night. According to Ritmala (2014) a normal good night's sleep consists of light sleep, deep sleep, and rapid eye movement (REM) sleep. In the light sleep stage, the mind and body begins to slow down, this stage can range from 5-10 minutes on average, and causes the individual to get drowsy and feel relaxed. During the deep sleep phase, the body's energy sources are restored and tissue repair is at its peak. The REM stage is then where energy is restored in the brain, the mind processes the past day's experiences, and prepares room for new experiences. There is also non-REM (NREM) sleep which refers to sleep that does not go through the REM stage (Williams, 1973).

Apart from the REM cycle, when it comes to whether or not someone is getting good sleep or bad sleep, there are two components commonly taken into consideration; sleep quality and sleep quantity. While sleep quality is the overall satisfaction of sleep, sleep quantity is the amount of sleep a person has. In order to achieve a good quality of sleep a person experiences the REM cycle undisturbed. In regards to how much you should be getting, Hirshowitz et al. (2015) says you should be getting anywhere from 6-8 hours of sleep per night. Poor sleep quality is defined as a disturbed sleep cycle and when a person is not hitting all the stages of the sleep cycle as well as experiencing sleep disturbances such as insomnia, nightmares, and sleep walking. Poor sleep quantity is defined as someone getting less than 6 hours of sleep and over 10 hours per night (Hirshowitz et al., 2015).

When people are not getting the sleep that they need it is mainly due to sleep disturbances. Sleep disturbances are problems with sleep onset and maintenance, sleepiness, sleep-wake schedule, dysfunctions in sleep, sleep stages, or partial arousals (Amirii, 2020). Sleep disturbances also refers to the amount of sleep shortened or even lengthened for various reasons. Many people may find it difficult to fall and/or maintain sleep (insomnia) while others struggle to stay awake and alert during the day regardless of the amount of sleep they had prior (hypersomnia) (Webb, 1978). There is also selective sleep deprivation, also known as partial sleep deprivation, that involves the reduction or deletion of specific sleep stages. These disturbances along with others (e.g. sleep walking, nightmares) affect the standard pattern of sleep which then creates dilemmas in the brain's ability to function properly.

Individuals who are unable to get the proper amount or quality of sleep have an increase risk of psychological issues, increase in existing mood/psychological disorders, and suicidal behaviors such as suicidal ideation. Once sleep starts to suffer, so do these various functions.

Psychological functioning in particular will play a part in the increase risk of suicidal ideation with thoughts and feelings of being disorganized due to poor quality of sleep. Individuals have a higher chance of experiencing feelings of sadness, low concentration, low energy, and low motivation, especially in individuals who are already experiencing symptoms of depression. Though sleep may not be directly connected to suicidal ideation, it has been shown to affect the possible onset of suicidal behaviors, especially when put together with other psychological disorders. In Calandre's (2015) study, patients with fibromyalgia, a disorder that involves chronic pain, sleep disturbances, and depression, suicidal ideation was exceedingly high. It was found that with a combination of poor mental health and poor sleep quality had the strongest association with suicidal ideation. In McGlinchey's (2015) study of samples taken from the National Longitudinal Study of Adolescent Health (Add Health) negative health outcomes and sleep was examined. It was found that later bedtimes were cross-sectionally associated with all the outcomes of interest such as emotional distress and suicidality. It is especially prevalent in adolescence, insufficient sleep during that time of brain development resulting in dysregulation of emotion and cognitive dysfunction (McGlinchey, 2015). This in turn has been hypothesized to lead to feelings of depression and snowball into more serious matters such as suicidal behavior.

Topic 3: Depression as a mediator for sleep and suicide

Depression is a variable to be considered when looking at both sleep and suicide. Depression has been noted as the main risk factor that's been associated with suicide. According to the World Health Organization (WHO), 350 million people worldwide suffer from depression (Yang, 2015). It has been found that the suicide rate among those with depression is up to 36 times higher than the general population (Gibbons, 1984). According to Vuorillehto (2014) the rate of suicidal ideation in patients with major depression is 11%-63% with 15% attempting

suicide. Miquel's (2019) study protocol aimed to evaluate the alterations of executive functioning (EF) in past cross-sectional studies in patients with Major Depression Disorder (MDD). This protocol had shown that the first onset or episode of MDD can predict suicidal behavior. It was also noted that about 50% of patients who commit suicide have visited Primary Care physicians three months before their self injury behavior, 40% in the month before, and 20% one week before (Pirkis 1998). Those with depression have an increase risk of suicidal behaviors, possibly starting with thoughts of suicide to self-injury, and lastly attempted suicide. For these reasons, depression has become an important adjustment variable to account for when looking for suicidal behaviors in individual with psychological issues.

In regards to sleep, there seems to be a debate on whether or not sleep can stand alone when predicting suicide or does it need a preexisting psychological aspect such as depression to be the driving force in predicting suicide. For example in Lin's (2018) study, they examined whether or not insomnia could be an independent predictor of suicide attempts using a cohort study from hospitalization data from the National Health Insurance Research Database (NHRID) from the years 2000-2013. By using a regression model they were able to find that insomnia was indeed an independent risk factor in a 479,967 sample size of ages 15 and up. This study specifically shows how poor sleep can predict suicide attempts without another factor being mediated for. However there other studies such as Nadroff's (2011) study which examined how insomnia and nightmares were possibly related to suicidal ideation, while also testing whether they are independent from symptoms of anxiety, depression, and posttraumatic stress disorder (PTSD). The study consisted of 583 undergraduate students from the United States and used various surveys to measure each variable. They found that while nightmares were an independent

risk factor for suicidal ideation, insomnia's relationship with suicidal ideation did not exist without the symptoms of depression, anxiety, and PTSD.

It is important to recognize patients with depression that are commonly seen paired with various sleep problems. Tubbs (2020) notes that sleep disturbances such as insomnia are core features of depression. Their study used preexisting data from the Sleep and Health Activity Diet, Environment, and Socialization (SHADES) study to examine sleep disturbances and depression. The study contained 1007 adults from the ages 22-60 in Philadelphia. Participants' depressive symptoms and severity were measured using the Patient Health Questionnaire-9 (PHQ) which included items covering depressed mood, anhedonia, sleep disturbance, fatigue, appetite dysregulation, feelings of failure, concentration, and suicidal ideation. Sleep duration was measured using a question from the National Health and Nutrition Examination Survey which asked "how much sleep do you usually get on weekdays or workdays?" Lastly insomnia was measured using the Insomnia Severity Index (ISI) that measured symptoms from the last two weeks. By using statistical analysis it was found that short sleep and insomnia were independently associated with increased depression severity and frequency. It was also found that individuals with short sleep durations had a higher risk of depression at low insomnia and then increased with the severity of insomnia when compared to those who were sleeping 7-8 hours. This data shows how low sleep duration and insomnia increased depression. It also indicates how important it is to look at sleep as whole when assessing severe depression in individuals with symptoms of depression.

These findings on depression shows sleep to be an indirect factor when looking at suicide and depression to be a direct factor when looking at suicide. However the **mediating** connection between sleep, depression, and suicide is seldom in research. It is understood that depression as a

risk factor for suicidal behaviors is grave and at large (Fleming 2007). At the same time it is understood that sleep problems and deficits are very common among patients with depression (Tubbs 2020). However the argument of whether or not sleep can be directly impacting suicidal behaviors, such as suicide attempts has yet to reach a consensus. The present study aims to fill in the gaps of the relationship between sleep and suicide, specifically looking at poor sleep quality and sleep quantity and how it affects suicide attempts. In addition, the present study tested a conceptual model wherein depression functions as a mediator between sleep and suicide attempts. The purpose of the study is to bring attention to current sleeping habits and the detriments that poor sleep has on psychological adjustment.

Methods

Participants

5024 participants will be pulled from Wave 4 of the publicly available Adolescent Health data. Participants ranged from the ages 24-32. demographics, percentage of gender/ethnicity (whatever is important) mean and SD

Measures

The present study pulled from preexisting data from Wave 4 of the Add Health database that included items on suicidality, sleep, and depression. Suicidality, specifically suicide attempts were measured with the question “during the past 12 months, how many times did you actually attempt suicide”, participants answered using a 5 point Likert scale where 0 was “none” and 4 was “5 or more attempts”. Sleep quantity was measured using the questions “What time do you usually go to bed/wake up during work/school/etc?” and “What time do you usually go to bed/wake up on your days off?” Each question was separated into three parts where participants indicated the hour and minute, as well as state whether it was in the AM or PM. Variables were

recoded using SPSS into a 24 hour variable, where 0 is 12:00 am, 12 is 12:00 pm, and 23 is 11:00 pm . Poor sleep quality was measured by combining the following items: “How often do you have trouble falling asleep?” and “How often do you have trouble staying asleep?” Participants answered using a 5 point Likert scale where 0 was “never in the past four weeks” and 4 being “5 or more times a week”. Lastly depression was measured using 6 items from the Center of Epidemiologic Studies Depression Scale (CES-D) (Radloff 1977). Items were then combined to make an average scoring using SPSS, such that higher scores indicated higher levels of depression. Items included questions asking “How often is the following true during the past week” followed by “Felt sad”, “were unable to shake off the blues”, “felt disliked”, etc.

Results

A series of mediation analyses using SPSS Process macro version 4 was performed to assess the influence of sleep quantity and poor sleep quality on suicide attempts and the mediating role on **depression** between these variables. The first mediation analyzed sleep quantity, depression, and suicide attempts. The second mediation analyzed poor sleep quality, depression, and suicide attempts.

The first mediation tested the influence of sleep quantity on suicide attempts, with depression as a mediating factor between the two variables. In step 1, regression results show sleep quantity was an insignificant predictor of suicide attempts ($b=.001$, $p>.005$, $p=.949$). In step 2, sleep quantity was found to significantly increase depression ($b=-.0042$, $p<.005$). In step 3, depression was a significant predictor of increasing suicide attempts ($b=.0002$, $p<.001$). However in step 4, when depression was added to the model as a mediator, the impact of sleep quantity on suicide attempts was insignificant and not shown as a predictor ($b=.0001$, $p>.005$). To further test this, an indirect effect test was conducted. The indirect effects revealed that

depression was not a significant mediating influence, ($B=.0002$, $SE=.0009$, $p=.8388$), 95% CI $[-.0003, .0000]$.

The second mediation analysis tested the influence of poor sleep quality on suicide attempts, with depression as a mediating factor between the two variables. In step 1, regression results show poor sleep quality was a significant predictor of suicide attempts ($b=.084$, $p<.001$). In step 2, poor sleep quality was found to significantly increase depression ($b=.0286$, $p<.001$). In step 3, depression was found to be a significant predictor of increasing suicide attempts ($b=.0256$, $p<.001$). In step 4, when depression was added to the model as a mediator, the impact of sleep quality was reduced but still remained a significant predictor ($b=.0126$, $p<.001$); this suggests that depression has a mediating influence. To further test this, an indirect effect test was conducted. The total effect of poor sleep quality on suicide attempts was significant ($B=.0119$, $SE=.0021$, $p<.001$), 95% CI $[.002, .0014]$.

Discussion

While the relationship between depression and suicide are apparent, the relationship between sleep and suicide continues to be debated. Studies like Lins (2018) and Nadroffs (2011) contribute to the argument of whether or not sleep can stand alone when predicting for suicidal behaviors such as suicide attempts and suicidal ideation. The current study tested this argument by examining sleep quantity and poor sleep quality on suicide attempts with depression as mediating factor.

Though the first mediation regarding sleep quantity predicting suicide with depression mediating, future studies should not ignore the potential information that could be obtained. Future studies should look at sleep quantity, analyzing the difference between too much and too little sleep as it relates to suicide. As mentioned previously, poor sleep quantity is not just about

not getting enough sleep, but also getting too much sleep, so being able to analyze the impact of both sides can be beneficial to everyday people and professionals in the field. Based on previous studies, it is possible to find that poor sleep quantity (whether that be too much or too little) can also affect and predict risk of depression and suicide. For example, in Lee's (2017) study, it was found that since sleep quantity was so connected to the overall satisfaction of sleep, when sleep duration was poor, sleep quality went down as well. This suggests that they are more intertwined than being entirely separate from each other.

While the hypothesis regarding sleep quantity was not supported, poor sleep quality was supported. It was found that poor sleep quality played an important role in predicting depression and functioned as a distal (indirect) predictor of suicide. Depression was found to be the better predictor in suicide. Additionally poor sleep quality became stronger in predicting suicide attempts with depression as a mediating factor. The results were consistent with Nadroff (2011) in that poor sleep quality was an indirect factor when predicting suicide with depression as a mediating factor. Without depression as a mediating factor the relationship between sleep quality and suicide attempts would not exist.

Implications of these findings lie with how society can shift the way they view sleep and its true importance. Currently people of all status are losing their sleep to various things, whether that be responsibilities or doing something enjoyable. It could be that people are willing to lose sleep because of the low and common risks of irritability and tiredness. However there are other risks to take into account like low concentration and mood dysregulation which could affect a person's ability to function with daily tasks and responsibilities. Furthermore adding the risk of depression from poor sleep quality, having feelings of sadness and low self worth could lead to attempting suicide. With this information society can attempt to shift the way they think about

sleep, by seeing it as an important aspect of our ability to adjust and interact with the world in an efficient way. If the fact that sleep has serious risks of depression and suicide, it is possible that people would more opposed to sacrificing their sleep. Though it's common to hear how sleep is important, rarely is it coupled with the grave consequences. While it's known to improve mood, prepare people for new days, knowing the risks is just as important.

With this information, we can start being truly mindful of our sleep and establish that it isn't something you can do away with for the sake of other responsibilities. Sleep allows us to restart, make room for new experiences and information, as well as regulate our emotions (Ochab 2021). If we are unable to do this, then it could lead to an inability to obtain new information or to complete our responsibilities due to ill feelings of sadness or irritability. It is important for every person to be mindful of their current sleeping habits and make an effort to practice good sleeping habits in order to obtain good sleep quality. With this effort being made, there can be a decrease risk of depression that could later lead to attempting suicide.

Likewise, professionals such as therapists, intake counselors, and policy makers should not only look at psychological adjustment, but also the physiological, cognitive, and psychological importance of sleep (Ochab, 2021). Sleep helps human beings reset and relax their bodies to be ready for the next day, it allows us to situate our memories and experiences, as well as regulating our mood to decrease the risk of dysregulation of the mind (Ochab 2021). Looking at the sleeping habits of current and future clients can be beneficial when assessing for the risk of future suicide attempts. Clinicians and the like can implement advice to obtaining better sleeping habits to increase sleep quality and decrease the risk of suicide attempts. It can also be helpful for professionals who work with children who are showing early signs of poor sleep and depression,

so that guardians can step in and help support their children not only emotionally, but physiologically.

All in all, recognizing sleep as an important aspect of human functioning is extremely important to maintain a good quality of life. While the study's purpose is to spread awareness on the risks of not obtaining adequate sleep, it's important to note the overall benefits of having good sleep quality. As mentioned previously, sleep allows us to restart and make room for new information, while also restoring energy, and having the ability to regulate oneself (Kühnel 2017). There is no need to sleep for the sole sake of decreasing the risk of depression or suicide, but more so for human beings to function at their best selves.

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**Latina's Undergraduate Experiences and Mentorship In
Preparation for Graduate School**

Abstract

This qualitative study examines the journey of four Latina women and their undergraduate experiences as it relates to mentorship in preparation for graduate school. Research shows that Latina students make up a small percentage of all doctoral programs. For this reason, it is important to understand college experiences that helped the participants decide on their graduate program. The interviews revealed the Latina women felt unsupported in their undergraduate programs. Other codes that emerged from the interviews were mentorship, the role of race and gender, the lack of diversity in the student population, a sense of belonging on campus, relationship building, community stereotypes, lack of preparation for college, and managing multiple family responsibilities. As a first-generation college student and Latina woman, I aspire to attend a graduate program and earn a doctorate in Education Policy. Coincidentally, I can relate to the participants of this study because during K-12 I was unable to get support due to the lack of resources found in my low-income school district. A second barrier that impacted my childhood education was growing up as an English language learner. After leaving high school, I was eager to see if I would get more support at a four-year university. Learning from the four Latinas in this study will provide me with insight for graduate school and its expectations. More importantly, this study exposed me to a literature review and the research process while preparing me to become a researcher, scholar, and author in education..

Many graduate students want their dream school that satisfies their needs. There are five main factors that most institutions look for when selecting graduate students: academic records, personal statement, letters of recommendation, research experience (and/or clinical experience if you're applying to a clinical program), and match to the program/advisor. Grad students also look at the location and the environment they will be in for the next couple of years. This literature review, it will be shown throughout the factors that made graduate students decide on the school they went to base on their real-life experiences. Several studies have found that low-income and underrepresented students navigate the college choice process.

Literature Review:

Theme #1: Lack of guidance and support

It was shown in the findings that lack of access to social and cultural capital hampers Latinos' graduate school choice opportunities and outcomes (Ramirez, E. 2011). Graduate students have needs and Many of these universities were showing support and were lacking guidance. These graduate students focused on seeing if there were people of color in their institutions. Lack of Latino faculty representation also has deleterious consequences for Latino undergraduate students' access to social capital within the university context, as the present study illustrates. First-generation students that are Latinos were shown to struggle more in the graduate application. Due to not knowing many of the documents that were needed when applying. Many of these grad students didn't feel comfortable asking for help and the students would struggle more (Ramirez, E. 2011). Research has found that many students do not know how to apply to graduate school or what the doctoral socialization process entails (Anderson, 1998; Lovitts, 2001). Given their greater levels of underrepresentation in higher education, lack of knowledge

concerning graduate school admissions (and college admissions in general) is even more pronounced for Latino students, particularly for first-generation Latino college students from working-class backgrounds. When graduate students were asked About their experience with graduate school applications and the admissions process most of the people responded that there was a lack of knowledge and familiarity with the process. for example many of The Graduate students fell " by the application process (Ramirez, E. 2011). A few Latino men also identified a lack of knowledge of college admissions as an obstacle. Raymond attributed his lack of knowledge to his parents' unfamiliarity with the higher education landscape therefore their father was unable to offer guidance to Raymond. Although not all respondents explicitly identified lack of knowledge as a barrier to success with graduate applications, some nonetheless demonstrated a lack of knowledge through their utilization of nonstrategic, or haphazard, application strategies.

For example, (Ramirez, E. 2011) found that Chicanx/Latinx students navigate through various challenges while applying to graduate school, including a lack of knowledge concerning graduate school admissions. It was highlighted that respondents felt that the lack of diversity in graduate school admissions committees perpetuated the exclusion of racial/ethnic minorities. Particularly Chicanxs/Latinxs, are drastically underrepresented among the nation's faculty (Ramirez 2017), and the lack of diverse graduate admissions committees will undoubtedly continue to be a problem in the future. Living close to home may in fact enhance Latino/educational success, insofar as it helps curb college costs, facilitates access to familial support, and increases degree attainment (Pérez & McDonough, 2008). One of the Hidden barriers was the lack of mentorship. It is important that we begin to identify the lack of mentorship as an all-encompassing barrier with which Chicanas/Latinas contend. The study reveals that an "identified advisor/ mentor can make a difference when it comes to factors that

contribute to Latino students' intent to persist at an institution" (p. 155). Thus, the absence of sufficient opportunities for appropriate types of mentorship is yet another barrier to retention and persistence (Villaseñor, M. J., Reyes, M. E., & Muñoz, I, 2013). For Latinas, it is well documented that factors such as a lack of finances, lower familial support, few mentors, cultural stereotypes, inhospitable campus climates, and a sense of cultural misfit influence their college navigation. UFGLI students who are pursuing graduate studies have been found to experience barriers and challenges such as marginalization and prejudice based on personal identities (e.g., gender and racial/ethnic identity; Gardner & Holley, 2011; Leyva, 2011; Wilson & Gibson, 2011), financial difficulties (Seay et al., 2008; Wilson & Gibson, 2011), and lack of support from social networks (Leyva, 2011; Seay et al., 2008; Wilson & Gibson, 2011). Further, due to the lack of clarity on how family values influence underrepresented first-generation, low-income students' pursuit of a graduate-level career, advisors, and counselors should note the critical importance of clarifying this further with students (Tate, K. A., Fouad, N. A., Marks, L. R., Young, G., Guzman, E., & Williams, E. G. 2015).

Theme #3:Standardize test

One of the many standardized tests that is focused on when applying to grad school is the GRE. It was pointed out that the faculty at this university often rely on GRE scores in their graduate school admissions and fellowship award decisions. Standardized college admissions exams such as the GRE have traditionally posed barriers to college entrance for working-class and underrepresented students (Walpole et al., 2005). Studies have suggested that standardized college admissions exams are culturally skewed (Durán, 1994; Jencks, 1998), lack predictive validity (Ibarra, 2001), and favor students with access to educational resources such as

high-quality commercial test preparation courses (Walpole et al., 2005). The vast majority of respondents reported experiencing difficulties with the GRE, describing it as “hard,” “dehumanizing,” and “intimidating.” The GRE can also potentially jeopardize Latinos’ access to, as well as financial support for, graduate studies (Yosso, 2006). Although research has by and large ignored the role of standardized college admission testing on the college choice process of Latinos and other underrepresented students (Walpole et al., 2005), results from this study illustrate the importance of the GRE in shaping Latinos’ graduate school choice experiences and outcomes. Lower test scores on standardized exams constrain underrepresented racial/ethnic minority (URM) students’ opportunities for college education, including graduate study (Ramirez 2011).

In addition to standard measures like grades and GRE scores, faculty at doctoral institutions often base their graduate school admissions decisions on (1) the quality (measured as selectivity or prestige) of the undergraduate institution; (2) the scholarly reputation of recommendation letter writers; and (3) faculty judgments of program alumni with similar characteristics (Posselt 2018). Admissions decisions are thus reputedly based on a holistic/comprehensive review process that considers multiple factors and views standardized exams (e.g., GRE) as just one component of the evaluation process. Because URMs, including Chicana/ Latinx students, are less likely to attend selective undergraduate institutions and tend to score lower on standardized admission exams compared to their white and middle-class peers, graduate admissions policies that prioritize these admissions criteria perpetuate the underrepresentation of URMs in doctoral education.

Theme #2: Lack of knowledge concerning graduate school

Research has found that many students do not know how to apply to graduate school or what the doctoral socialization process entails (Anderson, 1998; Lovitts, 2001). Lack of knowledge, or cultural capital, places Latinos at a disadvantage in the college choice process relative to their peers (Walpole et al., 2005) and ultimately contributes to their underrepresentation in higher education, including graduate school. A lot of grad students showed a lack of knowledge and familiarity with the process. Several respondents, for example, reported feeling “lost” and “intimidated” (Ramirez, E. 2011). One of the interviewees is middle class but they still had no insider knowledge of college admissions. His lack of understanding of his parents’ unfamiliarity with the higher education landscape even though their parents attended a community college and had taken state exams to become a professional in his field, he lacked knowledge of the college (particularly graduate school) admissions process and was therefore unable to offer guidance, to their child. These findings are consistent with the extant college choice literature, which has typically found that a lack of knowledge concerning college admissions constrains the postsecondary education decisions of low-income and underrepresented minorities. Lack of knowledge concerning college admissions is thus a barrier for both undergraduate school- and graduate school-bound Latinos. Many students felt overall the lack of diversity in graduate school admissions committees perpetuated the exclusion of racial/ethnic minorities (Ramirez, E. 2011). Lack of access to information and knowledge concerning graduate school admissions was thus a significant barrier to Latinos’ optimal success with the graduate school application process.

The experiences of Master's and PhD students in Australia, Canada, the Czech Republic, Finland, the Netherlands, New Zealand, Taiwan, the United Kingdom, and the United States

LATINA'S UNDERGRADUATE EXPERIENCES AND MENTORSHIP IN PREPARATION FOR GRADUATE SCHOOL

were the subject of studies that included qualitative (n=28; 62%), quantitative (n=12; 27%), and mixed methods (n=5; 11%) approaches to data collection and analysis. p. 552

Increased awareness of academic and program norms, the development of procedural and disciplinary knowledge, the improvement of research and methodological skills, and writing and academic publication competence were among the benefits that we assessed as falling under the purview of the academic domain. "Academic, psychological, social, and career outcomes were reported by the authors of 36 (80%) studies," p. 567. According to graduate students, peer relationships have helped them acquire crucial procedural and disciplinary information and decreased their academic anxiety. educational, psychological, social, and professional. Peer interactions, according to graduate students, happier interactions ve helped them acquire crucial procedural and disciplinary knowledge, lessen academic anxiety and isolation, and advance the development of job skills.

This seems to hold true regardless of degree or course of study. Our approach to integrating qualitative and quantitative data, as well as our exploration of the variety of roles that peers can play in the context of graduate education, appears to be unique compared to authors of prior reviews who have examined the relationship between peer mentorship and acclimatization to undergraduate education (Lorenzetti,2019).

Methodology:

The overall outcome of interviews will be to collect qualitative and quantitative data in order to show how students were impacted in regard to mentorship in academia. Also how this

affected them with knowledge of graduate school and the choices they had. This study had a consist of 40 questions that were created by Dr. Eligio Martinez. The interviews were conducted in 2020 with participants from in-state and out-of-state schools.

Participants:

The participants in the study will target only graduate students. Therefore only students that are in graduate school at the start of the study will be able to participate in order to get the most accurate results/data. Dr. Eligio Martinez conducted and launched the interviews. To get confirmation they will continue in the study Dr. Martinez read what the study will contain and they will need to verbally acknowledge that they will like to participate. After that, they will be asked multiple questions by Dr. Martinez.

Procedure/Measures:

The interview was conducted through zoom and or phone call. The interview will be 1-2 hours long. The goal will be for at least 10 graduate students to participate in the study. Each question should take no longer than 15-20 minutes to complete. Most of the questions will be in-depth questions that they will be able to explain their experience of undergraduate experiences that helped them/didn't help them for graduate school. Each of the questions asked in the study will pertain to the main themes in my research topic in order to prove the struggles these graduate students went through. Participants will be able to answer the questions in details due to the main question and follow-up questions that will follow in the interview. Once the interview is done I will be able to get the main themes and see the responses of the participants and go through the responses.

Analysis:

The overall data I receive from the interviews will help support the overall themes in my research paper. The quantitative and qualitative data received from the study will help align with the research I have already conducted on this topic. Identifying patterns and trends will help me analyze the data collected through questionnaires and can help to identify patterns and trends in the responses. This can help to answer research questions and provide insights into the attitudes, beliefs, and behaviors of the target population. If the questionnaires get answered how I expected them to get answered I will be able to argue the claims that I believe that graduate students go through a lot in undergrad and do not get supported. I will then make a chart that shows the recurring issues or just highlight the issues that were brought up in this project.

Findings & Analysis:

After analyzing all my data from my participants, I noticed different experiences. Many individuals did have mentors. My study was targeted to see how students that are in graduate school were helped in undergraduate mentorship. This study was anonymous so that the individuals who took it felt comfortable speaking about their mentorship. It was 4 Latina women were interviewed.

Many of these individuals said that they enrolled in a public institution, an Ivy League institution, and a highly selected private. Then the question of participants attending graduate school in-state was whether the schools, the programs, the proximity to home, and financial assistance help them choose and also because of primary faculty members. The other individual did not attend in state so therefore it did not help them.

Support of mentorship:

Only one participant was able to discuss on how they felt over on the study and they felt supported they had a couple of mentors in McNair and for research thought and their Mentor helped them decide where they wanted to attend, looked at their application and gave feedback every step of the way. they also help them feel included in the lab throughout their undergraduate career and we're available for them in any type of concern that they needed. The other individuals said that there weren't that many people that look like them so they were unable to resonate and obtain a mentor. the other individual came in with the mentality to just get through Community College but did have a mentor who helped them but it was not a mentorship relationship. This connects with one of the articles, it talks about how many individuals were helped by McNair (Tate,2013). As you see one of the individuals was helped out by the program.

Preparedness for Graduate School

Many of these individuals felt that they were out of three to five and that they felt ready for graduate school. The reasons that they chose these answers are that they knew other students who were in grad school and had a pretty good idea of what it would be like and they also felt that their undergraduate career was a lot like grad school since it was doing research being a teaching assistant and part of other student organizations. although it wasn't as intense as graduate school but they felt prepared in what to expect for grad school. The other responses were that they had great professors and their majors helped them greatly due to the amount of research and in-depth writing it requires. The other person said they were good students but no one was able to help them in their family so they just knew that it was a new experience and did not have much support and preparation. Another thing that these individuals talked about is their undergraduate experience and if it helped them in graduate school. Only two of them felt that it

did help and some programs that they were in felt that prepared them for graduate school and another thing is that they had like-minded people around them and help them learn and gain one experiences and what will continue. but the other individual did not have the same experience and felt that they were not prepared with their

Overall, I have seen that I was only given some interviews which is why I only had 4 participants in the study. Yes, I was able to get 4 but I feel that I was limited to the research and answers I was looking for. I got answers that some were in-depth but others where one answer responses. I was not the main researcher in the interviews, so I feel that I was not able to really hear the full story from the participants. I feel that if I would have conducted these interviews some of these individuals would have felt more comfortable speaking about different things that happened with their mentors. I also think that if some individuals had a mentor their experiences would have been different in undergraduate school and then going to graduate school.

Conclusion:

Many graduate students seek out their ideal institution that meets their requirements. Academic records, a personal statement, letters of recommendation, research experience (and/or clinical experience if you're applying to a clinical program), and fit with the program/advisor are the five key criteria that most institutions use to choose graduate students. Graduate students also think about where they will be and what kind of atmosphere they will be in in the next years. The elements that affected graduate students' decisions about the schools they attended based on their real-world experiences will be demonstrated throughout this research study. Low-income and

disadvantaged students successfully negotiate the process of selecting a college, according to several research.

Academic mentoring for undergraduates is a system or program where more seasoned students or faculty members offer advice and support to undergraduate students. The mentors, who are typically graduate students or upperclassmen, impart their wisdom, experiences, and expertise to assist the mentees in navigating their academic journey and achieving their objectives.

Enhancing undergraduate students' overall educational experiences and academic success is the main objective of undergraduate academic mentoring. Mentors are a source of information for mentees, offering advice on choosing courses, making academic plans, developing study habits, and managing one's time. They could also provide guidance on graduate school applications, job paths, internships, and research opportunities.

Undergraduate academic mentoring has several advantages, some of which include academic help, individualized guidance, networking opportunities, skill development, and emotional support.

Mentors can aid mentees in comprehending challenging material, offer study advice, and provide direction on tasks and projects. Mentors can help mentees choose their academic route by providing guidance that is specifically tailored to their needs and interests. Mentors can broaden mentees' networks and open doors to new opportunities by connecting them with pertinent academics, professions, and organizations in their field of study. Essential abilities like critical thinking, problem-solving, communication, and research skills can all be developed with the help of mentors. Mentors can create an environment that is encouraging and supportive,

assisting mentees in overcoming the difficulties of college life and fostering personal development.

Depending on the university, undergraduate academic mentoring programs might be formal or informal. In structured mentorship programs offered by some colleges, mentees and mentors are paired according to shared academic interests or experience. In other instances, mentorship might evolve naturally through unofficial connections made between students and faculty. I suggest getting in touch with your university's academic advising office, departmental coordinators, or student organizations associated with your field of study if you're interested in taking part in an undergraduate academic mentoring program. They can help you get involved by giving you details about the mentorship programs that are available.

It's crucial to remember that the success of undergraduate mentoring programs can vary based on a number of variables, including the nature of the mentoring relationship, the level of dedication shown by both mentors and mentees, and the organization and support offered by the institution. Undergraduate mentoring, however, has the ability to have a significant effect on students' academic, personal, and professional journeys when done correctly.

Lastly, I discovered through this study that a large number of people lacked the necessary support. However, only some participants received the help they required during their college studies. Undergraduate mentoring has the potential to have a good effect on students' academic, personal, and professional journeys, though, when it is properly done.

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**Examining the Motivational Impact of A Podcast Assignment
Highlighting an On-Campus Faculty Member in An Introductory
Biology Classroom**

ABSTRACT

This study investigated the impact of a podcast assignment in a biology course on student motivation in Spring 2023. Students enrolled in an introductory biology foundation's course listened to a podcast where a scientist was interviewed. The control received an episode of an established STEM podcast, *Ologies*, while the treatment received a podcast, *The World of Scientists*, featuring an on-campus biology professor. Students then completed a modified version of the Instructional Materials Motivation Survey with four subscales: attention, relevance, confidence, and satisfaction. Results showed both condition groups were motivated by the podcast assignments. When analyzing differences between the two groups, there were no significant differences between groups for the attention measure. However, the treatment group scored significantly higher in the relevance, confidence, and satisfaction measure. This study supports prior research that podcasts are effective at motivating students and goes one step further to illustrate how faculty narratives can provide a greater impact on biology students' motivation.

Introduction

Online learning has had a negative effect on communication between faculty and students. Although, classrooms are shifting back to in-person instruction, the impact of the pandemic on student motivation, should not be overlooked (Tan, 2020). Instead recommendations have been made to integrate communication with students via informal channels, like podcasts, to encourage student motivation (Alawamleh et al., 2020).

During the pandemic, college students in the U.S had increased anxiety and depression compared to prior academic terms (Alawamleh et al., 2020). A national survey four out of five college students had decreased motivation for their academic work, particularly intrinsic motivation. However, most students expressed appreciation of their instructors understanding their circumstances and this slightly offset anxiety (Usher et al., 2021). When students feel like their instructors empathize with the challenges they face outside of the classroom, it can reduce stress inside the classroom.

An additional challenge comes post-pandemic, as there has been a need to reconnect students to the classroom, their majors, and departments (Alawamleh et al., 2020; Hardin & Longhurst, 2016). An additional underlying psychosocial factor many students face is negative group stereotypes in STEM. This is where an individual feels like an outsider in their subfield because they belong to a group of people who have been excluded historically in the science world (Beasley & Fischer, 2012). STEM majors from historically excluded groups are navigating the collegiate system with no prior knowledge of university norms and the rapid shift to online learning left many students without guidance to the opportunities available to them, or how to access them. The COVID-19 pandemic highlighted inequities many undergraduate students face in the STEM field (Katz et al., 2021). Fortunately, as online tools become popular post-

pandemic, consistent exposure to digital media has bolstered students' learning outcomes (Katz et al., 2021).

This study serves to determine whether Cal Poly Pomona undergraduate students are motivated by a podcast assignment, focusing on a scientist's life narrative. A podcast is unique compared to other classroom interventions because of the financial accessibility and easy implementation in the classroom. Podcasts have positively affected student's perception of who is a scientist, and the narration of storytelling helps students visualize themselves in the STEM field (Dang et al., 2022; Yonas et al., 2020). Since the podcast will feature interviews with biology faculty highlighting their academic and career experience, the content will remain relevant and can remain as a long-term intervention over the years.

Methods

Experimental Design

This study took place at a large, public, Hispanic-Serving Institution (HSI) in Southern California and was approved by the Institutional Review Board (Protocol # 22-249). The podcast intervention was implemented into the 14 sections of BIO 1220L Foundations of Biology Laboratory in Spring 2023 and a randomization sorter was used to categorize 7 sections into the control and 7 sections into the treatment. Both groups had the podcast intervention integrated into their course and points were added to their syllabus in exchange for class credit. To incentivize students to complete the post survey after completing the assignment, extra credit points were offered. There were no advertisements or messaging on the course catalogue indicating this intervention would be in the course.

During the Spring 2023 semester, BIO 1220L Foundations of Biology was conducted in person for 2 hours and 50 minutes each week, spanning 15 weeks. This course is an introductory

biology lab required of all biology majors to take as part of their core curriculum., covering the evolution, ecology, and the application of the practices of science. On week 12, students received their respective podcast episode and had 2 weeks to listen and complete a summary activity on Canvas. On week 13, students took a Likert-scale post-survey. The instructors of the 14 sections all received the same instructional training and related materials, in accordance with the biology department's expectations, and delivered the intervention in person. The assignment related to the podcast intervention was submitted by students via the Canvas learning management system with an answer key provided to instructors for grading consistency.

Intervention Activities

On week 10, the treatment sections received the *World of Scientists Podcast* assignment, and the control sections received their *Ologies* assignment. Students had 2 weeks to listen to their respective episodes, then complete a summary activity by week 12 on Canvas that consisted of 5 questions recapping the episodes to ensure students listened and provide credit for the assignment. On week 13, instructors displayed a PowerPoint slide with a QR code linked to a post-survey. Students were incentivized to complete the survey with 5 points extra credit.

Data Collection Instrument

Instructors in the control and treatment sections administered the post-survey, via a Qualtrics link, in lab on week 13. Only responses from students who completed the assignment, and the entire survey were used for analysis. Additionally, because of the low number of non-binary and "prefer not to state" respondents, these survey responses were removed from analysis as to not risk identifying these students. Additional studies should investigate these demographic variables if a larger sample size is available.

The survey contained modified questions from the Instructional Materials Motivation Survey (IMMS) which was originally created to assess how instructional material affects learner motivation (*The Effect of Instructional Media on Learner Motivation*, 2005). The original survey contained 36 questions with 5-point Likert scale-items, while the modified one used for this study contained 11 questions. Each question on the IMMS corresponds to a measure from the ARCS (Attention, Relevance, Confidence, Satisfaction) model. The IMMS is considered a valid survey instrument with a reliability coefficient (.96). This survey has previously been modified for a prior podcast intervention study and reported a reliability coefficient of .97. For the design of this project, I modified questions from the IMMS and computed Cronbach's alpha coefficients to check the internal consistency of the instrument, where $< .5$ is unacceptable, $.5$ is poor, $.6$ is questionable, $.7$ is acceptable, $.8$ is good, $> .9$ is excellent (Gliem & Gliem, 2003). In this study, the overall Cronbach's coefficient was $.86$ which is good. The subscales had Cronbach's coefficients: attention = $.61$, relevance = $.82$, satisfaction = $.83$. The confidence measure only contained 1 question therefore, it was not appropriate to calculate Cronbach's. The overall Cronbach's coefficient for the IMMS survey was $.88$, which is good.

Additionally the survey contained demographic questions, including underrepresented minority (URM) status defined by the CSU as people who identify as African American, Latinx, or Native American (*Students | CSU*, 2021).

Analysis Approach

The data was downloaded from Qualtrics, an online survey software, and cleaned so only completed surveys were used for analysis. I conducted statistical analysis using SPSS (SPSS Statistics | IBM, 2019). Means are reported \pm the standard error (SE). An alpha level of $p \leq 0.05$ was used for rejecting null hypotheses in all statistical analyses. Cronbach alpha coefficients

were calculated to determine the instrument's internal reliability, relative to this study.

Independent t-tests were conducted to identify differences in mean scores between male and female students for each ARC measure. Analysis of variance (ANOVAs) were used to determine differences in motivation among students based on age, class standing, first-generation college status.

Results

Results of Demographic and Academic Profile Characteristics

Most students in both the treatment and control group were between the ages 18 – 22. Additionally, there was a slight majority of females enrolled in the course and non-URM students. The treatment group did have more first-generation college students enrolled compared the control (Table 1).

Table 4 Descriptive demographic results of the treatment and control group for Spring 2023.

Demographics	Treatment (N = 123)	Control (N = 113)
Gender		
Female	84 (66%)	77 (65%)
Male	39 (30%)	36 (30%)
Race/Ethnicity		
Non-URM	68 (54%)	59 (52%)
URM	55 (46%)	54 (48%)
Age		
18 – 21	107 (86%)	103(91%)
22 – 25	14 (11%)	8 (7.0%)
26+	2 (1%)	2 (1.7%)
First Generation College Student		
No	56 (45%)	63 (55%)
Yes	67 (55%)	50 (45%)

Descriptive Results of Student Responses for IMMS Measures for Spring 2023

Table 2 lists the mean scores for all students who completed the assignment, regardless of condition group to determine overall motivation after completing their respective assignment. Because the Likert-scale ranges from 1 to 5, with a different number of questions for each measure, the maximum scores vary. However, results indicate that the students were motivated

by the assignment. The average attention measure score was 81%, confidence was 78%, relevance was 80%, and satisfaction was 73%.

Table 5 Descriptive statistics of all student responses for the four subscales on the IMMS survey for Spring 2023.

Measure	M	SD
Attention (out of 10)	8.10	1.51
Confidence (out of 5)	3.90	.882
Relevance (out of 20)	16.04	2.86
Satisfaction (out of 15)	11.05	2.52

Attention Between Treatment and Control

Independent sample t-tests were conducted to determine if there were differences in attention between the treatment and control after listening to their respective podcast assignments. Students in the treatment groups scored 8.03 ($\pm .159$) out of 10 points and the control scored 8.18 ($\pm .111$) after the assignment with no significant differences between the groups ($F(1, 234) = .608, p = .228, \text{partial eta squared} = .096$ (Table 3).

Confidence Between Treatment and Control

Independent sample t-tests were conducted to determine if there were differences in confidence between the treatment and control after listening to their respective podcast assignments (Table 3). On average, students in the treatment groups scored 4.00 ($\pm .085$) out of 5 points and the control scored 3.80 ($\pm .076$) after the assignment with significant differences between the groups ($F(1, 234) = .142, p = .038, \text{partial eta squared} = .232$ (Figure 1).

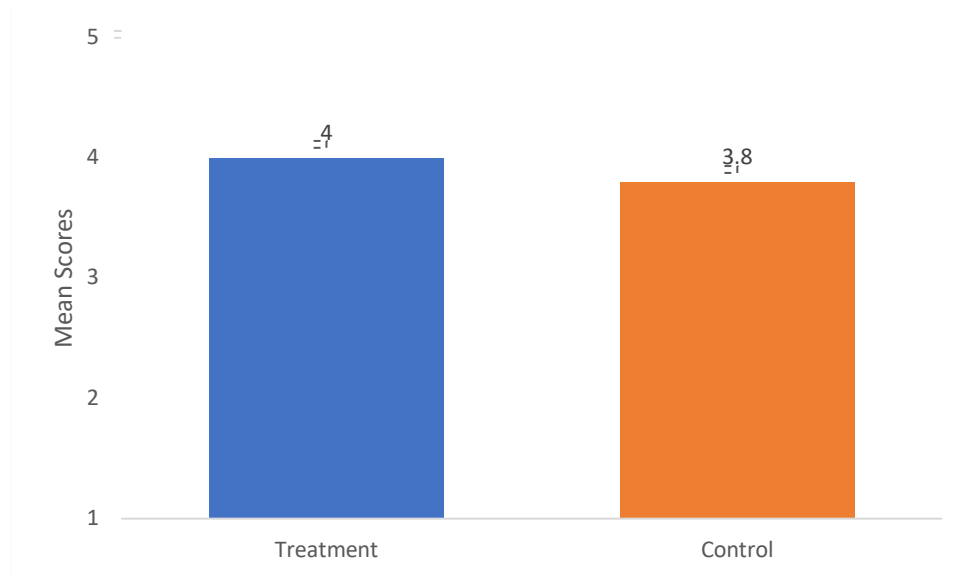


Figure 3 Student confidence scores after podcast assignment. Average scores on post-survey for treatment (blue) and control (orange) groups. Possible score of 5 points, error bars represent \pm SEM.

Relevance Between Treatment and Control

Independent sample t-tests were conducted to determine if there were differences in relevance between the treatment and control after listening to their respective podcast assignments (Table 3). On average, students in the treatment groups scored 16.61 (\pm .263) out of 20 points and the control scored 15.42 (\pm .253) after the assignment with significant differences between the groups ($F(1, 234) = 2.403$, $p < .001$, partial eta squared = .425 (Figure 2).

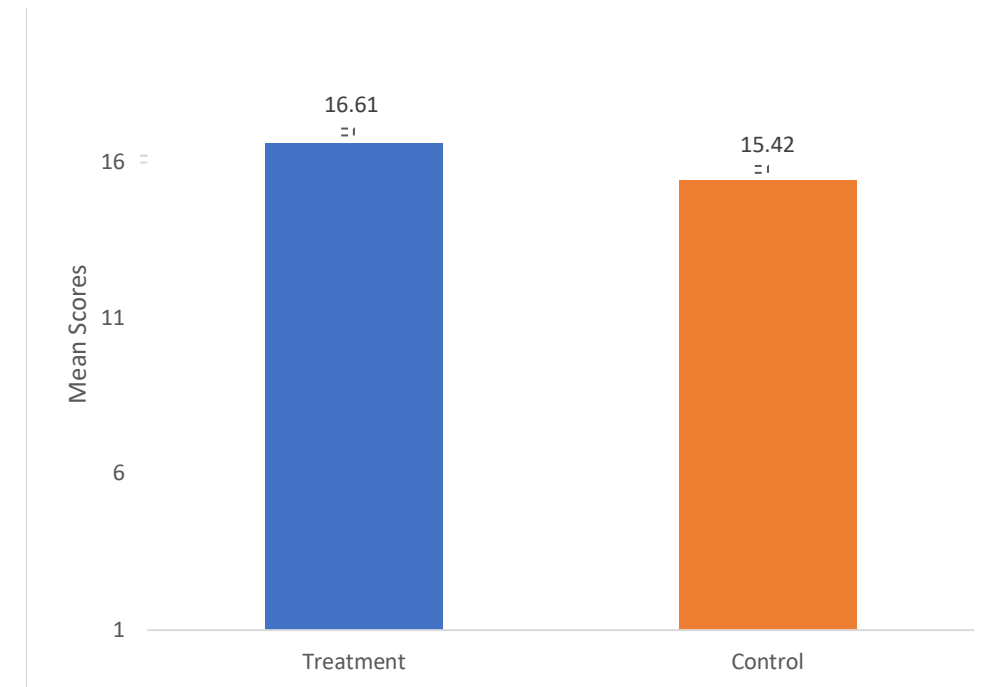


Figure 4 Student relevance scores after podcast assignment. Average scores on post-survey for treatment (blue) and control (orange) groups. Possible score of 20 points, error bars represent \pm SEM.

Satisfaction Between Treatment and Control

Independent sample t-tests were conducted to determine if there were differences in satisfaction between the treatment and control after listening to their respective podcast assignments (Table 3). On average, students in the treatment groups scored 11.32 (\pm .254) out of 15 points and the control scored 10.75 (\pm .199) after the assignment with significant differences between the groups ($F(1, 234) = 13.367$, $p = .041$, partial eta squared = .225 (Figure 3).

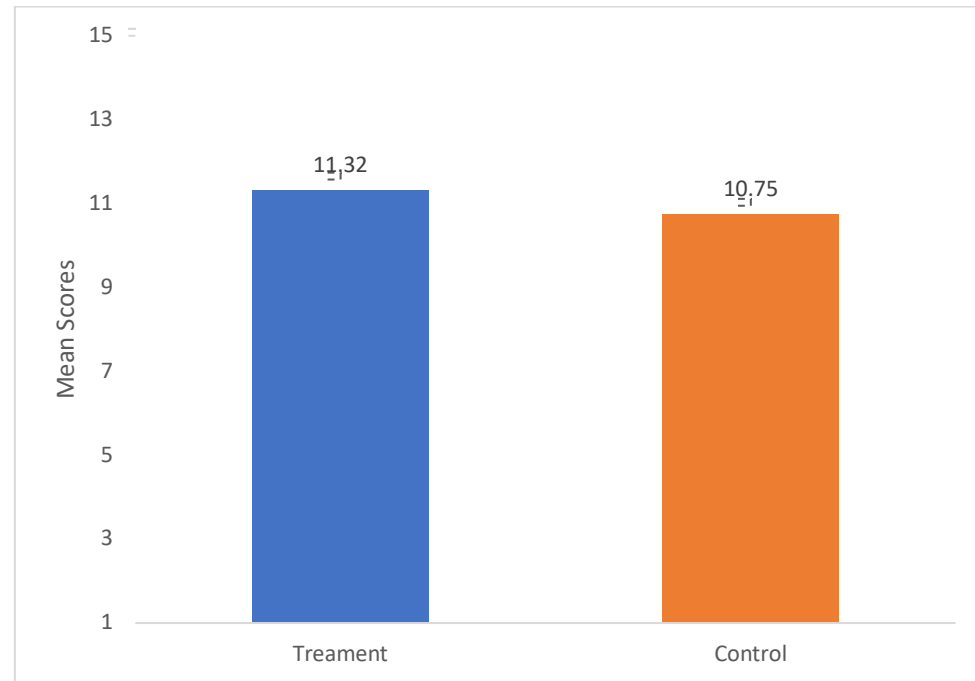


Figure 5 Student satisfaction scores after podcast assignment. Average scores on post-survey for treatment (blue) and control (orange) groups. Possible score of 15 points, error bars represent \pm SEM.

Table 6 Means, standard deviations, and standard errors for ARCS measure between condition groups, after listening to podcast assignment at a large, public, Hispanic Serving Institution in Spring 2023.

Measure	Group	Mean	Std Deviation	St Error	p-value	eta square
Attention (10 pts)	Treatment	8.03	1.76	.159	.228	.096
	Control	8.18	1.18	.111		
Confidence (5 pts)	Treatment	4.00	.941	.085	.038	.232
	Control	3.80	.804	.076		
Relevance (20 pts)	Treatment	16.61	2.91	.263	<.001	.425
	Control	15.42	2.68	.253		
Satisfaction (15 pts)	Treatment	11.32	2.82	.254	.041	.225
	Control	10.75	2.11	.199		

Discussion

This study investigated the impacts of a podcast assignment, highlighting scientist narratives, on student motivation in a biology classroom. Overall, this study supports the prior research that finds podcast assignments help motivate STEM students and additionally found that a podcast assignment featuring an on-campus faculty member had greater impact on students’ confidence, relevance, and satisfaction levels, with no difference in attention.

Exploring Outcomes Between Condition Groups

Students in the control group scored slightly higher than the treatment group in the attention subscale (Table 3). However, it should be noted there was not a significant difference in

attention which we attribute to the impact a faculty narrative can have on attention. The control group listened to an episode of *Ologies* which was established in 2017 with over 19,000 reviews on Spotify as of writing this paper (*Ologies Episodes*, 2023). Whereas, the treatment group listened to *The World of Scientists*, which is much more recently developed and a novice podcast in comparison. We theorize that because the treatment group listened to a narrative of a person they could potentially interact with, their attention was held to a similar level of a well-established podcast.

Students in the treatment scored significantly higher in the confidence measure compared to the control group (Table 3). We hypothesize this is the case because *The World of Scientists* covered topics like imposter-syndrome, being a first-generation student, and mentioned programs offered at the university where this study took place. Therefore, the information provided, from someone within their academic community, likely gave students more confidence to apply the information they listened to, compared to *Ologies*. However, only one question was used for the confidence measure to avoid student survey fatigue, therefore future research should include more questions to get a better look at the dynamics at play.

Students in the treatment also scored significantly higher on the relevance measure compared to the control group (Table 3). This podcast assignment served the purpose to determine if an on-campus faculty narrative had a greater impact on biology students and this finding greatly supports that claim. While both podcasts had information relevant to first-year biology students, *The World of Scientists* was a more personalized episode because the faculty member grew up in a nearby town before attending the same university these students were at. Additionally, the faculty member's narrative aligns with the demographic data in the study (Table 1) as he was a first-generation, underrepresented minority student in STEM. While

Ologies also featured a person of color, the anecdotes provided likely did not resonate with the control group as it did with the treatment group.

Lastly, students in the treatment group scored significantly higher than the control in the satisfaction measure (Table 2). Although students overall found the podcast motivating (Table 2), it was an additional assignment in a lab course and therefore likely came at a cost for students, for example their time. Therefore, the control group likely felt a greater cost since the podcast was not as relevant to them and therefore was a less satisfying assignment to complete. The treatment group likely had more satisfaction out of listening to their episode because the content was catered to their academic interests more. Future research should include qualitative analysis to parse out the underlying dynamics that are occurring here.

Study Limitations

This study was done to establish a general baseline for biology student motivation. Therefore, limitations mostly surrounded logistics to keep the survey and assignment efficient and low cost for students' time. That included only having one question for the confidence measure and so future studies should expand the number of questions to get a more powerful analysis. Additionally, *The World of Scientists* podcast was fairly new, and the quality of the content has since increased. Future studies should try to streamline the content more strategically along with the IMMS assessment to get a better idea of why these assignments are impacting students the way they are. However, the podcast episode served its purpose for this study, and we would recommend using a similar format in future studies.

Conclusion

This study investigated the impacts of scientist narratives on student motivation in a biology classroom via a podcast assignment. Overall, we found a podcast assignment featuring

an on-campus faculty member had greater impact on students' confidence, relevance, and satisfaction levels, with no difference in attention compared to an interview of a nonaffiliated scientist.

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APPENDIX A

Survey Questions

1. The podcast episode included information that stimulated my curiosity
2. I learned some things from the podcast episode that were surprising or unexpected
3. I could not really understand quite a bit of the material in the podcast episode.
4. The content in the podcast episode is relevant to my academic interests
5. I can apply the information given in the podcast episode to my experience here at CPP.
6. The content in the episode is worth knowing
7. The content in the podcast episode is useful to me
8. I enjoyed the podcasts so much that I would like to know more about academia
9. I really enjoyed listening to the material in the podcasts.
10. It was a pleasure to use the podcasts in class.

Likert Scale Used

Strongly Disagree 1	Disagree 2	Neither agree nor disagree 3	Agree 4	Strongly Agree 5
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Demographic Questions

- Gender
 - Male
 - Female
 - Non-binary
 - Prefer not to say
- Age
 - 18-21 (1)
 - 22 – 25 (2)
 - 26+
- How would you best describe yourself:
 - White
 - Hispanic, Latino or Spanish
 - Black or African American
 - Asian
 - American Indian or Alaska Native
 - Middle Eastern or North African
 - Native Hawaiian or Other Pacific Islander
 - Not listed:

Ojeda Evelyn* **DREAMers in high education: Mental health challenges, supportive factors, and resiliency**

Dr. Pumacchua

Abstract

DREAMers, or undocumented students, are heavily underrepresented in higher education. According to the American Immigration Council, the United States comprises 44.9 million immigrants, and among those immigrants, there are 10.3 million undocumented immigrants. However, only 454,000 undocumented immigrants are pursuing higher education, constituting only 2% of the student population in higher education. Although limited, past literature addressing DREAMers in higher education focuses on Latinx individuals and their political and legal challenges. However, there is a significant gap regarding their lived experiences in higher education, especially with a mental health focus. Therefore, the present qualitative study explored the mental health challenges, supportive factors, and resilience that DREAMers (AB-540, DACA recipients, TPS, ISRT eligible) encounter in higher education. Specifically, DREAMers from diverse racial/ethnic backgrounds were highly encouraged to participate. Moreover, the CRT UndocuCrit framework was used to highlight DREAMers' lived experiences and resiliency. The emerging themes from preliminary findings illustrate strong parental motives behind their motivation to pursue higher education, and institutions having a serious lack of resources for DREAMers, specifically mental health resources. Notably, final findings will illustrate fundamental information on the supportive and challenging factors that impact the mental health of DREAMers and their perseverance within higher education.

Major objective(s)

The aim of this study was to examine the challenging and supportive factors, especially related to mental health, that DREAMers from diverse racial/ethnic backgrounds experience in higher education. This study examined these factors within a CRT UndocuCrit framework, in order to contextualize their experiences and highlight their resilience. Research Question(s):

1. What supportive factors contribute to the mental health of DREAMers within higher education settings?
2. What challenging factors impact the mental health of DREAMers within higher education?

Background research with analysis and summary of literature review

The United States is a country largely made of immigrants. According to the American Immigration Council, there are a total of 44.9 million immigrants in the U.S. population, within those immigrants there 10.3 million undocumented immigrants and only 33% of all immigrants hold a college degree or more (American Immigration Council, 2021). From the total number of undocumented immigrants, approximately 454,000 are pursuing higher education degrees, with only 45,400 of those students enrolled in graduate

school (Freeman & Valdivia, 2021). In fact, DREAMers constitute only 2% of the student population in higher education (Nienhusser & Romandia, 2022).

It is important to take into consideration the different factors that are preventing the DREAMer student population from increasing in higher education. To a large extent, the most common limiting factor is their documentation status, as some students are AB 540, In State Resident Tuition (ISRT) eligible, Deferred Action for Childhood Arrivals (DACA) recipients, others have a Temporary Protective Status (TPS), while others might be unauthorized immigrants. Each legal status has different qualifications and benefits. For instance, the AB 540 status allows undocumented students in California to be eligible for in-state financial aid. ISRT allows undocumented students to be eligible for in-state financial aid in some states outside of California. The DACA status allows students to apply for a work permit, driver's license, and a social security number; this status must be renewed every two years (American Immigration Council, 2021). Lastly, TPS is a temporary immigration status of 6-18 months that allows undocumented students to have a work permit and a stay of deportation (American Immigration Council, 2022). Further, when it comes to higher education, each state has policies regarding financial aid and educational access for DREAMers (Freeman & Valdivia, 2021). These barriers make the task of finding the right university to attend a much harder endeavor than it seems.

DREAMers in Higher Education: Challenging Factors

To begin with, aside from their documentation status, DREAMers face other challenges when attending higher education institutions. A study by Locke and colleagues (2020) examined the barriers that arise from racial oppression and social inequality for Latina DREAMers in higher education. The study found that participants had to be highly selective when looking for universities to attend as they had to take into consideration whether the university accepted DREAMers and if they provided financial support (Locke & Gonzalez, 2020). The study findings suggest that DREAMers undocumented status contributed to financial related stress, as well as a state of uncertainty of their futures when attending higher education institutions. In addition to financial related stress, other common factors that have been found to impact these student's educational experiences include the misinformation and lack of resources available for DREAMers in higher education. Previous studies have shown that not many universities provide resource centers for DREAMers, and as a result, many institutional agents lack the knowledge that could possibly help the student succeed in their academic journey (Castrellon, 2021). Other studies have focused on DREAMERS pursuing graduate degrees. Related to this, Freeman and Valdivia (2021) examined the opportunities and resources offered to undocumented graduate students. The study found a major lack of programs and resources available for undocumented graduate students. Consequently, these lack of resources created challenges for these students in terms of their mental health, sense of belonging, and disclosure status (i.e., disclosing undocumented status to institutional agents) (Freeman & Valdivia, 2021). Additionally, a common misinformation about DREAMers is that they are all Latinx individuals. Although Latinx individuals do make up a large amount of the DREAMer student population, there are also DREAMers from a variety of ethnic groups. Reed and colleagues (2022) highlighted the strong stigmatization on undocumented students, as most of them are stigmatized to be Latinx when this is not reflective of reality. In relation to this point, other studies have found

that non-Latinx DREAMers (Asian, Black, Middle Eastern/ North African, White) are less likely to disclose their documentation status and are often excluded from campus programming and resources aimed at DREAMers (Reed, Aptekar & Hsin, 2022). In addition to the previously mentioned factors, past literature has scarcely covered the mental health challenges that undocumented students encounter. Past findings have demonstrated that DREAMer's immigration status, the sociopolitical climate, as well as the various policies present affect their psychosocial well-being (as reflected in their experiences with stress, anxiety, depression, confidence, sense of belonging, identity development, and emotional stability) (Nienhusser & Romandia, 2022). All factors considered, there are several challenges that DREAMers inevitably encounter due to their legal status. It is important to consider the impact of these challenges on the educational trajectories of DREAMers, especially in the context of higher education.

DREAMers in Higher Education: Supportive Factors

Moreover, despite facing significant barriers outside their control, DREAMers have demonstrated a high level of determination in their academic journey, allowing them to succeed and account for the current 454,000 of DREAMers in higher education (Freeman & Valdivia, 2021). Martinez and colleagues (2021) emphasized that undocumented student's resilience and persistence is what has led them to overcome the barriers they encountered to achieve their dreams. Further, research has shown that obtaining education is an opportunity that DREAMers highly value, as they see it as the main path to strive and succeed (Martinez et al., 2021). In addition, although undocumented resources are limited in universities, past literature demonstrates that DREAMers feel safe from immigration police on their university campus (Reed et al., 2022). Also, when undocumented students have questions or face academic barriers it is most likely they search for help within the university. Freeman and Valdivia (2021) mention that DREAMers turn to their mentors, peers, and resource centers for advice regarding their academic plans. As most DREAMers are first generation students, it is unlikely that a family member can provide academic guidance for them. Additionally, having a community that is supportive to undocumented students can be highly encouraging. For instance, My Undocumented Life is an online service in which DREAMers can find opportunities and connect with other DREAMer students with similar academic journeys (Freeman & Valdivia, 2021). Ultimately, DREAMers desire to succeed academically is what really builds their resilience and perseverance in higher education.

Theoretical Framework: Undocumented Critical Theory

When examining the experiences of DREAMer students in higher education, it is essential to examine the sociopolitical context encapsulating those lived experiences. Aguilar (2018) introduces the Undocumented Critical Theory (UndocuCrit) framework which is based on the Critical Race Theory (CRT). The UndocuCrit framework highlights the importance of the lived experiences of undocumented individuals, along with illustrating their resilience and honoring their story. Apart from examining the lived experiences, UndocuCrit focuses on four main principles that are often overlooked in the traditional CRT. The first principle, fear is endemic among communities, explains that racist immigration practices, regulations, and policies were created to inflict fear among undocumented individuals.

As a result, many undocumented individuals avoid government entities and programs, including higher education institutions. The second principle, different experiences of liminality translate into different experiences of reality, states that differences in legal/ documentation status lead to different lived experiences. This principle highlights the importance of providing inclusion and a sense of belonging in undocumented communities. This principle is key, as undocumented individuals lived experiences are influenced by their education access, DACA status, race, ethnicity, and local context. The third principle, parental sacrificios became a form of capital, emphasizes that parents of undocumented individuals are a strong motive behind their resilience. Undocumented individuals witness and understand the sacrifices their parents make for them, as a result they are motivated to succeed. This principle also explains that parental sacrifices can be a cognitive capital for undocumented individuals-- witnessing the barriers their parents experience influences their motivation to gain knowledge, skills, abilities, and create networks. Lastly, the fourth principle, *acompañamiento* is the embodiment of mentorship, academic redemption, and community engagement, explains the importance of creating resources and providing knowledge to fit the experiences of undocumented individuals (Aguilar, 2018). The UndoCrit Theory encourages future research about DREAMers to contribute to the framework and tailor it if needed.

E.Methods (Experimental procedure/design):

Participants

This research study intended to explore the lived experiences of DREAMer students, age 18 and above, that attend 4-year higher education institutions in the United States for more than one year. The total number of participants were 6 students that identified as DREAMers (e.g., undocumented, AB-540, DACA recipients, Temporary Protected Status, ISRT eligible). DREAMers from diverse ethnic backgrounds were highly encouraged to participate in this study.

Materials

Online databases from the California State Polytechnic University, Pomona were used to obtain supporting literature for this research study. Also, digital platforms such as Zoom and social media/email were utilized for interviews and recruitment, respectively.

Measures

A demographic survey was created with the purpose of obtaining relevant background information from the participants. There were a total of 14 demographic questions, the questions inquired about participants' age, sex, gender identity, ethnicity, birthplace, immigration status, among others (see Appendix A for the complete questionnaire). A semi-structured interview was also constructed for participants to complete. The interview consists of a total of 17 interview questions, and focused on their experiences in higher education mainly emphasizing the supportive and challenging factors that impacted their mental health in higher education settings (see Appendix B).

Procedures

Before data collection commenced, the study was approved by the Institutional Review Board at California State Polytechnic University, Pomona. Subsequently, participants were recruited and provided with an informed consent form through email. Participants were recruited via email (see Appendix E), letters (see Appendix F), and flyers (see Appendix D), and social media. For example, recruitment flyers were sent out in email letters to DREAMer Resource Centers and other relevant resource centers and organizations within the United States. Then, participants completed a sign-up form attached to the flier. Afterwards, potential participants were contacted by email and were asked for their availability and to complete the informed consent form, which informed them about the purpose of the study, potential risks, video recording, compensation, etc., (see Appendix C). After they completed the informed consent form and sent their availability, interviews took place via Zoom lasting from 30-45 minutes average. Subsequently, after interviews were completed, participants received their \$10 Amazon gift card as compensation for their participation, along with a debriefing statement with resources that they could potentially find helpful (see Appendix G).

Ethical consideration

Before starting the interviews, the completed informed consent form was collected from all participants. Therefore, all the information that the participants provided was confidential and their responses were completely anonymous.

Preliminary Result

Preliminary results of common themes that emerged from the zoom interviews include strong parental motives. In other words, parents were a strong motivation behind DREAMers desire to pursue higher education and completing their degree. Additionally, another theme was the serious lack of resources for DREAMers in higher education institutions. Lastly, there are no mental health resources available specifically for DREAMers and their lived experiences.

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Analysis of the Physicochemical Properties of a CPP Compound Collection

Abstract

The majority of people use medicine in their daily lives, such as painkillers, blood pressure medicine, and cholesterol medicine. In order to have these successful-working medicines, researchers go through a strenuous process known as drug discovery. Drug discovery is the process of investigating a variety of small molecules in order to find a potential molecule that can later be synthesized or developed into a medicinal drug. To accelerate this time-consuming process, researchers developed computational methods in order to classify small molecules based on certain physicochemical properties. The majority of the computational methods are derived from Lipinski's Rule of 5, the Fragment Rule of 3, and Veber's studies. These guidelines serve to predict what makes a molecule well absorbed by the body and permeable, which correlates with increased success throughout the drug discovery process. In order to have good absorption, certain characteristics, such as their hydrophobicity, molecular weight, hydrogen bond donors, hydrogen bond acceptors, molecular flexibility, and polar surface area, fall within certain optimal ranges. We have analyzed a collection of molecules created by Cal Poly Pomona students and calculated the physicochemical properties of the collection. This study sheds light on the molecular properties of the collection and potential to become good lead-like molecules. Future directions include expanding the small molecule collection and creating a searchable database incorporating our findings.

Introduction

Drug discovery is a time-consuming process, begins by chemists and researchers combing through libraries that contain thousands of small molecules in the hope of finding a lead

that can be later developed into a successful drug. With intentions to create a faster process, several chemists examined the similarities of drugs that were well absorbed. For instance, Lipinski analyzed one library, searching for which characteristics made a drug orally active. In his research, he noticed similarities in the drug's chemical and physical characteristics that lead to a successful oral drug. This discovery, known as the Rule of 5, on orally active drugs helped in the predictability of potentially bioavailable molecules. This paper will focus on what makes an oral drug absorbable and the characteristics that correspond to good drug absorption and permeability by explaining Lipinski's rule of 5 and improvements on his 'rules'. The results of the experiment organize and details which previously synthesized molecules were within the 'acceptable' range.

Literature Review

Absorption and Drug Distribution

Drug action consists of three phases: pharmaceutical (how the drug dissolves), pharmacokinetic (how the body breaks down the drug), and pharmacodynamic (how the drug affects the body).⁴ Lipinski and Veber's rules are applied mainly to the pharmacokinetic phase (drug absorption, distribution, metabolism, and excretion), more specifically it focuses on absorption. Once an oral drug is absorbed into the bloodstream, it is distributed to different parts of the body; however, this distribution is not even.⁴

Polarity/ poorly absorbed

Typically, polar drugs can be taken orally. When polar drugs break the Rule of 5, then they often must be administered by injection because they're poorly absorbed by the digestive system.⁴ Highly polar drugs do have a chance of being absorbed in many ways. If a highly polar

drug has a molecular weight of less than 200 grams/mole, then it can be absorbed into the blood supply and pass in between cells that line the gut wall. A more common method involves a highly polar drug taking over transport proteins. These proteins usually transport other highly polar compounds that are needed for biosynthetic pathways. If the structure of the drug is similar in structure to what is needed, then it can be passed through.⁴ However, polarity in a drug can also be changed. Scientists can mask, remove, or add a polar group by changing its molecular structure using functional groups. By masking a polar functional group with an alkyl or acyl, polarity of the overall drug can decrease since an alkyl group is hydrophobic. The larger the alkyl group, the less polar the drug can become.⁴ The organic synthesis of certain molecules can help modify their polarity, which is important for the drug optimization process.

Rule of 3 & Rule of 5

With thousands of small synthetic and natural molecules, chemists and researchers have created libraries that organize and differentiate drugs based on their desired properties.¹ These libraries are vital for drug discovery as it can help narrow down the list of potential drugs, creating useful databases for potential hits and leads. To further reduce the number of small molecules to be studied, several computational methods can be used, such as fragment-based discovery and LLAMA (Lead-Likeness and Molecular Analysis). Fragment-based discovery follows the 'Rule of Three': molecular weight is less than 300, the number of hydrogen bond donors (HBD) and number of hydrogen bond acceptors (HBA) are less than or equal to 3, number of rotatable bonds (NROT) is less than three, and polar surface area (PSA) is less than 60.² This aids researchers in reducing the number of fragments (small molecules) that have the potential to be developed into a better lead. While LLAMA focuses on giving a "lead-likeness penalty" (LLP), penalizing certain properties that are outside the "lead-like" range.¹ Using

different software, these computations can be used to predict potential lead-like molecules, without the need to synthesize them.

However, for libraries that produce hits for oral drugs, they typically follow the 'Rule of Five' (molecular weight is less than 500, the number of HBD is less than 5, the number of HBA is less than 10, and logP is less than 5)³ and Veber's research (PSA is less than 140 and number of rotatable bonds is less than 10).⁴ If more than one of these set guidelines is not followed, the drug will most likely have poor absorption and permeability.⁴

Hydrogen bond donors and acceptors

One of the key characteristics of Lipinski's Rule of 5 is the number of HBD's and HBA's that are present in a compound, which can ultimately affect its permeability. Lipinski first stated that there can be no more than 5 HBD groups and 10 HBA groups in a compound, otherwise, it could also disrupt its permeability across a membrane bi-layer and may need to be administered by injection rather than orally.² HBA would account for the total oxygen and nitrogen atoms that are found in a compound, however, medicinal chemists and researchers would often disregard any weak HBA present.⁴ This ultimately caused Lipinski's Rule of 5 to be seen as a guideline rather than a strict set of rules. Another key finding by researcher Veber discovered that polar surface area could substitute the hydrogen bond group factor as a characteristic for the Rule of 5. A polar surface area less than (or equal to) 140 angstroms (\AA^2) and number of rotatable bonds less than (or equal to) 10.⁴

Partition Coefficient

Another fundamental factor that can affect absorption and permeability is how hydrophobic or hydrophilic the drug is. This factor is vital for absorption and distribution as it

helps researchers determine if the drug will make it to its intended target. In order to measure a compound's relative hydrophobic and hydrophilic natures, researchers examine $\log P$. P , the partition coefficient, is the ratio of concentration of a drug in octanol and its concentration in an aqueous solution, given in equation 1.⁴

$$P = \frac{\text{concentration in oct}}{\text{concentration in water}} \quad (1)$$

If P is a high value, the drug is too hydrophobic; thus, it will dissolve faster in the GI and will not properly be absorbed. If P is low, then it would be hydrophilic, and it will not be able to pass through lipid membranes.⁴ Therefore, the drug must have a balanced ratio of hydrophilicity and hydrophobicity to make it to its target.

$\log P$ can also indicate the polarity of a molecule. For a molecule to be considered polar, it must either be charged or neutral with a partial charge. Hydrophobic molecules are nonpolar, meaning they have a neutral charge; while, hydrophilic molecules are polar, having either a negative or positive charge or significant partial charges in polar functional groups.

Molecular flexibility/ rotatable bonds

Veber also demonstrated how molecular flexibility (and the number of rotatable bonds) plays an important part in oral bioavailability. The more flexible a molecule is, the less orally active it will become. Therefore, researchers and scientists tend to limit the amount of rotatable bonds to 7 or fewer to avoid this and improve the likelihood of its oral bioavailability.

Researchers have set this limit as to not disrupt Lipinski's guidelines and its administration method.⁴ However, there are some exceptions to the rule, where the molecular weight of a compound can affect the number of rotatable bonds that are present. If a compound has a molecular weight of more than 500 grams/mole, then it is more than likely that the compound

has more than 10 rotatable bonds present.⁴ In order to avoid surpassing the limit, rigidification was introduced as a means to improve a drug's interaction with the molecular target and to decrease the number of rotatable bonds in that compound. The guidelines provided by Lipinski are essential tools that can help predict oral bioavailability. Although there are some exceptions to these guidelines, most molecules tend to follow them, otherwise it is administered as an injection.

Methodology

To create the library, the 42 molecules were first drawn using ChemDraw. The files were then saved and imported into Data Warrior, a software that can compute physiochemical properties. With Data Warrior, the following properties were computed: SMILES (a string of characters that represents each chemical structure), total molecular weight, cLogP, HBA, HBD, PSA, drug likeness, molecular flexibility, molecular complexity, non-H atoms, rotatable bonds, and sp^3 -atoms.

The data was inputted in Excel, as seen in figure 1. Then, Excel was used to sort the data obtained from Data Warrior. The data was organized into 17 columns (as seen in figure 2): Ro5 (rule of 5) total molecular weight, Ro5 cLogP, Ro5 H-acceptors, Ro5 H-donor, polar surface area, drug likeness, molecular flexibility, molecular complexity, non-H atoms, rotatable bonds, sp^3 -atoms, Ro3 molecular weight, Ro3 clogP, Ro3 HBA, Ro3 HBD, Ro3 rotatable bonds, and ro3 PSA. For the Ro3 columns, an 'if' formula was used to determine whether the characteristic was 'good' (followed the rule of 3) or 'bad' (its value was not within the range of rule of 3).

These columns were then filtered out to determine which molecule obeyed the rules.

Molecule #	Smiles	Total Molweight	cLogP	H-Acceptors	H-Donors	Relative PSA	Druglikeness	Molecular Flexibility	Molecular Complexity	Non-H Atoms	Rotatable Bonds	sp3-Atoms	Polar Surface Area
1	<chem>CC(C)C(c1ccc1)N1C(C1=O)O</chem>	205.256	1.4665	3	1	0.19298	2.8832	0.19836	0.8218	15	1	6	40.54
2	<chem>CN(c1ccc1)c1c1=C[N+](=[O-])=O)C1=O</chem>	204.185	-0.4728	5	0	0.31667	-1.7046	0.14101	0.77373	15	1	2	66.13
3	<chem>CN(c1ccc(Br)c1)c1c1=C[N+](=[O-])=O)C1=O</chem>	283.081	0.2524	5	0	0.28136	-3.4946	0.13518	0.82449	16	1	2	66.13
4	<chem>CN(c1c(C1=O)ccc2c2Br)C1=O</chem>	240.056	1.3016	3	0	0.21715	-2.2035	0	0.79548	13	0	1	37.38
5	<chem>CS(c1ccc1)c1NC(C1)CC1=O</chem>	235.306	1.7922	3	1	0.3118	1.4467	0.32608	0.65055	16	3	5	71.47
6	<chem>O=C(C(C1)C1=O)Nc1ccc1c2cccnc12</chem>	240.261	1.631	4	1	0.26935	1.2919	0.2468	0.73114	18	2	3	59.06
7	<chem>O[C@H](C1)C[C@H]1C(Nc1ccc2cccnc12)=O</chem>	242.277	1.4873	4	2	0.26805	1.5365	0.2468	0.72413	18	2	5	62.22
8	<chem>O[C@H](C1)C[C@H]1C(NC(C1)CC1=O)</chem>	225.311	1.1774	3	2	0.33835	4.1431	0.49169	0.54381	15	4	7	77.57
9	<chem>O=C([C@H](C1)C[C@H]1)Nc1ccc1Nc1ccc1</chem>	294.397	2.2525	3	2	0.14969	1.7729	0.51414	0.626	22	6	7	41.13
10	<chem>CCOC(N(C1)CCC1NC(C1)C[C@H]1O)=O</chem>	270.328	0.6299	6	2	0.31131	-0.42453	0.39519	0.64597	19	4	13	78.87
11	<chem>O=C([C@H](C1)C[C@H]1)Nc1ccc1NC1(C(C2)C3)CC3CC2C1</chem>	338.493	2.9096	3	2	0.1401	2.3377	0.40111	0.72232	25	5	16	41.13

12	<chem>O[C@H](C1)C[C@H]1C(Nc1ccc2cccnc12)=O</chem>	242.277	1.4873	4	2	0.26805	1.5365	0.2468	0.72413	18	2	5	62.22
13	<chem>CS(c1ccc1)c1NC(C1)CC1=O</chem>	235.306	1.7922	3	1	0.3118	1.4467	0.32608	0.65055	16	3	5	71.47
14	<chem>CS(c1ccc1)c1NC([C@H](C1)C[C@H]1N(Cc1ccc1)C1=O)C1=O</chem>	416.587	4.7049	3	1	0.1386	3.3981	0.44407	0.74343	30	8	9	57.64
15	<chem>CC(O[C@H](C1)C[C@H]1)C(Nc1ccc2c1c2)C1=O</chem>	284.314	1.9719	5	1	0.27232	1.58	0.26701	0.74882	21	4	6	68.29
16	<chem>CCC(O[C@H](C1)C[C@H]1)C(Nc1ccc2c1c2)C1=O</chem>	298.341	2.4263	5	1	0.25593	2.4533	0.2936	0.75474	22	5	7	68.29
17	<chem>CN(c1c(C1=C[N+](=[O-])=O)ccc2c2Br)C1=O</chem>	283.081	0.2524	5	0	0.28136	-3.4946	0.13518	0.84479	16	1	2	66.13
18	<chem>CC(C)(C)[Si](c1ccc1)(c1ccc1)O[C@H](C1)C[C@H]1C(Nc1ccc1c2cccnc12)=O</chem>	480.682	5.794	4	1	0.12455	-31.925	0.3985	0.81812	35	7	9	51.22
19	<chem>CC(O[C@H](C1)C[C@H]1)C(Nc1ccc1c1S)C1=O</chem>	279.359	2.1331	4	1	0.30783	1.7957	0.31455	0.69754	19	5	8	80.7
20	<chem>CC(C)(C)[Si](c1ccc1)(c1ccc1)O[C@H](C1)C[C@H]1C(Nc1ccc1c1S)C1=O</chem>	475.727	5.9552	3	1	0.14384	-31.733	0.43342	0.79383	33	8	11	63.63
21	<chem>COc1ccc([C@H]([C@H]1)C(C2)C(Nc3ccc4cccnc34)=O)[C@H]2O)c1</chem>	348.401	3.1617	5	2	0.22358	3.2237	0.32787	0.81435	26	4	7	71.45
22	<chem>CC(O[C@H](C1)C[C@H]1)C(Nc2ccc3c1c2c3)C1=O</chem>	390.438	3.6463	6	1	0.23175	3.2506	0.31417	0.84401	29	6	8	77.52
23	<chem>CC(O[C@H](C1)C[C@H]1)C(Nc2ccc3c1c2c3)C1=O</chem>	385.422	3.5519	6	1	0.24425	-1.122	0.3001	0.84401	29	5	6	92.08

25	<chem>CCC(O[C@@H](C1C@H)1C(Nc2ccc3ccnc23)=O)C@H]1c1cc1)ccc1OC)=O</chem>	404.465	4.1007	6	1	0.22144	4.0896	0.32542	0.8486	30	7	9	77.52
26	<chem>CC(O[C@@H](C1C@H)1C(Nc2ccc2)c2SC=O)C@H]1c1cc1)ccc1OC)=O</chem>	385.483	3.8075	5	1	0.25694	3.4641	0.35874	0.82089	27	7	10	89.93
27	<chem>COC(Cc1cc1)ccc1O)=O</chem>	166.175	1.225	3	1	0.27096	-6.8927	0.60136	0.52258	12	3	4	46.53
28	<chem>COC(Cc1cc1)ccc1O)=O</chem>	166.175	1.225	3	1	0.27096	-6.8927	0.60136	0.56687	12	3	4	46.53
29	<chem>COC(Cc1cc1)ccc1Br)=O</chem>	229.072	2.2959	2	0	0.15818	-8.7725	0.60136	0.57233	12	3	3	26.3
30	<chem>COC(Cc1ccc(Br)c1)=O</chem>	229.072	2.2959	2	0	0.15818	-8.7725	0.60136	0.61059	12	3	3	26.3
31	<chem>COC(Cc1cc1)cc(-c1ccc(CC(OC)=O)c2c2O)c1O)=O</chem>	330.335	2.4496	6	2	0.2854	-6.8927	0.56009	0.79161	24	7	8	93.06
32	<chem>COC(Cc1cc1)cc(-c1ccc(CC(OC)=O)c2c2O)c1OC)=O</chem>	358.389	3.001	6	0	0.23179	-6.9825	0.53714	0.8267	26	9	10	71.06
33	<chem>COC(Cc1cc1)ccc1Oc1cc1C=O</chem>	270.283	2.8996	4	0	0.21301	-9.0694	0.63122	0.64597	20	6	4	52.6
34	<chem>C[C@@](C1(C)C@H)1C(O)=O</chem>	130.142	-0.1931	3	2	0.4213	-1.0059	0.5071	0.74893	9	1	7	57.53
35	<chem>CN(C)/N=C(/c1ccc1)c1N1)C1=O</chem>	189.217	0.3633	4	1	0.26956	4.2245	0.23878	0.71581	14	1	2	44.7
36	<chem>Oc1c(C(c1cc2)ccc2F)Nc2c2C(C)2)ccc1</chem>	271.334	3.3586	2	2	0.11697	-2.0731	0.4207	0.74499	20	4	7	32.26
37	<chem>CN(C)C1(c1cc2)cc(OC)c2OC)c1C2OC)=O)c1cc2Br</chem>	498.372	4.1536	6	0	0.16759	1.3425	0.33474	0.9244	32	6	10	57.23

38	<chem>CN(C)C(c1cc2)c1cc3cc(OC)c3OC)c1c2OC)=O)c1c2</chem>	498.372	4.1536	6	0	0.16759	1.3425	0.33474	0.92918	32	6	10	57.23
39	<chem>CN(C)/N=C(/c1ccc1)Br)c1N1C)C1=O</chem>	282.14	1.4468	4	0	0.17933	3.0117	0.21915	0.81243	16	1	3	35.91
40	<chem>C(c1cccc1)N(C1(CCC1)OC1)c2c1cccc2</chem>	265.355	3.0454	2	0	0.065927	1.006	0.28078	0.80343	20	2	8	12.47
41	<chem>O=CNC1C(C)CC1</chem>	155.196	0.6587	3	0	0.22286	1.9742	0.35043	0.68515	11	0	8	29.54
42	<chem>CN(C)C1(c1cc2)cc(OC)c2OC)c1C2OC)=O)c1cc2</chem>	419.476	3.4284	6	0	0.17738	3.1325	0.34103	0.88462	31	6	10	57.23

Figure 1: Table containing all computed molecules in the library including all factors of Lipinski's of 5, Veber's guidelines, the Fragment rule of 3, and the SMILES code.

Molecule #	Total Molecular Weight	cLogP	H-Acceptors	H-Donors	Polar Surface Area	Doughlance	Molecular Flexibility	Molecular Complexity	Non-H Atoms	Rotatable Bonds	qS-Atoms	Ros3 - Molecular Weight	Ros3 - cLogP	Ros3 - HBA	Ros3 - HBD	Ros3 - Rotatable Bonds	Ros3 - PSA
1	292.242	1.4465	1	1	40.24	2.832	0.1984	0.1212	15	1	1	0.000	0.000	0.000	0.000	0.000	0.000
2	294.146	-0.4728	1	0	66.13	-1.2048	0.14381	0.72373	15	1	1	0.000	0.000	0.000	0.000	0.000	0.000
3	281.081	0.3124	1	0	66.11	-1.4044	0.19181	0.82449	16	1	2	0.000	0.000	0.000	0.000	0.000	0.000
4	290.064	1.2028	2	0	37.24	-2.2028	0	0.79548	13	0	0	0.000	0.000	0.000	0.000	0.000	0.000
5	293.888	1.7922	1	1	71.47	1.4487	0.32689	0.60055	16	3	1	0.000	0.000	0.000	0.000	0.000	0.000
6	292.242	1.4465	1	1	59.86	0.2709	0.2468	0.7114	16	2	0	0.000	0.000	0.000	0.000	0.000	0.000
7	292.217	1.4873	1	1	62.21	1.1305	0.2468	0.73151	16	2	0	0.000	0.000	0.000	0.000	0.000	0.000
8	293.311	1.1774	3	2	77.57	4.1431	0.49289	0.54381	15	4	2	0.000	0.000	0.000	0.000	0.000	0.000
9	294.301	2.2525	1	2	41.13	1.7729	0.14414	0.1828	22	4	1	0.000	0.000	0.000	0.000	0.000	0.000
10	299.248	0.6299	1	2	78.87	-0.42453	0.39318	0.64937	16	4	1	0.000	0.000	0.000	0.000	0.000	0.000
11	308.493	2.8096	1	2	41.33	2.1377	0.40111	0.72123	21	5	1	0.000	0.000	0.000	0.000	0.000	0.000
12	292.217	1.4873	4	2	62.21	1.1305	0.2468	0.72418	16	2	0	0.000	0.000	0.000	0.000	0.000	0.000
13	293.888	1.7922	1	1	71.47	1.4487	0.32689	0.60055	16	3	1	0.000	0.000	0.000	0.000	0.000	0.000
14	416.817	0.7049	0	1	57.69	0.2021	0.44473	0.74443	20	0	0	0.000	0.000	0.000	0.000	0.000	0.000
15	284.314	1.9719	1	1	68.29	1.18	0.26701	0.74882	21	4	1	0.000	0.000	0.000	0.000	0.000	0.000
16	288.341	2.4281	1	1	68.29	2.4531	0.2994	0.7474	22	5	2	0.000	0.000	0.000	0.000	0.000	0.000
17	281.081	0.3124	1	0	66.13	-1.4044	0.19181	0.82449	16	1	1	0.000	0.000	0.000	0.000	0.000	0.000
18	480.682	1.794	4	1	51.27	-11.925	0.1984	0.81812	33	7	1	0.000	0.000	0.000	0.000	0.000	0.000
19	279.326	2.1331	1	1	80.7	1.7927	0.31453	0.60754	16	5	1	0.000	0.000	0.000	0.000	0.000	0.000
20	491.571	3.9015	1	1	83.81	-11.198	0.43842	0.79181	31	8	1	0.000	0.000	0.000	0.000	0.000	0.000
21	348.401	3.8817	2	2	71.45	3.2227	0.32787	0.81435	26	4	2	0.000	0.000	0.000	0.000	0.000	0.000
22	385.488	3.4463	1	1	77.57	3.7058	0.32478	0.84401	26	4	1	0.000	0.000	0.000	0.000	0.000	0.000
23	385.421	3.5109	1	1	92.08	-1.122	0.3001	0.84401	29	5	1	0.000	0.000	0.000	0.000	0.000	0.000
24	418.448	3.6297	1	1	84.89	0.80265	0.3312	0.87389	31	7	1	0.000	0.000	0.000	0.000	0.000	0.000
25	404.462	4.1007	1	1	77.57	4.0928	0.32474	0.8468	26	7	1	0.000	0.000	0.000	0.000	0.000	0.000
26	385.488	3.8017	1	1	89.81	3.4641	0.33874	0.82089	27	7	1	0.000	0.000	0.000	0.000	0.000	0.000
27	386.176	1.225	1	1	46.53	-6.8927	0.60136	0.52258	12	3	1	0.000	0.000	0.000	0.000	0.000	0.000
28	386.176	1.225	1	1	46.53	-6.8927	0.60136	0.56687	12	3	1	0.000	0.000	0.000	0.000	0.000	0.000
29	279.072	2.2959	2	0	38.1	-8.7725	0.60136	0.57233	12	3	0	0.000	0.000	0.000	0.000	0.000	0.000
30	279.072	2.2959	2	0	38.1	-8.7725	0.60136	0.61059	12	3	0	0.000	0.000	0.000	0.000	0.000	0.000
31	330.335	2.4496	1	2	68.29	1.18	0.26701	0.74882	21	4	1	0.000	0.000	0.000	0.000	0.000	0.000
32	358.389	3.001	1	2	71.45	3.2227	0.32787	0.81435	26	4	2	0.000	0.000	0.000	0.000	0.000	0.000
33	270.283	2.8996	1	0	77.57	4.1431	0.49289	0.54381	15	4	2	0.000	0.000	0.000	0.000	0.000	0.000
34	130.142	-0.1931	1	2	57.69	0.2021	0.44473	0.74443	20	0	0	0.000	0.000	0.000	0.000	0.000	0.000
35	189.217	0.3633	1	1	62.21	1.1305	0.2468	0.73151	16	2	0	0.000	0.000	0.000	0.000	0.000	0.000
36	271.334	3.3586	1	2	80.7	1.7927	0.31453	0.60754	16	5	1	0.000	0.000	0.000	0.000	0.000	0.000
37	498.372	4.1536	1	0	57.23	1.3425	0.33474	0.9244	32	6	1	0.000	0.000	0.000	0.000	0.000	0.000
38	498.372	4.1536	1	0	57.23	1.3425	0.33474	0.92918	32	6	1	0.000	0.000	0.000	0.000	0.000	0.000
39	282.14	1.4468	1	0	35.91	3.0117	0.21915	0.81243	16	1	0	0.000	0.000	0.000	0.000	0.000	0.000
40	265.355	3.0454	1	0	12.47	1.006	0.28078	0.80343	20	2	0	0.000	0.000	0.000	0.000	0.000	0.000
41	155.196	0.6587	1	0	29.54	1.9742	0.35043	0.68515	11	0	0	0.000	0.000	0.000	0.000	0.000	0.000
42	419.476	3.4284	1	0	57.23	3.1325	0.34103	0.88462	31	6	1	0.000	0.000	0.000	0.000	0.000	0.000

Figure 2: Condensed table containing all computed molecules in the library including all factors of Lipinski's of 5, Veber's guidelines, and the Fragment rule of 3. Data in this table is organized based on potential lead.

Analysis

This experiment was conducted to create and organize a database based on previously made molecules in a CPP laboratory. This database sorts and filters molecules based on whether they could be a potential lead. Although several physiochemical properties were computed with Data Warrior, the properties that were focused on were molecular weight, cLogP, HBA, HBD, PSA, and rotatable bonds. Using filters on Excel, the data was organized into categories of the guidelines that were emphasized for this research.

Lipinski's rule of 5 can help researchers predict whether a molecule has the required chemical and physical properties to be known or used as an orally bioavailable drug. Based on the data collected, all 42 molecules followed Lipinski's rule of 5. Veber focused on the number of rotatable bonds and the polar surface area as two new factors for determining drug potentiality and oral bioavailability. This method was used rather than focusing on the number of hydrogen bonds and molecular weight. Of the 42 molecules, 38 followed both Lipinski's and Veber's rules. When drug likeness was added as another factor, only 24 molecules passed. This indicates that these molecules are predicted to have good absorption, permeation, and have the potential to become good orally bioavailable drugs.

The Fragment rule of 3 is a stricter version of Lipinski's rule of 5, utilizing similar properties but with much narrower ranges for "passing" the Rule. When working with many molecules, Ro3 can condense the general number of lead-like molecules to be further tested using Lipinski's rule of 5. Additionally, Ro3 accounts for molecules that are not only orally bioavailable, but those that are injectable as well. The data collected notes that only 8 molecules follow the Fragment rule of 3, and 2 molecules are listed when drug likeness was included. This value was extremely small compared to other methods used.

To have a better understanding of which molecules obeyed both Lipinski's Rule of 5 and Fragment Rule of 3, visual representations were created. Figure 3 and figure 4 depict the cross-section between the two guidelines, with the Lipinski as the blue region and Rule of 3 as the red region. As seen in the graphs, the majority of the molecules fall under Lipinski's Rule; however, the more strict guideline, Rule of 3, has less.

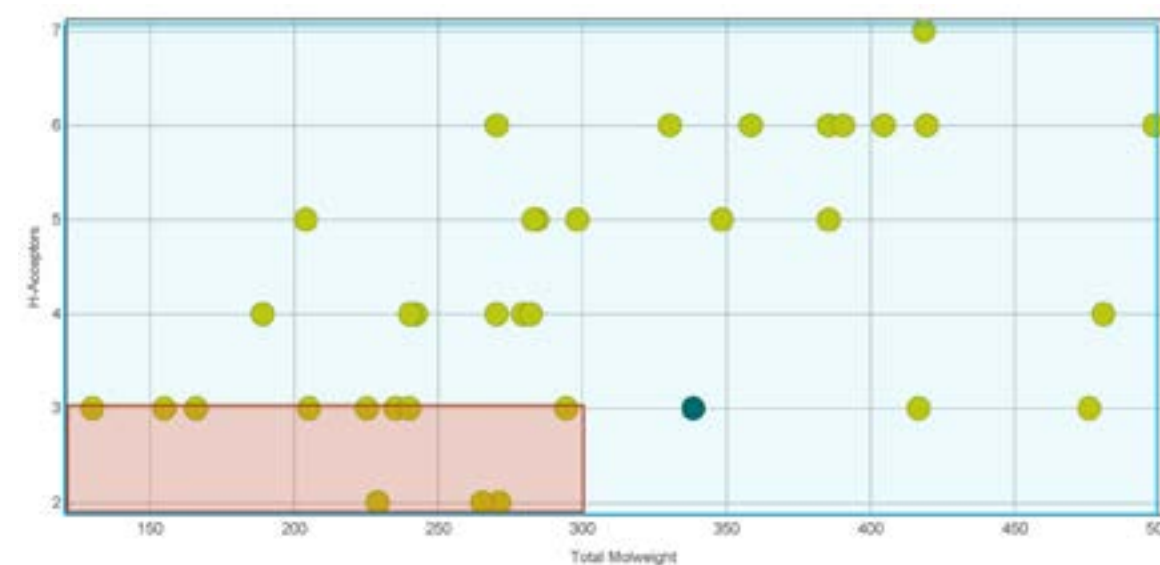


Figure 3: Computational analysis of the number Hydrogen bond acceptors in contrast to the total molecular weight. The blue region represents Lipinski's rule of 5 and the red region represents the Fragment rule of 3.

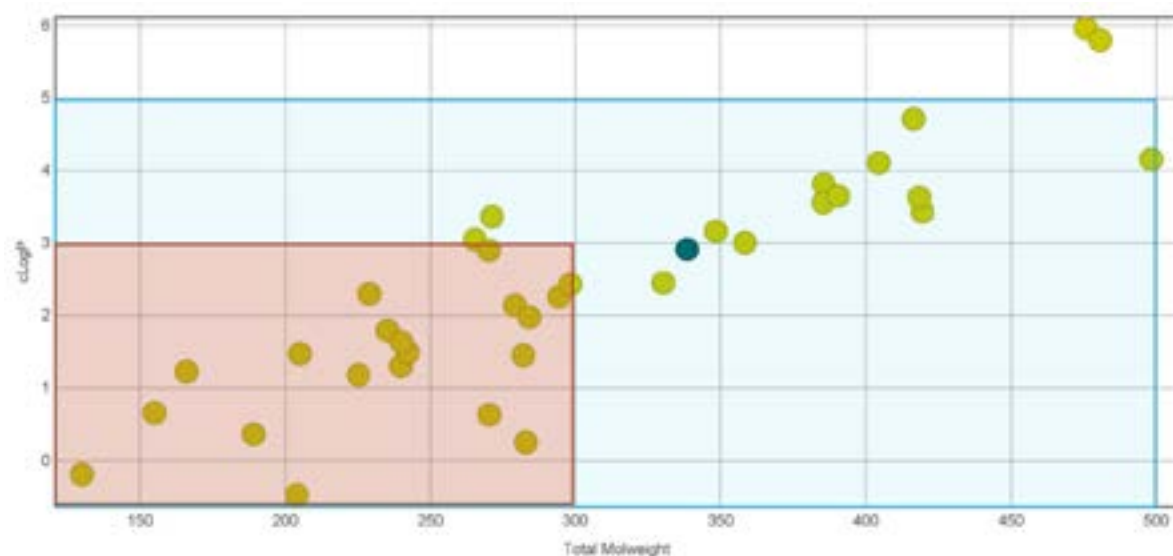


Figure 4: Computational analysis of the cLogP value in contrast to the total molecular weight.

Methods such as Lipinski's rule of 5, the Fragment rule of 3, and Veber's studies were used to determine drug likeness. Data Warrior can also calculate drug likeness, computing a qualitative score based on its similarities to pre-existing drugs. However, drug likeness is only a comparative method and cannot be used to discover new medicinal drugs. As stated previously, all 42 molecules follow Lipinski's rule of 5. When drug likeness is included as a factor, only 25 molecules were considered "good" orally bioavailable drugs.

Conclusion

With the majority of the molecules abiding by Lipinski and Veber's rules, there is a possibility for them to be used to discover potential orally bioavailable medicine. However, with only a handful of the molecules following the rule of three, the molecules cannot be used as fragments. In the future, more molecules can be added to this database to see their physiochemical properties and potential to be good molecules. This database is a tool to help guide future projects, as students and professors have an idea of which molecules can be further developed.

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**Powers
Brian*** **Practical Public Bioethics**

Professor Arago

Abstract

We are allowed to refuse a life-saving surgery, but we are not allowed to drive without a seatbelt. Why are we allowed to make damaging but ultimately self-regarding decisions in a doctor's office, but not outside? In "Public Bioethics," Jessica Flanigan argues that because we value the ability for people to make their own self-regarding health decisions, we should not limit that right in public situations. I argue that these two situations have different considerations; therefore, they require different procedure. In a doctor's office, a doctor can ensure that a patient is informed and competent. In the public context, the state generally knows nothing about the information and competency of the individual. I believe that the state has the right to interfere with potentially damaging self-regarding actions only as much as is necessary to ensure that the individual is competent and informed.

I will prove that the moral symmetry between public and private health choices does not imply a radical overhaul of public health policy.

My paper will exist in the context of contemporary bioethical theory. It is a direct response to Jessica Flanigan, an American bioethicist. I will be drawing upon seminal works, such as *A History And Theory of Informed Consent*, which illustrate the difference models of consent (1986). In this book, the authors describe a view of consent that goes beyond "authorizing powers"—informed consent is when the medical professional ensures that the patient understands the procedures that will be done to them. Additionally, modern liberal theories owe a debt to John Rawls in his book *A Theory of Justice* (1971), who argues that hierarchies can only be justified insofar as they ultimately serve to increase the quality of life for those at the bottom.

This is a theoretical paper. During this time period I was able to refine my diction and syntax to be clearer about my argument. I want to demonstrate that there is a tension in Flanigan's argument between her libertarian commitments and her defense of the doctrine of informed consent, which has some implicitly paternalistic tenets. Ultimately, I want to argue that it is possible to hold Flanigan's views, but the vast majority of people would not find them satisfactory. I offer an amended version of Flanigan's argument that incorporates paternalism with minimal coercion.

I was able to research my ideas thoroughly. I talked to multiple professors about my ideas and refined my thesis. Initially, my paper was based around a communitarian critique of the subject matter. It was a shallow approach to the topic that failed to produce a substantive argument. Instead, I decided to write a paper that agreed with her thesis that there is no moral asymmetry between public and private medical decisions. Such a paper would allow me to think alongside Flanigan's arguments and bring them to unexpected conclusions.

I have not been as productive during this period as I would have preferred. I have been focused on my other classes and assignments, but I have still made minor progress towards finishing the project.

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Ramirez Karla **How do multigenerational households deal with vaccine hesitant members?**

Abstract

What makes a person vaccine hesitant and how does that affect people who live in multigenerational homes? Our research examines how the decision by some members to not vaccinate against COVID-19 affected everybody living within the home. While studies on vaccine hesitancy have examined the perspectives of individuals, little is known about how multigenerational households respond to vaccine hesitancy within the household. We offer an anthropological perspective using research focused on multigenerational households. Currently, there is little to no qualitative studies on multigenerational households during the pandemic. We found five primary reasons for vaccine hesitancy among multigenerational household members: mistrust in the government, lack of information regarding vaccines, the FDA's rush towards approving the vaccine, health and medical reasons including but not limited to pregnancy and asthma, and family and friends influencing decision making. We also found that many multigenerational households had to take into consideration other family members who were more at risk of developing life threatening symptoms. In some cases, people felt pressured to get vaccinated. Ultimately, family and friend influence as well as lack of information have the greatest influence on vaccination status. These findings suggest that many people didn't want to get vaccinated at first, but rather felt as if they needed to in order to please or protect loved ones at home. These findings are important to document because it can lead us to find better ways of introducing vaccines in the future. It provides information on how to approach public health responses to benefit those within multigenerational households.

Intro

Vaccination records have become a debated topic due to the COVID-19 pandemic. Before the COVID-19 pandemic, vaccination records were not required to do basic activities such as going to work, amusement parks, or even boarding a plane. Hesitancy towards vaccines existed, but the pandemic exacerbated this thought. With the release of the COVID-19 vaccine, misinformation was spreading through social media, news outlets, and much more. This raised concerns of safety for the general public. The pandemic changed the way people lived their daily lives as a result of public demand for vaccination. While studies have shown reasons why individuals choose not to vaccinate, multigenerational households have not been researched. For multigenerational households, looking at vaccination status is interesting because it affects the way the household functions and navigates the pandemic. Our study explores the topic of vaccine hesitancy inside these households. Understanding why families chose not to vaccinate is relevant to this topic. We examine the questions: How did vaccine hesitancy affect relationships within multigenerational households during COVID-19? What were some of the reasons for vaccine hesitancy?

Literature Review

This research is meant to bridge the gap between people who decided to get vaccinated and ones that chose not to. This is an important topic to address as people remain divided. Many people come from very different backgrounds and perspectives, which is significant because the research will allow people to gain an understanding for one another. Many factors play a role in vaccine hesitancy, which include: a misunderstanding in science, not trusting the government, misinformation, or even historically rooted experiences of oppression (Matthews, 2022) A polarizing issue is receiving the vaccine. Many thought people would rush to the first sign of a vaccine; however, this was not the case we have seen during the pandemic. With the rise of Covid cases going up and the rise of political tensions, many patterns began to unfold. In a research study that collected 15 analyses on the COVID-19 vaccine in multiple countries, the acceptance rate was 77.6% for the general population. (Troiano, 2021) When looking at vaccine hesitancy, it is unclear what started the argument of being vaccinated or unvaccinated. It became a one sided topic, as many people were either anti vax or pro vax with very little meeting in the middle. Safety concerns emerged in the US, due to the vaccine being developed in an emergency situation (Troiano, 2021). There have also been concerns on the long-term effects of the vaccine, causing individuals to become cautious. (Mohamed, 2021) In light of these lingering questions, we seek to answer what the driving factors in vaccine hesitancy were among members of multigenerational households. Answering this question will allow us to understand the different reasons that exist relating to getting vaccinated and will give others insight on how to cope with the pandemic. This may be able to bridge the gap for others by giving stories of families who dealt with these issues within their household. It will give more context in the fears they might have faced, or the complex reasoning in which they decided to either get vaccinated or abstain from receiving the first dose.

There has been other research done to analyze vaccine hesitancy in individuals or single-family households. As of 2022, around 27% of children in the US are not fully vaccinated against COVID-19. (Matthews et al., 2022). Most studies involve other types of vaccines, not specifically the COVID-19 vaccine. There have not been studies done on multigenerational families and vaccine hesitancy during the pandemic. During COVID-19, vaccines were a highly debated topic. This research aims to discover what factors may have played a role in choices made by multigenerational families.

Methods

For our research, we focused on multigenerational households. Multigenerational households are defined as having a grandparent, parent, and child living in one household together. Results gained from our study help contribute information on strengthening public health responses to benefit families in multigenerational households. Participants identified as either Black/African American, Asian/Pacific Islander, Native American/Indigenous, or Latino. The study focused on interviewing multigenerational households in or around Los Angeles County. Our data was collected through semi-structured interviews conducted during the fall of 2021 and fall of 2022. In total there were 50 interviews conducted. Participation in this study involved a 30–90-minute conversation with a member of our research team. Conversations took place either in person, on zoom, or on the phone.

The series of questions ask about participants' experiences during the pandemic. Other information such as basic demographic information and city of residence were asked. The questions we focused on for our research discussed the use and concerns regarding the vaccine in each household.

The purpose of the interviews conducted was to understand the relationship within these households and how they navigated through the COVID-19 pandemic. It is difficult to adhere to public health guidelines to physically distance. When it came to our methods of gaining our information, we first had to find someone to interview. We spread the word through the internet and added a small incentive of 25 dollars, to hopefully find people to conduct our research with. Most of us recruited friends that lived in a multigenerational household or even our own family members. The main idea was it could be anybody if they lived in a multigenerational household that they could participate in our study. Once we had an interviewee, we then would set appointments either to meet in person or to meet over zoom as a way of starting the interview process. Once in contact, on the interview day we would start by getting their consent in order to be used in our research. After obtaining consent, we would begin. There were about 80 different questions all focused around getting information on how they have dealt with the pandemic and maybe even different opinions they had on certain topics relating to COVID-19. The interviews documented the experiences of multi-generational families and the challenges they faced navigating COVID-19. This research was done to understand more about how these households addressed COVID-19 and negotiated safety and care. Half of the interviews were conducted during the fall of 2022, with the other half being done during fall of 2021. Once the interviews were concluded, we would thank them for their time.

Once the interviews were done, we then would accurately transcribe everything that was said verbatim. This was done many times in multiple different ways. Many used an application that can transcribe audios for you and would go through their transcriptions to make corrections where it may have messed up, and others would have the audio playing as they typed every single word.

After transcribing it was time to analyze the data that we had collected. We carried out inductive coding. In this stage of the process, we were able to see similarities in themes and other things that were said in other people's interviews. Based on those similarities we coded accordingly in order to do research more swiftly based solely upon the similarities that we saw in our own interviews that we had conducted. One thing that was mentioned a lot was vaccine hesitancy. We found that many people were hesitant to get the vaccine as they were either misinformed about side effects or had strong opinions about it.

Based on the information gained on our analysis, we wanted to further explore and research the topic of vaccine hesitancy. To do that, we had to find peer reviewed articles based around the topic of vaccine hesitancy. The articles mentioned many different factors or reasons that might have influenced the decision on getting vaccinated for some people. This was done in order to gain a better understanding of our own interviews and to be able to see the patterns on who or what demographic might be less prone to getting vaccinated. Other information that was gathered was based upon past interviews that were done and still in the archives from last year's coursework in fall of 2021. These are also important

to our research as we find more cases of vaccine hesitancy, but at a much earlier date when things were still very much shutdown.

In conclusion to our methods and the process of coding, we found five interviews done in the semester of fall 2022 and four interviews in the semester of fall 2021 where there were vaccine hesitant members or members that did not get vaccinated. Some of the limitations that we have faced is the majority of the data is based in America, other than a few peers reviewed articles. This may mean that in other places around the world there could be many different reasons behind people's decisions to get vaccinated that we can't cover well. Another limitation that we have faced is finding enough of the right information. Even though COVID-19 was a huge pandemic there was a lot of misinformation spread out. Some scholarly articles on specific subjects based around COVID-19 aren't out to the public sphere yet, as the pandemic is still currently happening.

Results

Vaccine hesitancy has been a controversial topic with some families refusing to be vaccinated and others still hesitant. Multigenerational households experienced more pressure to get vaccinated due to concerns for family members with health risks. The main reasons we have discovered from our research about COVID-19 vaccine hesitancy is family and friend influence, mistrust in the government, lack of information regarding the vaccines, and health and medical reasons such as pregnancy or allergies. In multigenerational households, we found that some members agreed to vaccination while others refused, which led to family conflict. The data presented below shows 5 interviews conducted in the Fall of 2022. In respect to participants, we used pseudonyms to discuss their stories below.

Participant ID#: LSM01

Participant Pseudonym: Camila

Camila is a 20 year old, who is a part of the 2nd generation within the household. There were five individuals living in the household and three individuals who would visit almost every day. Camila describes vaccine hesitancy from her sister. The five living in the household are all vaccinated, except for the sister and her children, who are under the age of 12 and visit them almost every day. This leads to conflict between the household members and the sister. The father in the household has health complications, so family members are worried for their safety and for the father's safety. The parents are pushing for the sister to get vaccinated, as well as their grandchildren. It is mentioned that the parents are concerned about health risks for their daughter. They are worried that if something happens to their daughter, who would take care of her children? Based on the interview, there were themes of conflict, vaccine status, and safety concerns. At the time of the interview in Fall 2022, five members were vaccinated: father, mother, Camila, and brother. Three members were not vaccinated: sister, niece, and nephew.

Participant ID#: LSV01

Participant Pseudonym: Daniella

Daniella is a 20 year old, who is a part of the 3rd generation within the household. At the time of interview in Fall 2022, all five members of the household were vaccinated: parents, grandparents, and Daniella. Daniella's father was experiencing vaccine hesitancy due to conspiracy theories. This resulted in disagreements about the vaccine. Daniella explains that her father is a doubter. The father's doctor explained that he should get vaccinated due to being at high risk. "So that's kind of what made him end up getting the vaccine even though honestly he, he, uh, kind of fell into some conspiracy theories." (Daniella) This interview had themes of health/medical reasons and mistrust.

Participant ID#: AAG01

Participant Pseudonym: Naomi

Naomi is a 69 year old, who is a part of the 1st generation within the household. At the time of the interview in Fall 2022, two members of the household were not vaccinated: Naomi and daughter. One member of the household was vaccinated: granddaughter. Naomi and her daughter both did not want to receive the vaccine due to not leaving the house and not knowing the side effects. Naomi has heard that people with shellfish allergies cannot take the vaccine. "I don't know the side effects and I know one of them is um people who have shellfish allergies can't take it, so I don't because I have shellfish allergies." (Naomi) The granddaughter was not eager to get the vaccine, like her other family members, but did so because it was needed to graduate and get her degree. All three members discussed not wanting to get vaccinated and mutually agreed, despite the granddaughter receiving it. When asked if it is thought that the vaccine makes you more susceptible to the virus, Naomi feels like it is because that is what she has noticed around her. This interview has themes of health/medical reasons and family/friend influence.

Participant ID#: FNT01

Participant Pseudonym: Kevin

Kevin is a 22 year old, a part of the 3rd generation within the household. At the time of the interview in Fall of 2022, all seven members of the household were vaccinated: grandparents, father, Kevin, sibling, and two cousins. Kevin was skeptical about the vaccine when it first came out. He eventually received the vaccine due to work. Kevin's sibling had a different viewpoint on the vaccine, but also eventually got it. His grandparents were against the vaccine. "My grandma...oh my goodness, my grandmother was very...she was very against it." (Kevin) However, it is mentioned that both grandparents ended up receiving the vaccine. It is unclear why Kevin was skeptical, what his siblings viewpoint was, and why his grandparents were against the vaccine. Kevin stated that it was his father's decision to tell everyone to get the vaccine.

Participant ID#: LMM01

Participant Pseudonym: Mia

Mia is a 33 year old, a part of the 2nd generation within the household. At the time of the interview in Fall of 2022, all eight members of the family were not vaccinated, including children under the age of 12. No one in the household is vaccinated due to fear. Mia states that she was not comfortable with putting anything in her and her family's bodies that has not been studied for a long term. "We don't want to end up being one of those people that end up in the class action lawsuits against big pharma." (Mia) Mia feels like the vaccine does not provide much more protection than natural immunity and that the vaccine could make you more susceptible. Mia also would be upset if the vaccine was required for her children to go to school, due to not knowing the long term side effects of the vaccine.

The data collected below was gathered in the fall of 2021. It is important to note that the Moderna and Pfizer vaccines had just been approved by the FDA in 2020 and the Johnson and Johnson vaccine was still in the trial process. This is significant because in the interviews below, most participants claimed that the main reason for hesitancy was that they felt that the approval of the vaccines were rushed, and they wanted more time to see how it would affect their health. This was especially true for people who had preexisting conditions such as pregnancy, allergies, asthma, and Alzheimer's just to name a few.

Participant ID# LJA01

Participant Pseudonym: Socorro

Socorro is a 49 year old woman and part of the second generation in her household. She has a single person who is considered part of the first generation in her household which is her father. Her generation includes her husband and her sister, while the third generation includes her daughter, son, and two nephews. Socorro was skeptical of getting the vaccine because she thought the government was rushing everyone to get vaccinated. She felt that there wasn't any explanation as to what was in the vaccine and stated, "Not enough evidence, not enough testing, not enough of what side effects would occur after vaccination, what exactly would happen if that's, what, what basically, was making us get sick"(Socorro). The third generation ended up getting vaccinated right away because they were more at risk. The interviewee ended up getting vaccinated after her daughter convinced her to get vaccinated. Socorro did not want her daughter to worry about anything happening to her so she ended up getting vaccinated. It was made clear that after this interview conducted in the fall of 2021, everyone in this household became vaccinated.

Participant ID# LSS01

Participant Pseudonym: Consuela

Consuela is a 40 year old female who is a mother and daughter in this household. Her mother is the only person in the first generation. Consuela and her husband make up the second generation leaving her three sons to complete the third generation.

The adults in this household were vaccinated however the children were not vaccinated. The parents were undecided about vaccinating the children because they felt like there was not enough information or honest information regarding vaccinations for children. They did test their children before letting them go out. They mentioned the children were unhappy about having to get tested to do simple things such as going to play. Their twelve-year-old also has allergies so they were worried about him getting an allergic reaction to the vaccine. Consuela also mentioned that she has friends who work in a hospital, who were unsure about vaccinating their children so she would rather wait to vaccinate her three-year-old. When asked what would convince her to vaccinate her children, she said time and having an FDA approved vaccine for children that is not rushed. As of the fall of 2021 Consuela, her husband, and her mother are all vaccinated but their children ages 12,11,and 5 remain unvaccinated.

Participant ID# FAR01

Participant Pseudonym: Kimmi

Kimmi is a 33 year old female and part of the third generation in her household. Her grandmother is the only member of the first generation while the second generation includes her mom and step-father. The third generation consists of her, her husband, and her sister. There is a fourth generation in this household which would be her daughter. The interviewee and her husband were not vaccinated however everyone else was vaccinated. The participant was not vaccinated because she was pregnant. She mentioned that everyone else was vaccinated and it was very much left to everyone's discretion about getting vaccinated but they ended up getting vaccinated because grandma's age was a concern. As for her husband, she mentioned that the mRNA method of vaccines was too new, and they still saw it as a trial even though the FDA had approved it because it had only been used for less than a year. Had the mRNA vaccine been out for five to seven years like other vaccines then he would have considered getting vaccinated. As of the fall of 2021 the first two generations in this household were vaccinated along with Kimmi's sister. Kimmi, her husband, and her daughter remained unvaccinated. Their reasons for being unvaccinated pertain to medical reasons (her pregnancy) and the FDA's rush towards approving vaccines.

Participant ID# FRA01

Participant Pseudonym: Ezekiel

Ezekiel is a 20 year old male who is a member of the third generation in his household. The first generation includes his grandma and grandpa. His mother and uncle are the second generation members who live in his household. His dad is also second generation however he did not live with his father though had regular contact with him. Ezekiel and his brother are the third generation.

Ezekiel and everyone in his household were vaccinated. He was the last person to get vaccinated and was hesitant to get the vaccine. He was hesitant on getting the vaccine because his father was scaring him into not getting it. His father does not live in the same household. Ezekiel was afraid of how his father would respond when hearing he got

vaccinated. He was not afraid of the repercussions his father claimed would happen if he did get vaccinated. In other words, Ezekiel was more afraid of his father than the misinformation given to him by his father. As of the fall of 2021, Ezekiel ended up getting vaccinated because his family pressured him into getting vaccinated and because he was still in school, and he needed it to graduate. Everyone in the household is vaccinated. His father who does not live with him remained unvaccinated, his reasoning being mistrust in the government and lack of information regarding vaccines.

The data points to a lack of information regarding vaccines as the major factor for not being vaccinated. There is also mistrust in the government and the speed in approvals of vaccines by the FDA. Prior conditions such as pregnancy and allergies play a role in vaccination status. Family members also influence each other's vaccination status.



These graphs represent the comparison of multigenerational households vaccination status based on the semester fall of 2021 and fall of 2022.

Discussion

This paper analyzes how vaccine hesitancy affected the relationships within multigenerational households during Covid-19. By conducting semi-structured interviews, we are able to conclude some reasons for vaccine hesitancy. Among the multigenerational families that claimed to be hesitant towards Covid-19 vaccinations, we were able to distinguish 5 reasons for vaccine hesitancy which are as follows:

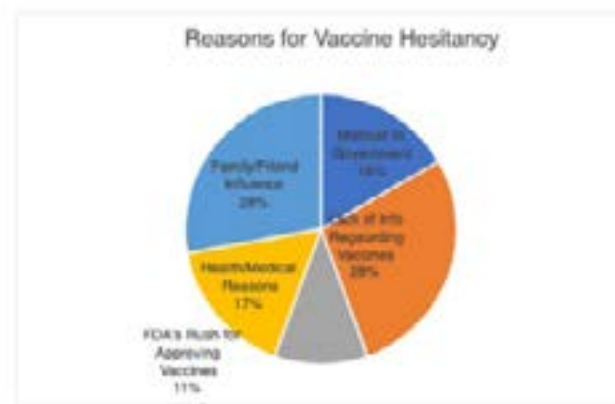
Mistrust in the Government

Lack of information regarding vaccines

FDA's rush towards approving vaccinations.

Health/Medical reasonings including but not limited to Alzheimer's, Pregnancy, Asthma, Allergies, ect...

Family and Friends influencing decision making.



The percentages represent how many times one of these factors were mentioned within the nine interviews. 2 out of 9 mention FDA's rush for approval. 3 out of 9 mention mistrust in the government and health and medical reasons. 5 out of 9 mention lack of information and family and friend influence.

Overall, our research suggests that although there is mistrust in the government regarding vaccines on the personal level, ultimately family members, friends, and lack of information has the greatest influence on vaccination status. The data suggest that people were more likely to be hesitant towards getting vaccinated in 2021 when the vaccines were beginning to be approved. The interviews conducted in 2022 showed that more families were vaccinated.

It is clear by this research that vaccine hesitancy by members of the family affected other members of the household. There were a few cases where discussions were held with all family members that resulted in members getting vaccinated. As mentioned in case #FNT01, Kevin and his family members were skeptical about receiving the vaccine. However, Kevin's father, being the decision maker in the household, ultimately wanted everyone to receive the vaccine. All members of the household are vaccinated. Discussions about vaccines proved to be highly significant during the fall of 2021 when there was more skepticism. As shown in two cases in the fall of 2021, these discussions ended up being successful in convincing members to get vaccinated. In case #LJA01, Socorro was convinced by her daughter to get vaccinated. Through this discussion with her daughter, she realized that she did not want her daughter to worry about her. In case #FRA01, Ezekiel ended up receiving the vaccine because his family discussed with him the need of vaccination records to graduate.

While discussions helped family members get vaccinated, lack of information caused other family members not to get vaccinated. In the fall of 2022, two case studies examined how lack of information enabled household members to not get vaccinated. In case #AAG01, Naomi and her daughter were unsure of side effects that could occur from the vaccine. Naomi felt like receiving the vaccine might make one more susceptible to catching the virus. In case #LMM01, Mia stated no one in the household received the vaccine due to fear and unknown long term side effects. Like Naomi, Mia also felt that the vaccine could make you more susceptible. Both case studies were unsure of side effects, since they felt there was no information being released about how the vaccine would affect people in the

long term. Both case studies also showed examples of how they felt the vaccine would make you catch the virus. We classify this as lack of information because they speak on their feelings and not of actual information. In the fall of 2022, all vaccines were FDA approved. During the fall of 2021, some vaccines were still on trial. Because of this, there were more concerns of lack of information, as shown in two case studies. In case #LJA01, Socorro mentioned that there was no explanation as to what was in the vaccine. She also mentioned that there was not enough evidence or testing to show what side effects would occur due to vaccination. In case #LSS01, Consuela mentioned there was not enough information regarding vaccinations for children. During the fall of 2021, vaccines for children are just starting to get approved/recommended. In the two cases, results differed were Socorro's family did receive the vaccine, however Consuela's family contended that the lack of information was justifiable to not get the children vaccinated.

Conclusion

Overall, we would like to highlight that every family's discussion of vaccinations and hesitancy during the pandemic was different. When we analyze our interviews, we discover the precise ways families handled these circumstances and how they affected their families. As we have observed in the news or social media, vaccine hesitancy was a topic covered during COVID-19. Our data is in line with the literature reviews that contend with the fear of side effects, misinformation, and mistrust from the government. Along with sociological factors, they have a significant role in vaccine reluctance for COVID-19. Our results found five main factors that contributed to vaccine hesitancy: mistrust in the government, lack of information regarding vaccines, the FDA's rush towards approving the vaccine, health and medical reasons including but not limited to pregnancy and asthma, and family and friends influencing decision making.

The data collected suggest that people are more likely to be vaccinated after two years of vaccines being approved by the FDA. It should be noted that the data collected was gathered during the fall of 2021 and fall of 2022, when differences in vaccine approval by the FDA differed. The vaccination status and hesitancy toward vaccines, regarding other viruses in exception to the Flu, was not disclosed. Our research differed from other research regarding Covid-19 because it gives us insight to how multigenerational families were affected by Covid-19. The suggestions we have for the public is to follow vaccination trials from when they are first suggested to when they are released and to discuss the benefits of getting vaccinated with family members and friends.

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Rio
Becerril*

Influences on Biracial and Multiracial Adolescent's Racial/Ethnic Identity Development in Higher Education

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Pumacchahua

Research problem

Previous research has demonstrated that a relationship exists between racial/ethnic identity and self-esteem among biracial and multiracial adolescents, as well as a relationship between self-esteem and parenting style. However, there is very little research that examines the racial/ethnic identity development of biracial/multiracial adolescents, especially in terms of how their parent/caregiver's cultural background influences their parenting practices and the corresponding impact it has on the adolescent's self-esteem and self-concept. Therefore, the goal of the present study is to fill this gap in the research by examining the experiences of biracial adolescents. More specifically, the study aims to further understand the influence of parenting/caregiver style, as well as how biracial adolescents make sense of their racial/identity development within a higher education context. To aid in examining these factors, an intersectionality framework will be utilized to contextualize the lived experiences of biracial/multiracial adolescents within a sociopolitical context.

Keywords for Literature

Racial/Ethnic identity development, parenting style, biracial, multiracial, adolescents, self-esteem, self-concept.

Purpose Statement

According to the 2020 U.S census, the multiracial population has significantly increased by 276% from 2010. In 2010, 9 million people identified as multiracial, and in

2020, that number increased to 33.8 million people. The significant increase in the multiracial population emphasizes that there should also be an increase in research regarding multiracial or biracial individuals. Root (1992) defines *multiracial* as one who has parents from multiple racial backgrounds. Hud-Aleem and Countryman (2008) defined *biracial* as one who has parents from two racial backgrounds. In addition to identifying as biracial or multiracial, self-esteem is another important factor in one's life since it is typically associated as a crucial developmental outcome. As such, being biracial or multiracial is connected to self-esteem, as the development of one's racial ethnic identity significantly impacts their self-esteem.

This is important, as self-esteem is a salient aspect in one's life. Self-esteem could have a variety of positive or negative outcomes, depending on if it is low or high. Specifically, low self-esteem is characterized by negative thoughts and feelings towards oneself. In contrast, positive thoughts, and feelings towards oneself are indicative of high self-esteem. Mental health problems, substance dependence, and lower levels of life and relationship satisfaction are some of the possible outcomes of low self-esteem (Boden, 2008). In extreme cases, low self-esteem can lead to severe depression and death by suicide (Yoo et al., 2015).

Other studies, such as the work by Mann and colleagues (2004), have found that low self-esteem is a determinant in developing depression, eating disorders, anxiety, poor social functioning, and the engagement in risky behavior (e.g., drug use and unprotected sexual activity). On the other hand, overall happiness, as well as resilience to developing mental health problems are some of the outcomes of high self-esteem (Baumeister et al., 2003). Further, high self-esteem has been associated with academic

success, high social functioning, and less risky behavior (Mann et al., 2004). As highlighted by past literature, self-esteem is a crucial part of the adolescent development period and impact various aspects of an individual's life. Consequently, the outcomes of how an individual feels about oneself carry on into adulthood, thus continuing to impact the quality of their lives.

Adolescence is an important population to study, as this is a population that will continue to significantly increase (Kipke, 1999). These increases are relevant, as they also represent increases in the biracial and multiracial adolescent populations. To further define the developmental period of adolescence, Kipke (1999) explains that this period ranges from ages 10-24 years old. Furthermore, as adolescents develop, they are exposed to a multitude of different types of peers. It is important to recognize the influence of peers, as well as the individuals adolescents surround themselves with. Research has consistently demonstrated that for adolescents, their immediate peer group plays a large role in shaping their sense of identity during this developmental period (Kipke, 1999). Meeting different types of peers presents the adolescent with a myriad of social scenarios to practice, learn from, or otherwise be influenced by. For example, one peer might influence another to do well academically, or in the contrary, to engage in delinquent behaviors. Although peers could positively influence other adolescents during this developmental period, it is worth noting that adolescents are keenly vulnerable to negative influence. This developmental period is typically the time in which adolescents engage in the most risk-taking behavior and are the most vulnerable to academic failure, poor developmental outcomes, as well as psychological

problems (Kipke, 1999). As highlighted, adolescence is an important period to study in order to further support their healthy development and success.

Another critical factor that occurs during adolescence is the development of an individual's racial/ethnic identity (Tatum, 2017). To understand this concept, it is essential to discuss what is meant by race and ethnicity. As defined by the American Psychological Association, one's race is determined by the socially significant physical differences between various groups and cultures. Additionally, One's Ethnicity is determined by shared cultural characteristics like practices beliefs, language, and ancestry. According to Umaña-Taylor and colleagues (2014), racial/ethnic identity development is a psychological construct with many facets that consider how people think and feel about their ethnicity and race. Tatum (2017) further expands on this concept when she explains the various dimensions and/or factors that contribute to one's racial /ethnic identity development, as well as how they affect biracial/multiracial adolescents. For instance, factors to consider include: if a child is visibly identifiable as one race more than the other or if they look racially ambiguous, if they have parents/caregivers that are involved in their socialization, the race/ethnicity the main caregiver identifies as, if the child's parents agreed on and promoted their racial/ethnic identity, if the child's extended families are supportive of their biracial/multiracial identity and their parents' relationship, and if the child lives in a predominantly White, mixed neighborhood, or a community of color (Tatum, 2017).

In terms of an individual being visibly identifiable as one race, researchers from Pew Research Center (2016), report that biracial/multiracial adults who are recognized by others as a minority race based on how they look are more susceptible to

experiencing discrimination than those who look White. Similarly, Marks and colleagues (2020) found that multiracial adolescents who frequently experience racial discrimination, also experience higher levels of depression. Undoubtedly, discrimination can cause significant strain on a person, and ultimately lead to low self-esteem. However, when a child has parents or caregivers that are involved and support their racial socialization, they are far more likely to be resilient to discrimination. Thus, resulting in higher self-esteem compared to those with uninvolved and unsupportive parents or caregivers. It is important to note that studies have found that if a parent or caregiver identifies as the same race as the child, it is much easier to be involved and supportive in their child's racial socialization (Tatum, 2017). This is due to the parent and/or caregiver having a common lived experience to that of their child. In contrast, if a caregiver does not share the same racial or ethnic identity as the child, it possible that the child may feel uncomfortable or experience barriers in navigating and making sense of their racial/ethnic identity. Parents/caregivers taking a race-conscious approach to their child's racial socialization has been found to greatly contribute to the child's self-confidence and comfort with their ethnic identity, which will consequently have a positive impact on their self-esteem (Tatum, 2017). To be a race conscious parent or caregiver means to not only openly discuss racism with their children, but also be involved in multiracial communities, and expose their children to the cultures associated with their biracial/multiracial identities (Tatum, 2017).

The support of a child's extended family in relation to their biracial/multiracial identity, as well as the quality of relationships between parents/caregivers are key factors that contribute to the child's self-esteem. For instance, if a child's extended

family is not supportive of their parent's relationship or their biracial/multiracial identity, they may discriminate against the child and comment racial slurs about their parent(s), which will consequently negatively impact the child. The racial/ethnic composition of the neighborhood a biracial/multiracial child lives in is also an important factor influencing the child's racial/ethnic identity and self-esteem. For instance, if a biracial/multiracial child lives in a predominantly White neighborhood, it is more probable for them to feel out of place and be discriminated against. On the other hand, if a biracial/multiracial child lives in a mixed neighborhood or community of color, they are more likely to feel accepted and comfortable, thus promoting high self-esteem (Tatum, 2017).

Overall, research suggests that there are added challenges in raising a biracial/multiracial child to have a positive sense of their racial/ethnic identity, as they may be treated differently and/or poorly by their parents, extended family, as well as peers (Gibbs, 1989). Furthermore, biracial/multiracial adolescents also appear to be at a greater risk of developing various mental health concerns. Some researchers found that biracial/multiracial adolescents may develop conduct disorders, substance abuse, academic problems, psychosomatic disorders, depression, and suicidal behaviors (Gibbs, 1989). However, supportive families and peers act as a protective barrier from these varying issues, which also promotes high self-esteem and resiliency.

In addition to racial/ethnic identity, the practices involved in how a parent/caregiver raises a child (i.e., their parenting and/or caregiving styles) are also a critical factor shaping children and adolescents' development. A parenting style is defined as the various ways in which a parent/caregiver and child interact (Steinberg, 1993). Joseph and John (2008) explain that parenting styles affect a child and adolescent's overall

psychological and social functioning, which underscores its critical importance. In terms of parenting styles, Baumrind (1967) describes four main types-- authoritarian, authoritative, permissive, and neglectful. An authoritarian parent usually values obedience and respect from their child over autonomy. They are likely to control every aspect of their child's life, they are less supportive, and will result to corporal punishment when their child disobeys. Authoritarian parenting has been associated with children being unhappy, indecisive, having low self-esteem, lacking social and academic competence, as well as developing resentment towards their parents/caregivers. In contrast, authoritative parents are not only known to promote autonomy in their children, but are also warm, nurturing, and supportive. Thus, their children are likely to be happier, independent, have high self-esteem, as well as good social and academic skills (Joseph & John, 2008).

Next, permissive parenting is characterized as being nurturing and accepting; however, these parents do not tend to set boundaries with their children and let them do whatever they want. Although this parenting style will enable children to develop high self-esteem, children are likely to be unhappy and exhibit problem behaviors such as not respecting boundaries or authority, as well as lacking self-regulation. Lastly, uninvolved parents are also known as neglectful parents. They act as if their children do not exist and leave them to raise and care for themselves. This results in children having low self-esteem, minimal self-control, and being less competent than their peers (Joseph & John, 2008).

Furthermore, a study by Zakeri and Karimpour (2011) assessed the effects of different parenting styles on self-esteem, but more specifically, they examined which

parenting style predicts self-esteem. Findings suggested that students were more likely to develop high self-esteem when their parents/caregivers followed an authoritative parenting style. Meaning, their parents/caregivers were involved and supported their independence.

As highlighted by the aforementioned research findings, environmental factors have a vital role on a person's racial/ethnic identity development. This is especially true when an adolescent's environment changes as a result of them leaving home for college. For many students, this can be a drastic change. For instance, if a person that identifies as Black goes from living in a predominately Black or diverse community their whole lives, to living on a predominantly White campus, they may face discrimination. The change in how people are treated based on their race/ ethnicity depends on how salient their race is to others in their environment (Tatum, 2017). In contrast, if a person of color goes from living in a predominantly White neighborhood to living on a campus that is highly diverse, their race will not be as hyper-visible to the students as it would be on a predominantly White campus. This, in turn, creates a more comfortable and supportive environment for students in the adolescent stage to develop their racial/ethnic identity (Tatum, 2017). This will then aid in building high self-esteem and a positive self-concept in adolescence (Tatum, 2017).

To effectively understand adolescents and the different factors they encounter that impact their development, the Intersectionality Framework will be utilized. The intersectionality framework is a great guide for examining how various forms of inequality and discrimination can come together and hinder those who are not inherently privileged in different ways such as their age, gender, environment, race/ethnicity,

sexual orientation, socioeconomic status, among others (Crenshaw, 1989). For instance, a homosexual White male is automatically privileged in terms of gender and race, as these social identities are privileged in the West, but not in terms of their sexual orientation. In contrast, a heterosexual Black woman is privileged in terms of her sexual orientation, but not her race/ethnicity or gender. The intersectionality framework is a useful lens in holistically understanding the unique lived experiences of an adolescent.

As highlighted, parent/caregiver styles are a vital part of adolescents' self-esteem/self-concept, and overall development. Additionally, one's environment, and change in environment is also important during adolescence. More specifically, an adolescent's environment changes once they go to college, especially if the college is different in demographics than the previous environment, they were in. This is important because college is where a large portion of adolescents spend their time, as well as when they are further developing their racial/ethnic identity. Understanding how adolescents develop their racial/ethnic identity is relevant because of the impact it has on their self-esteem and overall wellbeing. And, given what we know about how the importance of environment, parenting/caregiver style, and racial/ethnic identity development, a lot is still unknown about how these factors impact biracial/multiracial adolescents in higher education. Therefore, the aim of my study is to fill this gap in the research by qualitatively examining the experiences of biracial/multiracial adolescents. More specifically, the factors that influence biracial/multiracial adolescents' racial/ethnic identity, and self-esteem/self-concept, such as parenting style, and environment will be evaluated. The Intersectionality framework will be utilized to contextualize the lived experiences of biracial/multiracial adolescents within a sociopolitical context.

Research Question

What factors influence biracial and multiracial adolescent's racial/ethnic identity in higher education?

Methods

Participants

The purpose of this study was to investigate the influence parenting/caregiver style, and environment has on biracial/multiracial adolescent's racial/ethnic identity development in higher education. As such, participants in this study included five adolescents aged 18-24 that identify as biracial or multiracial. Furthermore, they were also current students at four-year universities in the U.S.

Measures

Participants were required to answer demographic questions, which consisted of questions on how they identify in terms of their race, age, sexual orientation, gender, and socioeconomic status (see Appendix A). The study utilized a qualitative approach. Meaning, the participants were asked a series of questions in a semi-structured interview regarding their self-esteem, the parenting/caregiver style they were exposed to, racial/ethnic identity, and environment. For instance, participants were asked how they came to understand what it meant to be biracial or multiracial (see Appendix B for the complete list of questions).

Procedures

Before data collection commenced, this study was approved by California State Polytechnic University, Pomona's Institutional Review Board (IRB). Once the study was approved, recruitment occurred through emails, announcements, and social media.

Qualifying participants were then selected. Participants were given informed consent authorizing participation followed by the completion of interviews. Once interviews were completed, research assistants were recruited through announcements and received IRB approval before starting interview transcriptions.

Ethical Considerations

Participants' informed consent was necessary before the start of the study. To ensure the privacy of the participants, their responses were not linked to any information that would identify them.

Resources

Access to the literature on the topics of multiracial or biracial adolescents' self-esteem was necessary. As such, the library databases at California State Polytechnic University, Pomona were utilized. In addition, this study required the use of audio recording for the semi-structured interviews.

Results

Demographic and Contextual Data

To better understand participant's backgrounds, they were asked a series of questions regarding their racial/ethnic identity, their parents/caregivers, their school and home environment, their living situation, etcetera. More specifically, questions on the demographic questionnaire addressed (a) how they identify in terms of race/ethnicity, (b) who their main parent(s)/caregiver(s) were growing up, (c) their main parent(s)/caregiver(s) race/ethnicities, (d) if they identify as biracial, multiracial or both, (e) how they identify in terms of gender, (f) their age, (g) what 4-year university in the United States they are currently attending, (h) their class standing (e.g., sophomore,

senior), (l) their major, (j) what their current living situation is like (e.g., currently living at home with parent/caregiver, on campus, living off campus with roommates or others, etc.), (k) Which country they were born in, (l) What language(s) they speak, (m) if they are the first in their family to attend a four-year university, (n) hat the demographics were like in their neighborhood growing up (e.g., Predominately White, Black, etc.), and (o) what the demographics are like on their college campus (e.g., Race and ethnicity of students on campus).

There was a variety of different responses regarding how participants identify in terms of race/ethnicity (see Table 1).

Table 1
Race/Ethnicity participants identify as

Race/Ethnicity	<i>n</i>	%
Filipino and Peruvian	1	20%
Mexican, Black, and Cuban	1	20%
Mexican and Turkish	1	20%
White, European, and Mexican	1	20%
Filipino and Mexican	1	20%

Note. N=5.

As shown in Table 1, some of the participants identify as a couple of the same ethnicities. For instance, 2 out of the 5 participants (40%) identify as Filipino, and 4

participants (80%) identify as Mexican. In terms of who participant's main parent(s)/caregiver(s) were growing up, 4 (80%) reported their main caregivers were their mother and father. In contrast, 1 participant (20%) reported that their mother, aunts, and grandmother were their main caregivers. Similarly, to participant's race(s)/ethnicities, participant's parents identified as different race(s)/ethnicities (see Table 2).

Table 2
Parent(s)/Caregiver(s) Race/Ethnicities

Race/Ethnicity	<i>n</i>	%
Filipino Mother	1	20%
Filipino and Chinese Mother	1	20%
Mexican Mother	3	60%
Peruvian Father	1	20%
Cuban and Black Father	1	20%
Turkish Father	1	20%
European and White Father	1	20%
Mexican Father	1	20%

Note. N=5.

As depicted in Table 2, most participant's parents identify as different races and ethnicities. However, 2 (20%) of participant's mothers identify as Filipino, and 3 (60%) of

participant’s mothers identify as Mexican. With respect to participants identifying as biracial or multiracial, 2 (40%) identify as biracial, and 3 (60%) identify as multiracial. As for the participant’s gender, 3 (60%) identify as female, and 2 (40%) identify as male. Additionally, there is some variation between participant’s ages, but not much. For instance, 3 (60%) of participants were 22 years-old at the time of the interviews, 1 (20%) was 21 years-old, and 1 (20%) was 19 years-old. Moreover,

In terms of the 4-year universities participants were enrolled in, 3 (60%) of them were enrolled at California State Polytechnic University, Pomona, and the other 2 (40%) were enrolled at California State University, Fullerton. Moreover, 1 participant (20%) was a sophomore, 1 participant (20%) was a junior, and 3 participants (60%) were seniors. Out of all 5 participants, 4 (80%) were psychology majors, and 1 (20%) was majoring in art with a concentration in animation. Additionally, all 5 participants reported that they all live with their parents.

In regard to the country participants were born in, all 5 (100%) were born in the United States. Additionally, most participants speak only English, but there are some participants that speak more than one language. For instance, 3 (60%) of participants only speak English, 1 (20%) speaks English and Spanish, and 1 (20%) speaks English, Spanish, and Tagalog. 3 participants (60%) are not the first in their immediate family to attend a 4-year university, but 2 (40%) were. As for what the demographics were like in participant’s neighborhoods growing up, was a variety of responses with some similarities (see Table 3).

Table 3
Demographics in Participant’s Neighborhoods Growing Up

Race/Ethnicity	<i>n</i>	%
Predominately Hispanic	1	20%
Predominately White	1	20%
Mixed (White and Hispanic)	1	20%
Mixed (White, Asian, Hispanic, Black)	2	40%

Note. N=5.

As shown in Table 3, 3 participants (60%) grew up in neighborhoods that were mixed, and the other participants grew up in predominately Hispanic or White communities. Most participants also described the demographics on their college campus to be mostly mixed (see Table 4).

Table 4
Demographics on Participant’s College Campus

Race/Ethnicity	<i>n</i>	%
Asian and Hispanic	2	40%
White, Asian, Hispanic, Black	2	40%
Mixed, Predominately Hispanic	1	20%

Note. N=5.

Research Question

The main research question assisted in the production of the various interview questions that touched on things like participant’s racial/ethnic identity, parent/caregiver’s styles, as well as their environment. Tables are provided to depict the categories and responses to the interview questions. What was found is shown through quotations from participant testimonials. The use of quotations from participant responses are used to back up the researchers claims (White & Marsh, 2006).

Research Question: What factors Influence biracial and multiracial adolescent’s racial/ethnic Identity in higher education?

The first interview question asked participants in their view, what does being biracial or multiracial mean to them. Participant’s responses were separated into two main categories (see Table 5).

Table 5

In your view, what does being biracial or multiracial mean to you?

Categories	<i>n</i>	%
Having two or more races, ethnicities, and/or cultures	5	100%
Growing up in a mixed environment	3	60%

Note. Some of the participant’s responses fell into more than one category; thus, the total does not equal 5 (100%).

Having two or more races, ethnicities, and/or cultures. All participants expressed that to them, being biracial or multiracial means to have two or more races, ethnicities, and/or cultures. For instance, one participant explained what being biracial means to them when they talked about having parents from different countries.

For me being biracial is basically like my parents came from different countries. They have different ethnicities, so that makes me like a little conglomerate of them.

Growing up in a mixed environment. In addition to having two or more races, ethnicities, and/or cultures, some participants also thought someone who is biracial or multiracial is someone who grows up in a mixed environment. One participant expressed this when they discussed being born in or growing up in an environment with people from multiple racial backgrounds.

I would say multiracial means um that your um are either born in or are um... or grow up in an environment with multiple racial groups.

Once participants responded to the first questions, they were then probed with an additional two question. The first probe was “How did you come to understand what it means to be biracial or multiracial?” See Table 6 for the category’s participant responses fell into.

Table 6

How did you come to understand what it means to be biracial or multiracial?

Categories	<i>n</i>	%
Through lived experiences growing up	4	80%

Not thinking about their racial/ethnic identity until adolescence	3	60%
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Note. Some of the participant’s responses fell into more than one category; thus, the total does not equal 5 (100%).

Through lived experiences growing up. Participants thought people come to understand what it means to be biracial and multiracial through their lived experiences growing up. For example, a participant explained they came to understand what it means to be multiracial through interacting with others.

I think I came to understand the concept of multiracial through interacting with other individuals and noticing similarities and differences in our races.

Not thinking about their racial/ethnic identity until adolescence. Participants reported that they did not start thinking about their race and ethnicity until they are in the adolescent period (10-24 years old). For example, a participant stated they did not think about their racial/ethnic identity until they were in at least high school.

You know it’s something that I’ve always dealt with, but never thought about until like college, like in college and high school

The second question participants were probed with was “how do you think being biracial or multiracial has impacted your experience in higher education?” Participant responses were once again separated into two categories (See Table 7).

Table 7

How do you think being biracial or multiracial has impacted your experience in higher education?

Categories	<i>n</i>	%
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Makes them more culturally competent	2	40%
Enables them to easily relate to people	2	40%

Note. One participant’s answer did not align with either category, thus the total does not equal 5 (100%).

Makes them more culturally competent. Participants think being biracial and/or multiracial enables them to easily understand the cultural beliefs and values of others. One participant expressed feeling more culturally competent because growing up, they were exposed to different cultures.

I feel like I am more cult- culturally competent, of things I feel like um, because I had to grow up around different cultures

Enables them to easily relate to people. Participants thought being biracial and/or multiracial enables them to easily relate to people. This was conveyed in a participant’s response when they explained that their multiracial identify has enabled them to have an easier time relating to others.

It has helped me understand and relate to other people in various ways.

The second question participants were asked was how they would describe their parent’s/caregiver’s approach to raising them. Like the previous questions, participant’s answers fell into two categories (see Table 8).

Table 8

How would you describe your parent’s/caregiver’s approach to raising you?

Categories	<i>n</i>	%
------------	----------	---

Participant's parents had an authoritative parenting style	3	60%
Participant's parents had an authoritarian parenting style	2	40%

Note. N=5.

Participant's parents had an authoritative parenting style. The participants described their parents to be warm and supportive. For instance, one participant explained that their mother is supportive and willing to communicate.

So, my mom is a very like uh, she still can get like mean of course, but she's a very like um, soft type of parenting like she's um, authoritative not authoritarian, so like she's very like here are the rules we can talk about them, if you wanna talk I'm here, she was never mean or overbearing or anything.

Participant's parents had an authoritarian parenting style. The participants described their parents to be cold and unsupportive. For example, a participant explained how they were not given much autonomy as they were growing up.

I think it's authoritarian, yes, authoritarian um type of parenting role where um pretty much whatever they say goes and it's something that you respect and you don't question and you do not give your feedback to because if you do, it wasn't. If you do, then um you're most likely seen as disrespecting, or you'll be reprimanded. And um so there was not collaboration between child and caregiver. It was more listen to the caregiver and do as you're told.

Once participants answered the second question, they were probed with one additional question. They were asked "How do you think the way your parents/caregiver's raised you impact how you feel about being biracial/multiracial?"

See Table 9 for the category the responses fell under.

Table 9

How do you think the way your parents/caregiver's raised you impact how you feel about being biracial/multiracial?

Category	n	%
Proud of their racial/ethnic identity for different reasons	3	60%

Note. N does not equal 5 (100%) because not every participant endorsed this category.

Proud of their racial/ethnic identity for different reasons. Participant's parents/families made them feel proud of their racial/ethnic identity when they themselves are proud of their racial/ethnic identity, when they teach their children about their cultures, and when they incorporate cultural traditions into their lifestyle. In particular, a participant conveyed feeling proud of their racial/ethnic identity because their family was also proud and talked about their culture in a positive light.

I was always proud of who I was, and my parents were always proud of who they are. Um. My dad would talk about all the time, how like Cuban food is so good, like the culture is awesome, and my mom too like my mom's side of the family too like talking to them and they're all really proud, so, I've always felt like the sense of pride

The third interview question asked participants How supportive and inclusive their neighborhood/community environment was while growing up, especially in regard to being biracial or multiracial. The following categories emerged (see Table 10).

Table 10

How supportive and inclusive was your neighborhood/community environment while growing up, especially in regard to being biracial or multiracial?

Category	<i>n</i>	%
More included and supported in a diverse environment	2	40%
Environment with same race(s) and/or ethnicities	3	60%

Note. N=5.

More included and supported in a diverse environment. participants feel more included and supported when their environment is racially and ethnically diverse. One participant revealed now that they have met people from various racial/ethnic backgrounds, they do not feel as excluded as they did as a child.

I feel as I've gotten older, I've met more people of different backgrounds so far as of now as an adult I don't feel excluded, as a kid maybe sometimes

Environment with same race and/or ethnicities. participants feel more included and supported when they are in an environment with others who identify as the same race(s) and/or ethnicities. A participant who identifies as Hispanic and white explained the following:

In my adolescent years, when I grew up in a Hispanic and white um neighborhood. Um the people were very accepting and um open and they were very- it was a very supportive environment, and it was very friendly

After participants responded to the third question, they were probed with another question that asked how that level of support and inclusivity make them feel about being biracial or multiracial. See Table 11 for the categories that emerged.

Table 11

How did that level of support and inclusivity make you feel about being biracial or multiracial?

Categories	<i>n</i>	%
Sense of belonging	2	40%
Feels like they're in limbo	2	40%

Note. One participant's answer did not align with either category, thus the total does not equal 5 (100%).

Sense of belonging. The level of support and inclusivity the participant's felt gave them a sense of belonging. For example, a participant explained that it felt good for them to know they were supported by those around them, and it gave them a sense of belonging.

It felt good to know that- to that- to know that um our family was supported, and we could get along with different groups of people and from different backgrounds with different beliefs. Um. So, it-there is a sense of happiness and belongingness and um pride and um just overall acceptance.

Feels like they're in limbo. On the other hand, a couple of participants reported that they did not feel as if they fully fit in with either parent's/caregiver's races and/or ethnicities. One participant explained they do not feel like they fully belong with either of their racial/ethnic groups. They reported the following:

I feel like, if I wasn't biracial, if I was like just like a white kid, if I was just middle eastern, if I was just Hispanic, I feel like um, I feel like in the Hispanic community, I would've been loved, like just, just as much, probably even more actually, I feel like I probably even would've got some more love if I was straight up Hispanic, um, but again, if I was in the white neighborhood, and I feel like if I didn't look

white, if I looked more Hispanic, I feel like I would, we probably would've been pushed down even further, so I feel like it was a really big give and take, like um, you can't have all of it on either side, but you can have little bit on both sides, um, that's kin- kinda how it feels to be biracial

The fourth question participants were asked was how they felt their college environment shaped them. In particular, how it has impacted how they see and feel about themselves. Participant's responses were separated into two categories (see Table 12).

Table 12

How has your college environment shaped you? In particular, how has it impacted how you see and feel about yourself?

Categories	<i>n</i>	%
Sense of inclusivity	4	80%
Built confidence in their racial/ethnic identity	2	40%

Note. Some of the participant's responses fell into more than one category and not every participant endorsed either category; thus, the total does not equal 5 (100%).

Sense of inclusivity. Participants felt their university environments gave them a sense of inclusivity. For instance, a participant reported feeling included on their university campus once they moved to a racially/ethnically diverse campus.

while I love my college, I loved [sic], I feel um, it was, there was negativity , surrounding, there was negativity around my aura, my headspace, I felt like, I don't know, just felt weird, I was like oh my goodness , this is so much pressure to be like a good, Hispanic and trying to do all these things like, whereas when I transferred to [sic]

all of that kinda dissipated, like everybody here was like all inclusive, everybody here was talking, everybody here was like let's get better together. Like, like we have a diverse campus, there's blacks, whites, Asians, Hispanics, like there's not that aura around our campus, where were like we need to push this one community up, like in our campus we have all these clubs, like surrounding all the different ethnicities and like were trying to better each other, so I feel like now, now I'm in a place where I feel like I, should've just came here after high school.

Built confidence in their racial/ethnic identity. Participants felt their university environments helped them feel more confident in their racial/ethnic identity. A participant expressed that the environment on their university campus has promoted their confidence towards their racial/ethnic identity.

There's just a lot of different support groups. So, I think in that aspect and in that-that environment has definitely helped me um create um an acceptance and non-judgmental view towards myself. I would say definitely in terms of my racial and ethnic identity because of the-the groups on campus knowing that there are groups I can go to and um share experiences with other individuals that um that are a part of a group that I'm a part of it. Um. It's helped me you know shape that pride and um nonjudgment and then as far as other aspects of myself. Um... I would say my sexuality as well, because they um have a queer group on campus and um and I think just an overall sense of- of um... I guess confidence.

In addition to the fourth question, participants were probed with additional three questions. The first question participants were probed with was "How does the environment of your college campus compare to the previous environment you were in growing up (e.g., in terms of diversity, sense of belonging, etc.)?" Some of the participants fell into one category (see Table 13).

Table 13

How does the environment of your college campus compare to the previous environment you were in growing up (e.g., in terms of diversity, sense of belonging, etc.)?

Category	<i>n</i>	%
Sense of belonging	3	60%

Note. Some of the participant’s responses did not align with the category; thus, the total does not equal 5 (100%).

Sense of belonging. Participants felt more of a sense of belonging in their campus environment than their previous environment growing up. For instance, one participant said they feel more of a sense of belonging in their campus environment than their previous environment growing up because unlike their environment growing up, their school is racially/ethnically diverse.

At school I definitely meet all types of people of different ethnicities and yea to gives you that sense of belonging, like, wow like I’m not alone like there’s someone else here with the same story or similar story, but they could look completely different, but I know like, hey I’m not the only minority like in the room.

The second question participants were probed with was “How do you think your college environment has impacted how you feel about being biracial/multiracial?” See Table 14 for the category the responses fell into.

Table 14

How do you think your college environment has impacted how you feel about being biracial/multiracial?

Category	<i>n</i>	%
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Increased self-esteem	2	40%
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Note. Some of the participant’s responses did not endorse the category; thus, the total does not equal 5 (100%).

Increased self-esteem. Participant's college environment has increased their self-esteem relating to their racial/ethnic identity. One participant explained that because their campus is racially/ethnically diverse, they are not afraid to be themselves, thus increasing their self-esteem.

I'm not afraid to like show my curly hair, or I'm not afraid to um what's it called? um talk a certain way or have like a little like like, my acc- like I have an accent but not really but like you can like definitely like hear it when like you talk to me and look at me. you know?

The third question participants were probed with was “What are your relationships like with friends, peers, and faculty on campus?” See Table 15 for the category the responses fell into.

Table 15

What are your relationships like with friends, peers, and faculty on campus?

Category	<i>n</i>	%
Positive experience with friends, peers, and faculty on campus	4	80%

Note. One participant’s response did not endorse the category; thus, the total does not equal 5 (100%).

Positive experience with friends, peers, and faculty on campus. Participants

have had an overall positive experience with their friends, peers, and faculty on campus. A participant expressed having a positive experience with their friends and faculty on campus when they said the following:

All of my friends are so different, because were all so different from each other, I feel like there's no barrier between us, whereas, if there like, if whether like, the school is predominately one thing and they were that one race, I feel there would be gap but because my friends are also biracial, I don't feel that pressure to like, to be like them to be like this one race, I feel like, I just feel like everything is natural there, and when it comes to my professors, like, I feel I closer to them too, cause they're really different from me.

Appendix A- Demographic Questionnaire

Dear participant: As noted in the consent form, the information you share in this questionnaire is confidential. Participation in this study is voluntary and you may refuse to answer any questions. Thank you!

1. How you identify in terms of race/ethnicity? _____
2. Growing up, who were your main parent(s)/caregiver(s)?

3. What is/are your main parent(s)/caregiver(s) race/ethnicities? If you had more than one primary caregiver, please specify their race/ethnicity and their relationship to you (e.g., mom - black, dad - Asian).

4. Do you identify as biracial, multiracial, or both? _____
5. How you do identify as in terms of gender? _____
6. What is your age? _____
7. What 4-year university in the United States are you currently attending?

8. What is your class standing (e.g., sophomore, senior)? _____
9. What is your major? _____
10. What is your current living situation (e.g., currently living at home with parent/caregiver, on campus, living off campus with roommates or others, etc.)

11. Which country were you born at? _____
12. What language(s) do you speak? _____
13. Are you the first in your family to attend a four-year university? _____
14. What were the demographics like in your neighborhood growing up (e.g., Predominately White, Black, etc.)? _____
15. What are the demographics like on your college campus (e.g., Race and ethnicity of students on campus)? _____

The Cal Poly Pomona Institutional Review Board has reviewed and approved for conduct this research involving human subjects under protocol IRB-22-158

Appendix B- Interview Guide

Hello, my name is Rio Becerril; I am an undergraduate student from the Psychology Department at the California State Polytechnic University, Pomona. I recently contacted you about participating in an online interview via zoom regarding how parent/caregiver practices and environmental factors have impacted your racial/ethnic identity development in the higher education setting. Thank you again for agreeing to participate. As noted in the consent form, the information you share in this interview is confidential. Any identifying information will be removed from the transcript and pseudonyms will be used. Moreover, this study is voluntary, and you may refuse to answer any questions and/or discontinue the interview at any time. Let's begin.

(Ensure that Zoom is working properly, if technical difficulties arise, re-schedule the interview with the participant.)

I would like to start this interview by asking you about your racial/ethnic identity, experience with your parent/caregiver's practices, environment, and racial ethnic identity.

1. In your view, what does being biracial or multiracial mean to you?

Probes Include:

a. How did you come to understand what it means to be biracial or multiracial?

b. How do you think being biracial or multiracial has impacted your experience in higher education?

2. How would you describe your parent's/caregiver's approach to raising you?

Probes Include:

a. How do you think the way your parents/caregiver's raised you impact how you feel about being biracial/multiracial?

Thank you for those answers. Now, I would like to ask you some questions about the characteristics of the environments you have been in and how they have impacted you....

3. How supportive and inclusive was your neighborhood/community environment while growing up, especially in regard to being biracial or multiracial?

Probes Include:

a. How did that level of support and inclusivity make you feel about being biracial or multiracial?

4. How has your college environment shaped you? In particular, how has it impacted how you see and feel about yourself?

Probes Include:

- a. How does environment of your college campus compare to the previous environment you were in growing up (e.g., in terms of diversity, sense of belonging, etc.)?
- b. How do you think your college environment has impacted how you feel about being biracial/multiracial?
- c. What are your relationships like with friends, peers, and faculty on campus?

Thank you very much for sharing your experiences with me. Your input has been very helpful, and I appreciate your willingness to participate. As a thank you for your participation, I would like to provide you with a \$10 Amazon gift card. I will send you a follow-up e-mail shortly to set that up. Right now, do I have your e-mail correct? Is it _____?

Great! Again, thank you very much for taking the time to participate! Have a great rest of the day!

Appendix C- Consent Form

California State Polytechnic University, Pomona
 Psychology Department
 3801 W Temple
 Pomona, CA 91768
 Phone: (909) 869-7659
 Project Title: Influences on Biracial and Multiracial Adolescent's Racial/Ethnic Identity Development in Higher Education

Dear _____,

CONSENT FORM FOR RESEARCH

You have been invited to take part in the research project described below. You are free to ask any questions you may have. If you have further questions or concerns, you may contact Rio Becerril, Principal Investigator, at (909) 586-4980. You may also contact Dr. Tatiana Pumacahua, Co-Principal Investigator, at tpumacahua@cpp.edu.

Description of the project:

This research study involves responding to a series of questions regarding your experience as a Biracial or Multiracial adolescent in higher education. More specifically, questions about your experience being biracial/multiracial, parenting/caregiver styles, and your environment will be addressed in the interview.

What will be done:

If you decide to participate in this study, you will take part in an online recorded zoom interview lasting about 30-45 minutes.

Benefits of this study:

If you choose to participate, your answers will help increase what is known about the influence of environment, parenting/caregiver style, as well as how biracial or multiracial adolescents make sense of their racial/ethnic identity development within a higher education context. You will also receive a \$10 Amazon gift card as compensation for your participation.

Confidentiality:

Your participation in this study is strictly confidential. This means that none of the information will identify you by name and only pseudonyms will be used. All data will be maintained in a password-protected laptop and secure digital folder.

Decision to quit at any time:

If you decide to take part in the study, you may choose to withdraw your participation at any time. There are no consequences for not participating in the study, and you are free to refuse to answer any questions.

Rights and complaints:

If you have any questions, or if you are not happy about the way in which this study is conducted, you may discuss your complaints with Rio Becerril at (909) 586-4980 or Dr. Tatiana Pumacahua at (909) 979-6984, anonymously, if you choose. In addition, if you have any questions about your rights as a participant, you may contact the office of the Vice President of Research, Innovation, and Economic Development, Building 1, Room 225, California State Polytechnic University, Pomona, telephone: (909) 869-2955. You have read this Consent Form and your questions have been answered. Your signature on this form means that you understand the information and you agree to participate in this study.

 (Signature of interviewee)

 (Printed name of interviewee)

 (Date)

Zoom Recording:

I hereby give my consent for audio recording:

 (Signature of interviewee)

 (Printed name of interviewee)

 (Date)

Enclosed are two copies of this consent form. Please keep a copy of this form and return a signed copy to Rio Becerril via e-mail to Ribecerril@cpp.edu.

Thank you for your time and help in this study. Your assistance is greatly appreciated!

The Cal Poly Pomona Institutional Review Board has reviewed and approved conducting this research involving human subjects under protocol IRB-22-158.

Appendix D- Flyer

Attention Undergraduate Students!

You may be eligible to participate in a research study about the Influences on biracial and multiracial adolescent's racial/ethnic identity development in higher education.



You must meet all of the following criteria to participate:

- Enrolled in a 4-year University in the United States**
- Self-identify as biracial or multiracial**
- 18-24 years old**
- English speaker**

Participants that meet the criteria will be invited to participate in a 30-45 minute online interview.

A second interview will be scheduled only if supplementary information is needed or if technical difficulties arise during the interview.

All participants who successfully complete the study will be awarded a \$10 Amazon gift card



Please email Rio Becerril at Ribecerril@cpp.edu for more information.

The Cal Poly Pomona Institutional Review Board has reviewed and approved conducting this research involving human subjects under protocol IRB-22-158

Appendix E - Recruitment E-mail/ Recruitment Letter

California State Polytechnic University, Pomona
Psychology Department
3801 W Temple
Pomona, CA 91768
Phone: (909) 869-7659

Project Title: Influences on Biracial and Multiracial Adolescent's Racial/Ethnic Identity Development in Higher Education

Dear _____,

I am an undergraduate student in the psychology department at California State Polytechnic University, Pomona. As part of my McNair research project, under the direction of my mentor, Dr. Tatiana Pumacahua, I am conducting a study using the intersectionality framework to contextualize the lived experiences of biracial/multiracial adolescents within a sociopolitical context.

I am writing to ask for your time and participation in this research project. If you choose to participate, you will take part in an online interview via zoom relating to your experiences in higher education. Any information that is provided will be strictly confidential and your name will not appear in any reports resulting from this study. More specifically, questions about your experience being biracial/multiracial, parenting/caregiver styles, and your environment will be addressed in the interview.

The interview is expected to last for approximately 30-45 minutes. I am interested in your unique experiences, and I encourage you to freely share them during the interview. A second interview will be scheduled only if supplementary information is needed or if technical difficulties arise during the interview. If you choose to participate, you will be sent a \$10 Amazon gift card as a thank you for your time and participation.

Individuals that meet all the following criteria may be eligible to participate:

- Students enrolled in a 4-year University in the United States
- Students who self-identify as biracial or multiracial
- Students who are 18-24 years old
- Students who are English speakers

If you meet the above criteria and are interested in participating in this study, please review, sign, and return the attached consent form via e-mail at ribecerril@cpp.edu. I will be setting up interviews shortly. If you have any questions or concerns about this study, you may contact Rio Becerril, Principal Investigator, at (909) 586-4980. You may also contact Dr. Tatiana Pumacahua, Co-Principal Investigator, at ttpumacahua@cpp.edu.

Appendix F- Social Media Announcement

California State Polytechnic University, Pomona

Hello, my name is Rio Becerril and I am an undergraduate student at Cal Poly Pomona. For my McNair research project, I am conducting a study that examines the influences on biracial/multiracial adolescents' racial/ethnic identity development in higher education. I am currently looking for potential participants for this study. In order to participate you must be (1) enrolled in a 4-year University in the United States, (2) Self-identify as biracial or multiracial, (3) 18-24 years old, and (4) an English speaker. Participating in the study will include a 30–45-minute interview via Zoom that consists of questions about the parenting practices you encountered, your self-concept, as well as other factors in your environment. A second interview will only be scheduled if additional information is needed or if technical difficulties arise. All participants who participate in the study will be gifted a \$10 Amazon Gift Card as compensation for their time. If you are interested in participating or know someone who meets the criteria, please email me at ribecerril@cpp.edu interviews will be scheduled soon. Thank you!

Individuals that meet all the following criteria may be eligible to participate:

- 1) Enrolled in a 4-year University in the United States
- 2) Self-identify as biracial or multiracial
- 3) 18-24 years old
- 4) English speaker

Rios Jessica

Examining the Current Impact of Race on Disordered Eating Recognition

Abstract

Peers are often the first to recognize distress in their adolescent and young adult friends and encourage seeking professional help. The distressed individual's race/ethnicity may affect the perception of distress. Previous research into the recognition of eating disorders and disordered eating has demonstrated this, with European American conditions being recognized at a much higher rate than either LatinX or African American conditions. The current research sought to expand on previous research by including the addition of an Asian American and a No Race Control condition and having a picture of the character within the vignette. It was hypothesized of the five conditions that disordered eating would most often be recognized in the European American condition, followed by the Asian American condition, the No Race Control, and least often in the LatinX and African American conditions. This study recruited 285 undergraduate students from a large university through Sona, social media, and e-mail to participate in Qualtrics. This survey consisted of the same character vignettes in different race/ethnicity conditions, recognition of disordered eating question, the Eating Disorder Inventory - 3 "Drive for Thinness" subscale, and demographic questions. Statistical testing revealed that the race/ethnicity of the vignette character did influence recognition rates, but not assessment rates. Additional testing revealed that the gender of the participant also influenced recognition and assessment rates, with male participants' recognition and assessment rates lower than those of female participants. Future research should include dimensions of gender and sexuality and additional subscales or the entirety of the EDI-3.

The Impact of Race on Disordered Eating Recognition

Today's society is overwhelmed by Western beauty and weight-loss culture. Different products centered around the ideal beauty standard are advertised relentlessly. The ideal beauty standard focuses on being fair-skinned, thin, and young. Being fair-skinned is not realistically obtainable for people of color, and this shifts their focus to looking slimmer and more youthful and using products and services designed for those purposes. The Global Wellness Institute (2022) reported that in 2020 the global beauty and weight loss industries earned approximately \$955 billion and \$946 billion in revenue, respectively. For some individuals, these beauty and weight loss products or services may be unobtainable, and other measures may be taken. This can lead to eating disorders that can be life-altering and threatening due to the health risks from both short- and long-term effects of disordered eating and weight loss efforts. As there is an overlap in mental and physical health symptomology, it can also be assumed that the same healthcare inequities that exist for people of color in our society will also impact how they are perceived and evaluated for eating disorders and potentially act as a barrier to treatment. Thus, gaining insight into the relationship between an individual's race, the evaluator's race, and the recognition and assessment of disordered eating may benefit future research on this topic.

Literature Review

While eating disorders are typically believed to be Western or American phenomena, previous studies have demonstrated that they are not. One such study demonstrated that young girls in Iran, noted as having less Western influence in their media, were driven by concerns about their BMI, pressure from relatives about their weight, and messages in media that factored into weight concerns and weight management methods (Garousi et al., 2016). Even countries with their own beauty standards and media share similar outcomes regarding weight perception

and weight control behaviors. Shin and Nam (2015) found that adolescents in Korea who overestimated their weight often engaged in inappropriate weight control practices. These misperceptions about their weight were often influenced by Korean beauty standards pervasive in their country's media. Similarly, Yan et al. (2018) found that Chinese adolescents of average weight, who also overestimated their weight, focused on eating behaviors that promoted weight control or weight loss. These factors and features are similar to more Westernized countries, even those outside the United States. Mendes et al. (2014) evaluated adolescents in Porto, Portugal. They found an association between dieting and body dissatisfaction, where body dissatisfaction was influenced by societal pressures to be thin. While these different cultures share these similarities, it becomes a question of how beliefs about race and eating disorders interact and affect perception.

Pervasive stereotypes often influence the perception of disordered eating. Sala et al. (2013) found that bulimia nervosa was more often recognized as an eating disorder but that participants were more likely to recognize that care was needed for individuals with anorexia nervosa. Hunt & Rothman (2006) also found that general eating disorder knowledge and stereotypes impacted recognition and referrals for care. An example of these stereotypes is that anorexia nervosa is tied to restriction, while bulimia is tied to cyclical eating behaviors of restriction and bingeing. Participants also held stereotypical beliefs that an individual who suffered from an eating disorder was a young European American woman rather than men or people of color. These beliefs create additional barriers for individuals who need support and healthcare referrals. Wingfield et al. (2011) found that college students evaluated individuals differently due to eating disorder stigma. Individuals with bulimia nervosa were seen as more

self-destructive, pointing to stereotypes and stigma surrounding the different eating disorders.

These stereotypical beliefs were also related to those about an individual's race.

Due to conflicting research on the interaction of race and eating disorders, coupled with the previously described cultural and stereotypical perceptions, race has been discounted as being of importance to the recognition of eating disorders. While Berge et al. (2014) did not focus on race, it was found that parental involvement and presence acted as a protective factor and was beneficial when addressing the disordered eating behaviors of an adolescent. Multiple factors may prevent parental involvement or presence, such as financial difficulties and working long hours, which may affect people of a lower socioeconomic status more often. It is important to note that an individual's peers are often the first to notice and suggest help-seeking treatment for an individual. However, perceptions of race may impact the recognition of disordered eating. Gordon et al. (2006) and Gordon et al. (2002) found that racial stereotypes of LatinX and African Americans affected the recognition of eating disorders based on race. Peers and clinicians recognized eating disorders in the LatinX and African American characters least often. However, they scored these characters statistically similar to the European American character during the assessment of behaviors.

In this study, the researchers sought to explore the impact of race on participants' perception of disordered eating by updating and replicating the study done by Gordon et al. (2002) with the inclusion of an updated vignette, pictures of the characters, and an Asian American and No Race Control conditions. The first independent variable was that of the vignette character's race, where they were shown as being either African American, Asian American, European American, LatinX, or the No Race Control that lacked a picture and racial identifier. The second independent variable was the participant's race which was determined by

the collected demographic information. It was hypothesized that the character's race would influence the recognition of disordered eating behaviors described in the vignette. Based on the literature, it is hypothesized that eating disorders will most often be recognized in the European American (EA) character, followed by Asian Americans (AsA), the No Race Control (NRC), and least often in the LatinX (Lx) and African American (AfA) characters. It was also hypothesized that the character's race would impact the assessment of disordered eating by the participant. The following hypotheses were generated:

Hypothesis One (H1): Character race will impact the recognition of disordered eating.

Hypothesis Two (H2): Character race will impact the assessment of disordered eating.

Materials and Methods

Participants

A total of 285 student participants were recruited from a large public university with the use of SONA and through social media and e-mail recruitment. Students received either SONA credits for participating in this study or entry into a raffle for one of five \$15 Amazon gift cards. Participants gave informed consent to proceed with the study and were randomly assigned to one of the five-race conditions. Participants answered demographic information about gender, age, race/ethnicity, educational attainment, employment, and relationship status. There were 74 males, 209 females, 1 gender non-conforming participant, and 1 participant who declined to identify. Age ranged from 18-77, with a median age range of 21.00 in this study. There were 176 Hispanic/LatinX, 37 Asian, 24 White or European American, 22 Biracial or Multiracial, 12 Middle Eastern or North African, 8 Black or African American, 4 participants with missing race/ethnicity data, 1 American Indian or Alaska Native, and 1 Native Hawaiian or Other Pacific Islander identifying participants. Educational attainment included 40 "high school

diploma or equivalent,” 122 “some college,” 106 “Associate’s degree,” 32 “Bachelor’s degree,” and 2 “some post-undergraduate work.” There were 82 unemployed participants, 144 participants working less than 35 hours a week, 47 participants working more than 35 hours a week, and 12 with missing employment data. There were 123 participants not in a relationship, 155 with one partner, 1 with more than one partner, and 6 participants with missing relationship data. Of the participants in relationships, 23 participants were marked as unmarried and living together, 87 were unmarried and living apart, 13 were married and living together, and 33 participants with missing data. Participants were able to self-select into multiple categories; thus, some demographic variables exceeded the 285-participant count.

Materials

Qualtrics was used to create and host the study. Both consent and debriefing forms were included with the survey. Each condition included a picture of the character, a vignette, a disordered eating recognition question, and the Eating Disorder Inventory-3 (EDI-3) Drive for Thinness Subscale (DfTS) was used as an assessment of the character’s disordered eating behaviors. All character pictures were the same size and included a computer-generated amalgam with the same background to reduce potential interference. The recognition question was a yes or no question that asked if the character had disordered eating/eating disorder behaviors. The EDI-3 DfTS included seven 6-point Likert scale questions that assessed attitudes and behaviors focusing on the desire for thinness.

Procedure

During a four-week period in the Fall of 2021, participants were recruited for the study. Participants that indicated an interest in the study were given a unique one-time access key. Upon entering, they gave informed consent and were randomly assigned to one of the five-race

conditions. They were then shown the character’s picture (Appendix A) and her information, including a racial identifier, followed by the vignette (Appendix B). After finishing the vignette, they were asked the recognition question, and those who answered yes were asked to list the behaviors they noticed. Following this, they were given the EDI-3 DfTS to fill out as if they were the character to assess disordered eating behaviors driven by a desire to be thin. Upon completion, the participants were debriefed and informed of the true nature of the study and exited by clicking the “End” choice.

Results

A chi-square test of independence was performed to examine the relationship between the race/ethnicity of the character and participant recognition of disordered eating behaviors. It was hypothesized that the character’s race would influence the recognition of disordered eating behaviors described in the vignettes; therefore, this relationship was observed similarly by examining participant recognition, a yes or no answer, and the vignette character’s race/ethnicity, one of five conditions that the participants were placed into. In addition to the four race/ethnicity condition, the No Race Control condition was intended to act as a control group for comparison, as previous studies had no such control group.

The race/ethnicity of the character in the vignette was found to impact whether the participant recognized disordered eating behaviors significantly, $X^2(4, N = 285) = 19.102, p < 0.001$. It was found that the AfA condition was recognized most often (71.67%), followed by AsA (58.73%), EA (58.06%), Lx (45.65%), and the NRC (33.33%) condition being the least recognized. As hypothesized, the character’s race did impact the recognition of disordered eating even though the results differed from the predicted recognition rates.

A two-way ANOVA ($\alpha = 0.05$) was performed to analyze the effect of the vignette character's race/ethnicity and the participants' race/ethnicity on the EDI-3 DfTS total. The EDI-3 DfTS total was determined by seven 6-point Likert scale questions that were meant to capture the perceptions and beliefs that the participants had of the vignette character's disordered eating behaviors. It was hypothesized that there would be an observable difference in the EDI-3 DfTS totals between the five race/ethnicity conditions due to the participant's assessment of the disordered eating behaviors.

The participants' race/ethnicity was condensed from the initial nine groups into four (Asian, Hispanic/Latino, Multiracial, and White) and excluded missing data ($N = 281$). When doing so, the two-way ANOVA revealed that there was not a statistically significant interaction between the effects of the vignette characters' race/ethnicity and the participants' race/ethnicity ($F(16, 256) = 1.026, p = 0.502, \eta p^2 = 0.057$). Upon further examination, the first simple main effects analysis showed that the vignette characters' race/ethnicity did not have a statistically significant effect on the EDI-3 (Drive for Thinness subscale) total ($p = 0.140$). Similarly, the second simple main effects analysis showed that the participants' race/ethnicity did not have a statistically significant effect on the EDI-3 (Drive for Thinness subscale) total ($p = 0.520$). These results were surprising in comparison to the recognition rate that was reported; regardless of the race/ethnicity of the participants, all the vignette groups had statistically similar totals for the EDI-3 DfTS. While the average for the AfA group ($M = 16.13, SD = 7.299$) was the highest of the five, the others were similar and as follows: AsA ($M = 15.29, SD = 7.302$), EA ($M = 14.90, SD = 8.216$), the NRC ($M = 14.31, SD = 7.307$), and Lx ($M = 14.14, SD = 6.978$). Unlike what was hypothesized, the character's race did not impact the assessment of disordered eating. With the comparison of the chi-square test of independence results and two-way ANOVA results, it

can be assumed that participants' rate of recognition differed from assessment scores of eating disorder behavior due to the race/ethnicity of the vignette character.

A preliminary data assessment demonstrated that further testing may have been warranted due to observable patterns based on participant gender. Thus, additional testing was performed in relation to the participant's gender, specifically, on the relationships between participant gender and recognition of disordered eating behaviors along with the effect of the race/ethnicity of the character and participant gender on the EDI-3 DfTS total. It was thought that the gender of the participant would have an effect on the recognition rates of disordered eating behavior; specifically, it was thought that females would recognize disordered eating behaviors more often than males. It was also thought that the race of the vignette character and the gender of the participants would impact the EDI-3 DfTS total in an observable manner.

A chi-square test of independence was performed to examine the relationship between the gender of the participant and the recognition of disordered eating behaviors. It was thought that the gender of the participant would impact the recognition of disordered eating behaviors described in the vignettes; like the previous chi-square analysis, this relationship was observed by examining participant recognition and the gender of the participant as either female or male. While there were other participants, one that self-identified as gender non-conforming and one that declined to identify, they were excluded from the final analysis ($N = 283$).

It was found that the gender of the participant significantly impacted whether the participant recognized disordered eating behaviors, $X^2(1, N = 283) = 13.522, p < 0.001$. These results indicated that female ($n = 209$) participants (61.2%) were statistically more likely to recognize disordered eating behaviors than male ($n = 74$) participants (36.5%).

A two-way ANOVA ($\alpha = 0.05$) was performed to analyze the effect of the vignette characters' race/ethnicity and the participants' gender on the EDI-3 DfTS total. As in the previous two-way ANOVA, the EDI-3 DfTS total was determined by the seven 6-point Likert scale questions on disordered eating behaviors. It was thought there would be an observable difference in the EDI-3 DfTS totals between the female and male participants.

Two participants that did not self-identify as either female or male were excluded from the final analysis ($N = 283$). The two-way ANOVA revealed that there was not a statistically significant interaction between the effects of the vignette characters' race/ethnicity and the participants' gender ($F(4, 273) = 1.153, p = 0.332, \eta p^2 = 0.017$). When examining the first simple main effect, the vignette characters' race/ethnicity did not have a statistically significant effect on the EDI-3 DfTS total ($p = 0.674$). The second main effect was statistically significant, as the participants' gender did have an effect on the EDI-3 DfTS total ($p < 0.001$). These results were somewhat expected due to the initially observed pattern in the data. An additional independent-samples t-test was conducted to examine this difference in-depth.

An independent-samples t-test was conducted to compare the EDI-3 DfTS total in female ($n = 209$) and male ($n = 74$) conditions. A significant difference was found in the total scores for the female ($M = 16.10, SD = 7.345$) and male conditions ($M = 11.97, SD = 6.960$) conditions; $t(281) = -4.211, p < 0.001$. These results demonstrated that gender did have an impact on the EDI-3 DfTS total. Specifically, that gender did have an impact on the evaluation and assessment of disordered eating behavior, with male participants scoring the character significantly lower than female participants. There were also observed significant differences in the individual questions of the EDI-3 DfTS, excluding question five. Due to the results of the chi-square test of

independence and independent samples t-test, it can be assumed that gender impacts both the recognition and assessment of disordered eating behavior.

Discussion

The purpose of this study was to gain a better understanding of the impact of race on disordered eating recognition. Similar to previous research studies, the race of the vignette character did impact the recognition of disordered eating behaviors but did not impact the assessment of disordered eating using the EDI-3 DfTS (Gordon et al., 2006; Gordon et al., 2002). This implies that racial bias may have influenced disordered eating behavior recognition. Even when accounting for the introduction of vignette character pictures and the additional AsA and NRC conditions, the recognition rate differed from the previous studies. Unlike the aforementioned research, the AfA condition (71.67%) was recognized more often than the EA (58.06%) or Lx (45.65%) conditions. The AsA condition (58.73%) was the second most recognized condition, while the NRC condition (33.33%) was the least recognized. These fundamental differences may have occurred due to several factors, including primarily Psychology major participants, the presence and quality of the vignette character photos, and potential positive bias from the Black Lives Matter and Stop Asian Hate social movements.

In addition, there was a sufficient number of male-identifying participants to investigate gender as an additional factor in the recognition and scoring of disordered eating behaviors. This is an important finding, as gender may act as another barrier to the recognition of disordered eating behaviors. Female participants (61.2%) were more likely than male participants (36.5%) to recognize disordered eating behavior. While this difference occurred, there was no statistical significance between the vignette character's race/ethnicity and participants' gender on the EDI-3 DfTS total. However, it was found that participant gender alone did have an effect on the EDI-

3 DfTS total. Thus, it is assumed that gender does impact the recognition and assessment of disordered eating behaviors. This may be due to gender differences in the perception of disordered eating and eating disorders.

It was also noted that participants who recognized disordered eating behaviors also made a note of the possibility that Alicia had specific eating disorders or indicators of an unspecified eating disorder. A total of 18 participants within the AfA condition noted specific eating disorders such as anorexia nervosa (15), bulimia nervosa (2), and an unspecified eating disorder (1). In the AsA condition, 17 participants noted anorexia nervosa (12), bulimia nervosa (2), and an unspecified eating disorder (3). The 18 participants in the EA condition noted anorexia nervosa (11), bulimia nervosa (1), binge-eating disorder (2), and an unspecified eating disorder (4). The Lx condition had the least amount of noted eating disorders, with 7 participants noting anorexia nervosa (6) and binge-eating disorder (1). The NRC condition had 11 participants that noted anorexia nervosa (8), bulimia nervosa (1), and binge-eating disorder (2). The differences in noted eating disorders between the different race/ethnicity conditions may have been caused by the participants' stereotypical knowledge of eating disorders because anorexia nervosa was the most noted of all conditions and should be further investigated in future research.

Limitations and Strengths

There were several identified limitations of the current research. The first being that there was a lack of a college major demographic question and that participants were primarily recruited from general Psychology courses. It is believed that Psychology students would be aware of and have more general knowledge about disordered eating and eating disorder behavior; thus, participants may have responded differently than those from other majors. The inclusion of a college major demographic question, along with the recruitment of participants

from outside of college, may reveal differences in the impact of race on disordered eating recognition. Additionally, the majority of participants being recruited from general Psychology courses, in combination with the sample being recruited from a diverse university campus, also affects the generalizability of the results. Thus, future repeated research in other geographical areas with varying population differences is suggested. Finally, the quality of the computer-generated images may have impacted participant responses. Future research should include similarly generated photos while addressing any as-needed photo editing to avoid negative influence from the uncanny valley phenomenon. Additionally, the inclusion of matched conditions without the vignette character photos may allow for further investigation into potential rating differences.

Two main strengths of the current study include vignette character photos and the inclusion of two new conditions. A previous study (Gordon et al., 2002) served as a foundation for the current research, and as previously suggested, photos of the vignette characters were integrated into the race/ethnicity conditions. This gave participants a visual of the vignette character and a reminder of the character's race/ethnicity while the participants evaluated her disordered eating behaviors. Additionally, there was the inclusion of the AsA and the NRC conditions. While studies on body image and weight control issues in East Asian countries (Shin & Nam, 2015; Yan et al., 2018) have been conducted, there have not been many to compare the rates between several racial/ethnic groups at once. Currently, as far as the researcher is aware, there has not been any research to replicate the earlier study (Gordon et al., 2002) with the inclusion of an AsA condition.

Direction for Future Research

In addition to the previous suggestions for future research, there are also multiple suggestions based on more current research. Based on a trauma-informed intersectional approach, these suggestions would address the potential for body objectification and sexual objectification in relation to disordered eating behavior, cultural nuances of disordered eating behaviors, and disordered eating behaviors as daily occupations (Elliot, 2012). Not only do these behaviors serve a purpose for those performing them, but they are also a part of their constructed identity. It may also reflect how people respond to observing, acknowledging, and assessing such behaviors. As such, it is essential to increase participant diversity based on preferred gender and sexual preference while being mindful of cultural and occupational considerations, which may be addressed by including different subscales or the EDI-3 in its entirety and disordered eating observation responses.

Like women, men that have eating disorders also experience depressed moods, stereotypes, and stigma (Hamilton et al., 2022; Veach & Munsell, 2022); similarly, because of the different expectations and expression of their eating disorder symptoms may be overlooked and evade detection (Siegel & Sawyer, 2020). The concepts of body objectification and perception have varying degrees of impact, such as depressed mood, on those that express feminine traits in various aspects of their social identities as they continue to evaluate themselves (Carr et al., 2015; Massey et al., 2021; Tiggemann & Kuring, 2004). This is also true of men who evaluate themselves and strive for socially accepted and praised forms of masculinity (Piatkowski et al., 2022). As they are continually objectified by themselves and others, they experience increased stress which may worsen the expression of mental health disorders (Carr et al., 2015). Although this may not be entirely applicable to heterosexual and homosexual men or heterosexual and homosexual women who display more masculine traits, this phenomenon

should be considered when considering the potential differences in disordered eating beliefs (Massey et al., 2021). When adding the additional dimension of race and ethnicity, the effects of body objectification and sexual objectification may be intensified.

The influence of both gender and race/ethnicity in eating disorder research has been observed. As Beccia et al. (2019) discussed, compared to European American boys, girls of all races/ethnicities were at a higher risk of disordered eating, and racial/ethnic minority boys were also more at risk. This, of course, counters stereotypical beliefs that disordered eating, and by extension eating disorders, predominantly affects European American girls and women (Beccia et al., 2019; Veach & Munsell, 2022). In addition, there was an observable difference in the presentation of disordered eating behavior, which likely impacts how disordered eating is evaluated and exists within those different genders and racial/ethnic minority groups; therefore, an intersectional approach to disordered eating research and education is important. Piatkowski et al. (2022) also demonstrated that boys and men might experience social influences, but their behaviors are observed as a drive for muscularity rather than thinness. Therefore, there should be repeated studies that include both male and female vignette characters as the sexual objectification of females, especially those of racial/ethnic minorities, is present and may alter participant evaluations of disordered eating behaviors.

Similarly, addressing the cultural nuances of disordered eating and eating disorder behavior is essential. As Kasardo (2019) discusses, while sizeism is referenced within some undergraduate and graduate textbooks, few textbooks include size as a diversity issue. Western culture often focuses on beauty standards, including thinness (Global Wellness Institute). Therefore, many participants may unintentionally evaluate the vignette character picture based on these ingrained beauty standards. As an extension of this thought, Clausen et al. (2011) found

the EDI-3 to be a valid measurement tool, but the DFTS should not be used alone as a screening tool for eating disorders. It was stated that there might be other reasons unrelated to eating disorders for a person to score higher on this subscale. Thus, it is suggested that either multiple subscales or the entirety of the EDI-3 be used in the future; this is especially true for future studies that may integrate male vignette characters with similarly realistic disordered eating behaviors framed as daily occupations driven by muscularity, consistent with the female character's vignette drive for thinness.

Future research may reveal new recognition and assessment patterns by creating equally consistent male and female vignettes reflective of disordered eating behavior and recruiting diverse participants. While the medical model directly addresses the behaviors of eating disorders, it often does not address the reasons for those behaviors. As Elliot (2012) highlighted, eating disorder symptomatology may serve a purpose within the context of the illness. Thus, the behavior should be regarded as both having meaning for the individual and having meaning as a part of their identity. In addition to including other EDI-3 subscales or EDI-3 as a whole, the repeated collection and examination of disordered eating observation responses, as some participants ascribed reasons for the disordered eating behaviors, may illuminate the reasoning behind the differences in disordered eating behavior beliefs and identification based on gender and race/ethnicity.

Conclusion

While it was hypothesized that character race would impact the recognition and assessment of disordered eating, it was found that character race may have only influenced the recognition rates. These recognition rates also differed from previous studies (Gordon et al., 2002), which may have occurred for several reasons, including recent social justice movements.

Significant differences between the gender of participants and rates of recognition and assessment were also found; therefore, it is suggested that additional dimensions of gender and sexuality, noted reasons for identified disordered eating behaviors, and additional subscales or the entirety of the EDI-3 are included in future research.

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Appendix A

Computer-Generated Character Photos



Note: There was no photo for the No Race Control Condition, a blank space of the same dimensions was used instead.

Appendix B

Vignette Example

Please read the following observational journal recorded prior to the pandemic and answer the questions that follow.

Alicia, 17-Year-Old, African American

Monday:

- She woke up early, did sit-ups, and took a shower. She spends an hour trying on different outfits in the mirror before finding one that she likes. She then spends thirty minutes doing her hair and makeup. For breakfast she has a bowl of oatmeal. Alicia then went to school. She received her last week's test back in her third period class and received an A. For lunch she had a bottle of water, half a peanut butter sandwich, and a banana. After school she played soccer with friends. When she got home, she took a shower. After her shower she spent time doing her homework for the next day. At dinner she had a sparkling water and a salad with grilled chicken. After dinner she watched a movie before going to sleep.

Tuesday:

- She woke up on time and took a shower. She spends half an hour picking out an outfit and doing her hair. For breakfast she had a glass of orange juice and a slice of toast. Alicia then went to school. She forgot her homework for her first period class at home and was upset because of it. For lunch she had a bottle of water and an apple. After

school she went to yearbook club and helped pick out photos for page spreads. When she got home, she took a shower. After her shower she studied. At dinner she had a diet soda, grilled chicken, and a baked potato. After dinner she spent time on Instagram going through the fitness tip hashtag. Before bed she gets drank bottles of water, ate several rice cakes with peanut butter on top, and an apple. After she finished eating, she went to sleep.

Wednesday:

- She woke up early, did sit-ups, and took a shower. She spent fifteen minutes picking out clothes to wear for the day and another forty-five minutes doing her hair and makeup. For breakfast she had three glasses of water and two rice cakes. Alicia then went to school. At lunch she had a soda, an apple, and a snack bag of pretzels. She stayed after school to get help with her homework from her teacher. When she got home, she took a shower. After her shower she spent time taking selfies and editing them to post on social media. At dinner she had water, grilled steak, a baked potato, and a small salad. Later that night she spent time talking to her friend on the phone. She spent time watching television before going to sleep.

Thursday:

- She woke up and took a shower. She spent forty-five minutes picking out her clothes and doing her hair. For breakfast she had a glass of apple juice. Alicia then went to school. For lunch she had two bottles of water, a bag of flavored rice cracker chips, and a snack bag of pretzels. She felt unprepared for a pop-quiz in her fifth period class and was upset

with the score she received. After school she went to yearbook club and was in several group pictures for the yearbook. When she got home, she had water, some rice cakes, and apple slices with peanut butter as a snack. Before she took a shower, she ran for an hour on the treadmill. After she took a shower, she spent time talking to her friend on the phone and going through her Instagram feed. At dinner she had a diet soda and a salad. After dinner she spent time scrolling through Instagram and editing pictures. Before bed she went downstairs and drank a diet soda while eating leftovers from the fridge. After she finished, she went to sleep.

Friday:

- She woke up early, did sit-ups, and took a shower. She spent an hour and a half trying on multiple outfits and re-doing her hair several times. For breakfast she had two glasses of water, apple slices with peanut butter, and a rice cake. Alicia then went to school. For lunch she had a carton of skim-milk, a granola bar, and an apple. After school she played soccer with her friends and spent time walking around with them downtown window shopping. When she got home, she spent time running on the treadmill before she took a shower. After her shower she spent the evening working on her homework. She then went to her room to watch a television show and scrolled through Instagram before going to bed.

**Rios
Karen** **Low-Power Lightweight Security for Collaborative Robotic
Environment using Raspberry Pi Pico W**

Abstract

Given the rising of cyber physical systems, cybersecurity and privacy are becoming more important and consequently higher in demand. One of the most examined areas is communication in the Internet of Things (IOT). The Internet of Things defines networks of physical objects that use sensors for data transmission. Examples include home security, motion detection, and activity trackers all of which measure environmental parameters and transmit corresponding data. Because data is being exchanged, security is a priority. Lightweight cryptography is now being researched as a primary method for user protection. It is an encryption method that functions efficiently at low computational costs while preventing unauthorized disclosure and modification of data. In our project, we examine the efficiency of lightweight cryptography using Pico W Terminals to further analyze the data transmission between server and client.

Lit Review

When we talk about IoT, it is important to consider confidentiality, availability, integrity, and authentication. Key encryption is the final and most valuable step as it ensures a secured connection with lightweight management systems. The accuracy and security of data transmission revolves around area, memory footprint, power, and energy consumption. In order to create a viable design system, it is important to consider which forms of encryption are more suited for IoT applications.

There are two forms of key cryptography: asymmetric and symmetric. Asymmetric key cryptography relies on a combination of public and private key. The public key is a large numerical value used to encrypt data and can only be provided by a designated authority whereas a private key is used to decrypt data and is only received privately. This combination, although complex, is not time efficient and is susceptible to attacks due to varying sizes of operands. Examples of asymmetric key cryptography include the Diffie-Hellman, Elliptical Curve Cryptography (ECC), and Digital Signature Algorithms(DSA). ECC, as of now, is the most efficient variation in terms of power and time.

Symmetric cryptography, also known as shared key cryptography, relies on a common key between server and receiver for both encryption and decryption. It is better suited for IOT applications due to its time efficiency. It is composed of stream ciphers and block ciphers such as Trivium, Chacha, and AES and DES. Block ciphers have a fixed length of bits and different stages of transformation which makes it easier to incorporate into systems, and because the encryption and decryption methods are nearly identical it is much more convenient for user applications.

In the article, Wireless Network Security: Challenges, Threats and Solutions:A Critical Review, Kibona and Ganame (2018) discuss the flaws and solutions in the Internet of Things (IoT). The authors state that the primary threat in these systems is the lack of authentication from the user before permitting data access, and similarly, the lack of intrusion detection. The authors continue to dismantle the challenges in wireless networks by addressing issues in the various layers of IoT, such as the physical layer, link layer, transport layer, presentation layer, etc.. These challenges include loss of power, VLAN circumvention, and information leakage. It is extremely important to consider the type of cryptography utilized in such devices to prevent the listed consequences. Doing so will allow for better user protection and technological efficiency.

Findings

Below are the discoveries formed using two of the Raspberry Pi Pico W in C code. The first picture includes the first Raspberry Pi Pico, the client, while the second picture would include the server of the second Raspberry Pi Pico. The purpose of this testing is to demonstrate that the two Raspberry Pi Pico are communicating with each other. The Client purpose is to send bytes to the Server. In this case, we test out to send 16 bytes in total. In the C code, we included whether they were successfully sent, how many were sent, and an update on the other pico. To this date, there have not been any failures in the time data was transmitted and if the information experienced any errors during the transmission process.

```

Iteration: 1434
-----
Successfully received 16 bytes from the server:
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Errors: 0.
Sending 16 bytes to the server:
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Sending...
Successfully sent 16 bytes to the server:
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Waiting for data from server...

Iteration: 1435
-----
Successfully received 16 bytes from the server:
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Errors: 0.
Sending 16 bytes to the server:
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Sending...
Successfully sent 16 bytes to the server:
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Waiting for data from server...

Iteration: 1436
-----
Successfully received 16 bytes from the server:
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Errors: 0.
Sending 16 bytes to the server:
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Sending...
Test failed with status: -1.

```

This image represents the quantity of iterations throughout our trials and the total amount of bytes delivered from client to server. Additionally, you can observe the errors stated between the transmission and the success of the delivery.

Conclusion

Although we have confirmed the efficiency of data transmission in Raspberry Pi Pico, there are a few aspects of this project that require continued investigation. We are attempting to include a similar software process in Raspberry Pi Pico in other softwares such as RUST, Golang, and Chisel. Some advancements currently have been made with Golang, but the lack of simultaneous functionality between server and client in C code remains. We are continuing research associated with the incorporation of Raspberry Pi Pico in both UAVs and UGVs.

References

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Exploring Collaborative Robotic Environment at CPP
Reconfigurable Space Computing Lab

Abstract

A collaborative robotic environment is a necessity when it comes to dealing with extreme conditions. They help accomplish and speed up tasks that are too dangerous for humans. Unfortunately, there seems to be no such environment for Unmanned Ground Vehicles (UGVs), but much interest is in pursuing such an environment for Unmanned Aerial Vehicles (UAVs). A collaborative environment where both types of unmanned vehicles interface are necessary for power efficiency. If one were to be on the moon, various robots could take care of each other or cooperate to accomplish a task without wasting much of their power or energy. Of course, this cannot be done without cyber security to prevent hacking. The aim of this project and paper is to come up with findings on how applicable a small UGV will interact when it eventually becomes integrated into a collaborative robotic environment in disaster situations, extreme climates, or places such as on a different celestial body like the moon.

INTRODUCTION

In today's world, disasters such as wildfires leave citizens and first responders in danger. They both happen to feel the consequences caused by such an unfortunate disaster. Does this have to be the case for both sides? The hard truth is that minimizing the spread and containment of wildfires is the leading way of combating wildfires. To help aid in this, as of recently, robotics have been deployed to help aid in the safe containment of fires to protect the first responders and, ultimately, the citizens. In "Climate Change is Increasing the Likelihood of Extreme Autumn Wildfire Conditions Across California," in 2020, note the following in their climate study in which they take into account various data points—spanning from 1979-2018—of the Fire Weather Index (FWI): Second, although the high-resolution climate datasets enable analysis of historical and projected changes in extreme fire weather potential, gridded datasets are imperfect approximations of real-world weather conditions, climate trends, and the response of local climate to changes in forcing (including the mesoscale atmospheric dynamics that generate strong wind events) [1]. Because of the difficulty in attaining wildfire data, there is a need to do something about clearing up an approximated picture of what is recorded while having a safer way of doing so. Not only can robotics help in this area, but they can also help contain the fire itself by rigging proper equipment. Thus, what seems to be needed is a robot that can gain data and combat wildfires simultaneously.

Not similar to wildfires, earthquake aftermaths may cause a very extreme atmosphere making it hard for first responders to help victims. Earthquakes are the central issue in states and areas such as California, especially as the "Big One" is said to inevitably rear its ugly head changing many lives when it occurs. Not much can be done during earthquakes to minimize them, but evacuations and solutions could be organized to deal with the aftermath after their initial impact. Robotics has also happened to show up in this type of disaster.

Take what is proposed in "Complete Coverage Path Planning for a Multi-UAV Response System in Post-Earthquake Assessment," where what is talked about is an "unmanned aerial vehicle" that can take images and make a "response map" [2]. Such an unmanned aerial vehicle (UAV) is a highly effective implementation for earthquakes as it can help aid first responders. However, it is crucial to remember that different vehicle types may also be needed to grasp a more specific situation to assess and set on route to do a different essential task, which may lead to more resources being freed up for first responders.

Robotics need not be applied only where disasters lay but where no ONE person can go. Whether on the Moon or Mars, there is a definite need to produce technology that eases the crew's lives once they head to accomplish their mission hindered by unimaginable hardships of the universe. Different celestial bodies in our galaxies happen to have extreme atmospheres. Where there is the extreme, robotics have already been applied there. Take, for example, the rovers that traverse Mars and collect samples of the environments they live in. With the National Aeronautics and Space Administration (NASA) planning its Artemis mission, more vehicles would be needed to interface with other robots or mechanisms. According to NASA, in their work NASA's Lunar Exploration Program Overview, they lay out a meticulous plan where the Artemis mission is split up between Artemis 1, Artemis 2, and Artemis 3, and then the document mentions how Artemis will have them move on to reaching Mars [3]. As can be seen, it is critical for no failure to occur at any stage in the mission, and accomplishing such a mission has already been thought out as NASA, in the same work, details that they plan to develop "mobility systems," human "exploration systems," "Create a pathway for component/sensor/technology," and much more regarding building housing and infrastructure on the moon—all of which they will manage via stakeholders [3]. In all, it can be seen that the moon is the "Next Frontier" regarding achievements in science, research, and initiative.

Lastly, there is the topic of security, and cyber security protocols are all critical to the above situations in which different vehicles or robots interface. The reason is that security is jeopardized if the device malfunctions or if anyone near such technology finds out how to hack or manipulate them. In the article, "Hackers Remotely Kill a Jeep on the Highway—With Me in It," by Andy Greenberg, hosted on the webpage Wired, they mention that, concerning the hacking of a jeep, the hackers "Miller and Valasek's full arsenal [included] functions that at lower speeds fully kill the engine, abruptly engage the brakes, or disable them altogether." [4]. Safety and cyber security are one and the same in the end, as accidents could occur with regards to newer technology that could be vulnerable to interference, interception, and bugs.

RESEARCH PROBLEM

The issue is that there is no versatile smaller vehicle robotic system(s) in place that can help to quicken the pace of tasks in different circumstances; thus, what can be deployed in scenarios involving wildfires, earthquake aftermaths, or space missions on other celestial bodies, to keep victims, corresponding people, and information safe and able to contribute in the designated scenarios?

PURPOSE STATEMENT

The research aims to introduce smaller robotic vehicle systems so that they can do tasks during disasters or in situations that may put people at risk.

RESEARCH QUESTIONS

1. What contributions would be possible to produce with a miniature vehicle containing robotics? 2. Why is there a need to make a versatile "system"? 3. How is a versatile system not riddled with compromises, and what do these compromises mean? 4. What methods would lead to the system having optimal security?

METHODS

To begin, one may wonder why a robotic vehicle system should be made instead of a simpler UGV or UAV. As stated in the introduction, security and cyber security are vital aspects, and legal troubles where wrongs arise. Not only can legal trouble arise, but the risk it puts onto the people that the technology has reached. What can be said for security is that certain parameters have to be set physically or digitally that keep technologies in check. Likewise, cyber security needs to be present to protect from cyber-attacks. Take the case in "Methodology of Using Terrain Passability Maps for Planning the Movement of Troops and Navigation of Unmanned Ground Vehicles," where Dawid and Pokonieczny analyze which algorithm is safer to use when it comes to mapping a route for their UGV: This makes the Dijkstra's algorithm more secure because it always avoids areas that are harder to overcome. For greater values in function (1), it never generates a route that crosses terrain of an actually worse passability. On the other hand, in very detailed passability maps (2 m and 3 m) in greater values in function (1) the A-star algorithm generated routes that led through less passable areas. In this algorithm it is sufficient to set a small value (not exceeding 8) in function (1) to obtain a route that meets the assumptions of this variant—longer but easier to overcome. Due to the fact that we do not know the exact value of ϵ , which will cause the shortening of a route and lead it through areas that are harder to overcome, it is more secure to use Dijkstra's algorithm [5].

In their work, Dawid and Pokonieczny explain which algorithm is safer, which is commendable as using the worse algorithm could lead to many issues arising when using/ implementing the technology. And so, because of security, it is no wonder why companies and researchers look into producing specific solutions to their problems, as specific variables that go wrong can easily be accounted for and corrected.

Next up, there is a reason to discuss UGVs specifically made for solving smaller-scale problems. For example, the work titled "Development of a Robotic Vehicle Complex for Wildfire-Fighting by Means of Fire-Protection Roll Screens" mention that the UGV they plan will have the following features:

In the same article in figures 1-3, Nikitin et al. seem to propose a "fire-fighting robot," "tree-harvesting machine," and "robotic trench cutting machine" (Nikitin et al., 2019, pp. 3-4). Many things have been proposed from these vital portions of information. However, there is room for condensing. What if one main robot was proposed and could have attachable and detachable portions that could be swapped in and out when needed? Overall small-scale UGVs have room to exist as they have been developed or proposed so that they could excel in their specific purposes. As previously said, the creation of a vehicle will be done where the UGV can handle the harsh circumstances/environments produced in scenarios such as a wildfire, or earthquake aftermath, and for utilization at another celestial body. This vehicle would then be able to provide applications that can be used to protect civilians, first responders, or space crew. The vehicle shall use up as little energy as possible, be fire-resistant, able to resist winds, travel at a fast pace, and interface with drones to transfer power and data between the vehicle and drone. The data that will be collected in the research project shall be energy utilization, energy wasted, and the speed at which it can do a task. Specific tools that will be utilized are the multimeter, oscilloscope, and speed sensor (or tachometer if unable to implement it). To be more specific, the vehicle will be built in a lab. In the lab, various systems, sensors, and designs will be utilized to make an efficient vehicle. Prototypes will be made and tested to approach what can be deemed as the "final product." Features may change depending on what occurs during the iterations of the prototypes, but the same goal will apply. The testing that will occur on the UGV will be how long it lasts on, a stress test to see points of failure, and testing its movement abilities (measuring how fast it can move in comparison to a good reference). If possible, the UGV will be tested in a simulated environment, as close as possible to either of the following environments: a wildfire scenario, an earthquake aftermath scenario, or moon-like territory. Lastly, one aspect that is very important to add to the proposed UGV is the ability to interface with other UGVs and potentially other UAVs. The way a UGV will interface with another UGV is through radio signals. The communication between a UGV and a UAV should occur through the same method to not cause complexity. This will be done to allow for communication and exchange of data between vehicles through some sort of encryption that will be needed to prevent signal hijacking. If possible, a battery exchange system will be added, allowing UGVs to charge UAVs (with the UGVs losing some power in the process).

MOTIVATIONS AND ETHICAL CONSIDERATIONS

There needs to be a robotic vehicle system, similar to an unmanned ground vehicle (UGV), that can be as versatile as possible. Complex events such as wildfires, earthquake aftermaths, and space missions may require technology that specializes on a broad scale. Ethically some aspects cannot be tested, such as the ability to help during a wildfire or earthquake aftermath. Such circumstances can only be simulated, leading to potential pitfalls that will be discussed. Safety precautions with the equipment will be used at all times to ensure no accidents occur that could jeopardize anyone. The final goal is to build a swarm of drones and UGVs that will collaboratively identify a set of rules to allow them



Fig. 1. Drone Docking Mechanism



Fig. 2. CPP Collaborative Robotic Environment

to dock in mid-air for exchanging data and energy. As shown in Figure 1, there will be a mechanism for these drones to identify specific spots to land on each other while operating in the air. Moreover, as shown in Figure 2, we can add UGVs as drone carriers based on the Traxxas RC car we received from our JPL/NASA collaborator for such a work.

PROGRESS REPORT



Fig. 3. CPP Collaborative Robotic Environment Gantt Chart

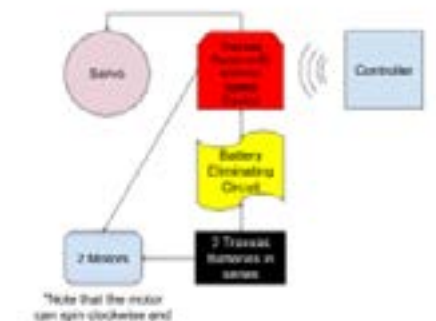


Fig. 4. Original System Diagram

A. August The project began in August when we were figuring out how to hack an RC car that would provide a stable system from which to branch out. The system then included two batteries in series (Traxxas 6700mAh 14.8V Lipo Batteries), which connected to 2 motors in parallel. The batteries, too, were connected to a battery-eliminating circuit, BEC. This circuit's whole job is to regulate the enormous voltage and make it into a smaller voltage measured at around 6 volts. This circuit then connected to the electronic speed control, which also doubled as a receiver called the Traxxas Stability Management Receiver TQI 2.4GHz. The Traxxas Stability Management connected to the motors and the turning servos, which provided a neat closed system. A transmitter then controlled the car, but this could have been made into a better system since the signal could be hijacked or manipulated by a third party.

After this thought, this was when the hacking began, and we found out that the transmitter sent over a signal which then the receiver happened to produce what seemed to be a PWM signal (which was the wrong assertion in the long term). Thanks to the help of Professor Aly (my advisor) and Miguel Gopar, we found out that if we used the Jetson Nano PWM pins to send the signal, in theory, we did not need to connect signal pins from the car to the receiver, which promptly occurred. The Jetson Nano was chosen because it utilized very little power and was similar to a Raspberry Pi. It thus ran Linux, specifically Ubuntu, and it has the edge over the Raspberry Pi because it utilizes Nvidia's AI acceleration for a smoother experience on such a small and compact device. To activate the PWM pins, what was needed to be done for the Jetson Nano was to access the Jetson Expansion Header Tool through the following command: `sudo/opt/nvidia/jetson-io/jetson-io.py`. From there, what needed to be done was to access the menu that popped up when accessing the prompt "Configure 40-pin expansion header", where `pwm0` (pin 32) and `pwm2` (pin 33) were activated. After this was done, we needed to understand how to use the pins, and it was straightforward as we could use the Jetson Nano like a microcontroller. When trying to use the Jetson Nano in this way, it was necessary to use Python for its simplicity and since it provided a library for the Jetson Nano known as "Jetson.GPIO". The goal from there was to utilize other libraries to make a Python script that could make the car run via the keyboard (more is explained in Figure 5). After the code was created and ran successfully, what was planned to be done next was to allow the LTE 6fab hat bought for the project to connect the Jetson Nano to the internet from which the Jetson Nano was to be accessed via remote access. Next were tested, and the results were troubling as it did not work at first, as 6fab's user interface was challenging to acclimate. This was pushed back and led to the camera code being developed. B. September and October Though the development for the camera code began in August, late September and October was when real breakthroughs occurred for getting camera video feedback. In August, what was used to get camera video feedback was 2 Raspberry Pi cameras. The Picams are connected to the board via the camera connectors (which look like tiny PCI slots) on the Jetson Nano. Once these cameras were plugged into the Jetson Nano physically, a long command was used to open the individual camera feeds. This was a not-so-good way of accessing the camera feeds, but along with VLC (a video player software), a camera could be accessed and streamed to the local network. Moving on to September, the goal was to get two camera feeds, and this was accomplished through running the camera script that set up Nvidia Deep-stream, which VLC then recorded. This allowed for seeing the camera feeds side by side; however, it could not be opened by logging into 6fab and turning the cameras on remotely to view the video feedback locally. Ultimately this led to the focus on getting the camera feedback to stream outside to the cloud; however, not much was accomplished here. Despite this, the system changed to resemble something similar to what will be presented in November, even if it was just locally (seen in Figure 6).

C. November and December Now that we are in November, a good amount of progress has been made regarding the project! What was assumed valid by the end of October became untrue at the beginning of November. However, this was because of inconsistencies in the logic and how the project worked. What had occurred, August-October, had been more of a proof of concept. Thanks to Chris Lai, who helped clear the air and helped transition the previously made system to a working one. We both found that the Traxxas Receiver was a weak link since it burnt out twice, which meant that the circuit was unstable. To overcome this, it was found that the receiver was a breadboard with an extra sensitive circuit inside. So, we plugged in the proper connections (ground to ground, power to power, and signal to signal), and the car exhibited unexpected behaviors. The speed seemed to work; however, the steering did not work, so the servo did not shift left or right. Through testing the car's receiver, it was found that there is a handshake protocol, which can be decoded if we utilize pulse position modulation (PPM). PPM works in the way that the duty cycle increases and decreases at a fixed point. Meanwhile, for PWM, it increased and decreased at the halfway point in both directions (to the left and right of the point). All this is illustrated in Figure 8 on the top left, where graphs are given.

```
#!/usr/bin/env python
import sys
import time
import RPi.GPIO as GPIO
import Jetson.GPIO as GPIO

GPIO.setmode(GPIO.BCM)
GPIO.setup(32, GPIO.OUT)
GPIO.setup(33, GPIO.OUT)

def forward():
    GPIO.output(32, 1)
    GPIO.output(33, 1)

def backward():
    GPIO.output(32, 0)
    GPIO.output(33, 0)

def left():
    GPIO.output(32, 1)
    GPIO.output(33, 0)

def right():
    GPIO.output(32, 0)
    GPIO.output(33, 1)

def stop():
    GPIO.output(32, 0)
    GPIO.output(33, 0)

def main():
    while True:
        key = sys.stdin.read(1)
        if key == 'w':
            forward()
        elif key == 's':
            backward()
        elif key == 'a':
            left()
        elif key == 'd':
            right()
        elif key == 'q':
            stop()
        else:
            pass
        time.sleep(0.1)

if __name__ == '__main__':
    main()
```

Fig. 5. Script for Controlling Car Via Keyboard
 Note: This figure demonstrates the script that controls the car. This script was scrapped in favor of the code run on an Arduino. This code activates the Jetson nano's PWM pins and allows the Jetson to send a 50 Hz PWM signal. A few global variables under all the libraries helped the RC car stay off when starting up the code. The code is enclosed in a loop that prevents glitches and errors from occurring when using the terminal window via the `termios` and `sys` libraries methods. On the other hand, the enclosed code has functions that allow it to move forward, backward, steer left or right, and go to neutral and reverse. The values in the functions were specifically chosen because it was within a valuable range of action. The code itself then ends with a sequence that safely terminates everything that was running.



Fig. 6. System Version 1 Diagram

Unfortunately, the Jetson Nano could not be used as the direct control, so an Arduino was implemented. This Arduino was a perfect way of unlocking the car's potential; however, the Jetson Nano is integral to providing the system's brains. The Arduino can then be thought of as the "hands," though now the Jetson Nano happens to relay the signal (which will not be the case in the future). The code now works well and essentially follows the flow of what was presented in Figure 5 and will be provided later as it is lengthy and needs to be debugged a bit further (note that it works great for now). Essentially what the code does is that it relays an angle from 0-180 degrees to control the steering and speed. The steering works well, with 180 degrees turning the car fully to the left, 90 is in the neutral position, and 0 is fully to the right. Meanwhile, the speed is extremely sensitive because relaying an angle under 89 degrees makes the car go backward, and around 90 and above go forward. The angles are translated into the 50Hz PPM signal, which tells the car how much to speed up and slow down. There are a few safety features to prevent the car from running mayhem as the speed is quite sensitive and comes in the form of a kill switch. Running a command and the code allows for a link between the Jetson Nano and Arduino, relaying the information to the Arduino, working via USB (through UART) when the Arduino is connected to the Jetson Nano's USB ports. Lastly, what was also developed was the camera code. Figure 8 shows that the camera activation was achieved by running a script that connected to the internet via the request library. The camera feed was obtained using OpenCV through the cv2 library. Both libraries had methods that regulated and provided streaming capabilities to a flask server. Via the NumPy library, the two video feeds, which are set by the code, are concatenated horizontally, allowing for viewing two camera video feedback if one wished to exit on the Jetson Nano, pressing "q" or "ctrl c" to exit the program promptly ending the transmission of data and stopping the camera feed.

```

# MIT License
# Copyright (c) 2019-2022 JetsonHacks

# Using a CSI camera (such as the Raspberry Pi Version 2) connected to a
# NVIDIA Jetson Nano Developer Kit using OpenCV
# Drivers for the camera and OpenCV are included in the base image

import requests
import cv2
import time
import numpy as np

'''
gststreamer_pipeline returns a GStreamer pipeline for capturing from the CSI camera
Flip the image by setting the flip_method (most common values: 0 and 2)
display_width and display_height determine the size of each camera pane in the window on the screen
Default 1920x1080 displayed in a 1/4 size window
'''

def gststreamer_pipeline(
    sensor_id=0,
    capture_width=480,
    capture_height=270,
    display_width=480,
    display_height=270,
    framerate=30,
    flip_method=0,
):
    return (
        f"nvarguscamerasrc sensor-id={sensor_id} ! "
        f"video/x-raw(memory=NVMM), width={capture_width}, height={capture_height}, framerate={framerate}/1 ! "
        f"nvvidconv flip-method={flip_method} ! "
        f"video/x-raw, width={display_width}, height={display_height}, format=(string)RGBA ! "
        f"videocvconvert ! "
        f"video/x-raw, format=(string)RGBA ! appsink"
    )

    sensor_id,
    capture_width,
    capture_height,
    framerate,
    flip_method,
    display_width,
    display_height,
)

def show_camera():
    window_title = "CSI Camera"

    # To flip the image, modify the flip_method parameter (0 and 2 are the most common)
    print(gststreamer_pipeline(flip_method=2))
    video_cap0 = cv2.VideoCapture(gststreamer_pipeline(sensor_id=0, flip_method=0, framerate=30), cv2.CAP_GSTREAMER)
    video_cap1 = cv2.VideoCapture(gststreamer_pipeline(sensor_id=1, flip_method=0, framerate=30), cv2.CAP_GSTREAMER)
    if video_cap0.isOpened() or video_cap1.isOpened():
        try:
            window_handle = cv2.namedWindow(window_title, cv2.WINDOW_AUTOSIZE)
            while True:
                ret_val0, frame0 = video_cap0.read()
                ret_val1, frame1 = video_cap1.read()
                resized_frame = cv2.resize(frame1, (frame0.shape[0], frame0.shape[1]))
                numpy_horizontal = np.hstack((frame0, frame1))
                # Check to see if the user closed the window
                # Under GTK+ (Jetson default), WND_FLAG_VISIBLE does not work correctly. Under Qt it does
                # GTK - Substitute WND_PROP_AUTOSIZE to detect if window has been closed by user
                if cv2.getWindowProperty(window_title, cv2.WND_PROP_AUTOSIZE) <= 0:
                    cv2.imshow(window_title, numpy_horizontal)
                    time.sleep(0.001)
                    _, imdata = cv2.imencode('.jpg', numpy_horizontal)

                    print('.', end='', flush=True)

                    r = requests.put("http://74.207.241.102:5000/upload", data=imdata.tobytes())

                    print(r)

                    if cv2.waitKey() == 27: # Esc = 200 frames per second (100ms/frame)
                        break
                else:
                    break
            keyCode = cv2.waitKey(10) & 0xFF
            # Stop the program on the Esc key or 'q'
            if keyCode == 27 or keyCode == ord('q'):
                break
        finally:
            video_cap0.release()
            video_cap1.release()
            cv2.destroyAllWindows()
    else:
        print("Error: Unable to open camera")

if __name__ == "__main__":
    show_camera()

```

Fig. 7. Camera Online Streaming Video Feedback Code

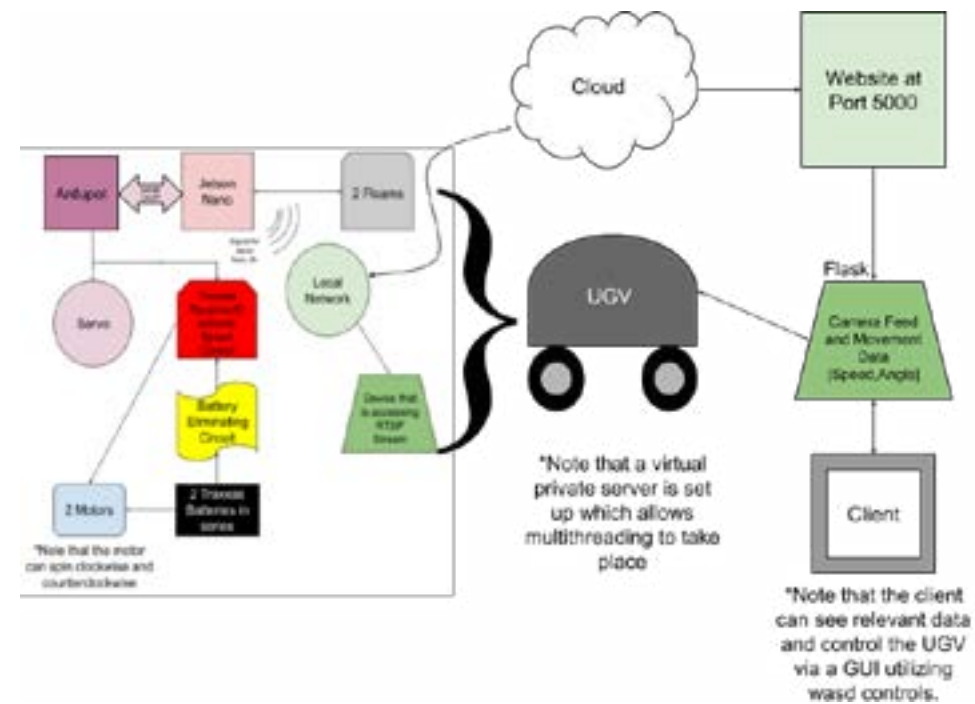


Fig. 8. System Version 2 Diagram

D. Present & Future As of the recent present, a test was conducted between the most recent UGV build and another team's project, a drone, as seen in figures 9 and 10. The UGV was controlled in person to reach a specific point and then made to be stationary. The other team's project then happened to use the aid of QR codes, which were positioned on the project, to be then able to land their project. The process occurred flawlessly and was proof that stationary collaboration was possible. However, more testing with other projects and devices is planned for a more realistic scenario. This leads to what is currently being worked on, as the implementation of lidar and computer vision onto the UGV is of priority. This will be done by wiring a lidar and putting it on top of a servo that the Jetson Nano will control. This will give the lidar movement capabilities when turning left and right. The lidar is to create a point cloud map to allow the UGV as a system to visualize what is in front of it. The plan is to implement new software and find a way to station the lidar and servo onto the current system to secure it well to keep it in place. In the future, what can be expected is the addition of video compression for the camera code. This will allow the video feed to be smoother in the sense that it will run faster. Another thing that will be added that is related to the camera feedback is AI recognition. This will allow the car to make decisions of its own accord depending on what it is meant to recognize (for example, if it sees a yellow light, it will slow down). On a different note, the system will have more additions, such as an NVME SSD, for storage reasons and faster read and write times. Another addition would be expansion hardware to accelerate computing and expand. After doing this, data can be accumulated through the data that the various sensors will gather. However, suppose specific ideas like what was proposed in the methods section, like weather/climate resistance, are not possible. In that case, data behind how the vehicle operates in a fixed scenario can still be gained. The plan is to follow the methods section as closely as possible, as most should be able to be accomplished or simulated.



Fig. 9. Drone Hovering above UGV



Fig. 10. Drone Landing on UGV

E. Discussion The current system is the most successful prototype to date. Due to many outside factors, the supplies that would have arrived earlier through a wrench in the mix. That being so, the UGV and the idea of a collaborative robotic environment pop up. This is through the experiment conducted between the UGV and another team's drone, showing that collaboration can come in two forms. The first form is the one that was envisioned in which where the devices themselves communicate deliberately. The second form is a softer way to communicate by making some symbol or flag, allowing the devices to communicate using cues such as the QR code. Though the idea is not ours per se, both are necessary for a collaborative robotic environment. For example, it allows for a safe way to establish a landing signal. Imagine a scenario where the drone was to be flying, and the car was moving remotely. A method for the drone to develop it wants to land is to send a land signal. Still, another efficient way would be to read or scout for a vehicle with a specific symbol to then be able to land safely or to accomplish something more specific like recharge. As mentioned, the current system is a prototype, so when it comes to accomplishing goals such as being applied in disaster zones, harsher environments, and other situations, not much could be said. As of now, what is envisioned is the usage of the UGV on the moon, for example, but since the car is not in a closed shell, it could scarcely accomplish that. So much would go wrong if it were to be used for this goal currently. That being said, all this could be easily fixed once a more finalized prototype is considered. Even so, more code would be needed to allow communication via a server to be established between unmanned aerial vehicles, other UGVs, devices, etc. If the adaptation of the UGV for earth-related uses were to be adapted from the view above, something similar would need to occur to ensure robust communication between all those devices to allow for a collaborative robotic environment. As mentioned in the "Present & Future" portion of the "Progress report section," more will be worked on and incorporated into the UGV to be later tested in a collaborative robotic environment.

F. Summary Overall, the project was a soft success, but more must be implemented to produce clearer and more concrete results. Unmanned ground vehicles and adjacent vehicle types can aid in many ways. In the concept of a collaborative robotic environment, so much comes to mind, like the interaction between unmanned vehicles, devices, and more. The UGV, which we plan to incorporate into such an environment, would allow remote control of the device via computer and connection to a server. The cameras make such a level of control possible in the first place, allowing the person controlling the device to see where the UGV is going due to the Jetson Nano, Arduino, scripts, and the current server working in tandem enable the UGV to run. Yet this is not a signifier that a collaborative robotic environment is efficient due to the lack of data gained. There are plans to implement more and obtain more concrete data than the more qualitative data produced.

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Gender, Race, and Ethnic Disparities in Undergraduate Philosophy and Economics

Abstract

While there is extensive literature focused on the underrepresentation of women and members of historically marginalized groups in STEM fields, the lack of representation of these groups is less understood in the social sciences and humanities. For example, positive experiences in introductory undergraduate STEM courses have been shown to significantly increase undergraduate retention in these fields, but little is known about the impact of introductory coursework in economics and philosophy, and their associated downstream educational influences.

This research project addresses the current gap in the literature by analyzing these disparities using a unique, unpublished panel dataset of economics and philosophy students in a majority minority, public institution from Spring 2017. This data includes extensive pre- and post-course surveys, course grades, and additional academic administrative data. We will test the following hypotheses: 1) We expect to see differences between women/URM's desire to study phil/econ when compared to non-women/URMs; 2) Difference measures Belonging (university) and desire to study field will be positively correlated over the course of the semester.

Given our results, we will propose possible intervention measures to support underrepresented undergraduate students in the fields of philosophy and economics.

Major Objectives

The biggest objective of this project is to see if there was any change from the pre and post measurements in regard to the surveys students filled out at the beginning and end of the semester and if these changes correlate to either a rise, drop, or no change in students majoring in

economics or philosophy. Given if the results show no or little to no change or a drop in enrollment into the two majors, possible interventions will be explored to curve such discrepancies. Consideration into the possible causes will be explored as well.

Literature Review

Much of the recent work done on the disparities within undergraduate philosophy have focused on gender inequality. A big portion of the literature has a focus on one's feelings of towards the field of philosophy relation to their gender with aspects such as identification with the field and their sense of belonging within it. There has been a push towards researching the possibly of cognitive differences between men and women in regard to philosophy as well. Buckwalter and Stich (2013) argued that the more courses in philosophy a woman takes the more likely that she will decide to not take another philosophy course since she will be exposed to philosophical thought-experiments that she and her teacher will not agree on (Adeberg et al. 2015 pg.619). A follow up study (Adeberg et al. 2015) was done on Buckwalter's and Stich's findings. The follow-up study attempted to replicate the results of the original Buckwalter and Stich paper. Based upon the follow-up study, they were unable to replicate the original findings and argued that it is doubtful that gender differences regarding intuition is an explanation for the gender gap in philosophy. Following similar results another paper looking at gender disparities beyond just cognitive differences between the sexes suggested that women identified less with the field of philosophy compared to their male colleagues within the introductory courses in relation to the topics and methods within them so it is possible that they would put less effort into the courses and that women left less confident in their skills to do well in philosophy (which could also suggest as to why they leave the major early on) (Thompson et. al 2016). Other

research suggests other reasoning for women to leave underrepresented fields early on that include that women may have internalized the idea that men are better suited for philosophy than women (Baron et al. 2015). The reasoning as to why these internalized perceptions of one's sense of feeling and identification within the major courses they take and within just the major field as well can be grouped into two camps of: Pre-university effect and Classroom effect. Pre-university effect meaning students who choose not to major within a certain field choose to do so due to things such as pre-existing internalized attitudes that relate to the major, lack of early educational experience of the field, feelings of gaps of self-efficacy. In simpler terms, students enter college with presupposed attitudes and ideas about major fields and thus would choose not to major in the field and take the introductory courses if the attitudes were of a negative nature. The classroom effect takes it to that the underrepresentation of certain demographics occurs within the early years of university at an introductory level example of this can include lack of peer support and mentorship within a major and the classroom environment itself. As presented in the Baron et al 2015 paper tackling the gendered disparities among Philosophy majors at University Sydney an interaction effect between gender and attitudes about the field of Philosophy coming into university which is possibly responsible for the lower rate of women in Philosophy.

Expanding outside of just research areas relating to philosophy and gender similar findings how been found within the economics aspect of research in relation to barriers that prevent women in economics from either continuing in the major or majoring in it at all. It's been suggested that things such as lack of mentoring and educational services for women have been the reason as to why many women early on in their career of economics put them at a disadvantage thus leaving them with less resources that can support them (Lundberg & Stearns

2019 pg. 16). In relation to mentorship, the lack of social networks for women in this field is also a concern in that it hinders the mentorship aspects thus limiting a sense of community for women within the field of economics (Lundberg & Stearns 2019 pg.17). There have also been suggestions that women are not as good at math than men which is the reason they choose to not major in economics. Evidence suggests that is not true and that it has been found that even though female students tended to have weaker math skills than males the math backgrounds had little to no impact on their drive to take introductory economics courses and that the gender gap in part may be due to other aspects such as assumptions made about the major prior to entering university and difference in career and social aspects (Dyanan & Rouse 1997 pg. 365-366).

When Black, Latinx, and Native American students were asked about how to better the field of economics and the courses within it the main issue that they felt needed to be addressed was the implicit and explicit messages that created the image of who does and doesn't belong within the field and profession. The stronger someone was within these three categories the better classroom performance they had in introductory courses and persistence to carry on into other classes within the major. As women may be more reactive to grades in introductory economics courses (Rask & Tienfenthaler 2009) this can also be a signifier as to why women (and similarly URMs) are underrepresented within the field of economics.

Outside of the humanities and social sciences, certain STEM major fields are more gender-balanced than others. Cheryan et al. found that a women's preference for certain STEM majors depend upon cultural and social factors within certain STEM fields (hostile environment etc.) (2017). One of the other big factors of students deciding in a major was the perceived utility value they had of the major and researchers have found that implementing utility value writing intervention within a classroom setting, where the students wrote about the how the

course material was personally useful to them, received better grades in the courses and were more likely to participate in the subsequent course (Canning et al., 2018). In relation to utility value, attainment value and one's desire to study and stay within a certain major field played a prominent role in students in deciding whether to stay in a major or not (Matusovich et al., 2010). A sense of belonging was also associated with better student engagement with one study showing that students who felt a higher sense of belonged tended to have a higher emotional and behavioral engagement when measured at a personal level and one a day-to-day level, regardless of a student's typical belonging at a personal level, if a student experience a certain sense of belonging (especially at a very high level) on a specific day than their emotional and behavioral engagement on that particular day tended to be higher than it usual was (O'Neel 2021).

Methodology

The research material for this project was collected during the Spring 2017 quarter at Cal Poly Pomona through anonymous pre- and post-surveys given to students in introductory courses for philosophy and economics. The total number of respondents collected was n=1374 but was downsized to n=349 due to respondents being removed from the analysis if they did not complete both the pre- and post- surveys.

For this paper, we will focus on a subset of preliminary results – looking only at student-level differences in data collected at the beginning of the semester. In particular, we are interested in differences between URM/non-URM students and male/female students.

Our research question is: *Do women/URMs feel differently about themselves compared to other students before beginning a philosophy/economics course?*

We test two main hypotheses with six different variables each. This will allow us to identify if URM (or female) students coming in to these intro classes view themselves as different as their non-URM (or male) peers. Note that all scales used below are detailed in the Appendix.

1. Hypothesis 1: URMs report different levels of ___ at the beginning of a course, when compared to non-URM students.

- a. H1a: Belonging (within the course)
- b. H1b: Belonging (within the University)
- c. H1c: Perceived competence
- d. H1d: Flourishing
- e. H1e: Resilience
- f. H1f: Desire to continue in the field

2. Hypothesis 2: Women report different levels of ___ at the beginning of a course, when compared to male students.

- a. H1a: Belonging (within the course)
- b. H1b: Belonging (within the University)
- c. H1c: Perceived competence
- d. H1d: Flourishing
- e. H1e: Resilience
- f. H1f: Desire to continue in the field

First, we explore correlations between these variables of interest. A Pearson product-moment correlation was run to determine the relationships between measures of interest (as shown in the hypotheses lists above). Correlations are shown in Table 1.

Results

With the Pearson product-moment correlations, we find significant and positive correlations between many of these measures (highlighted in bold in the table), implying the interconnected nature of positive affect in students.

Looking at the largest, significant correlation we see is between belonging to the University and flourishing ($r = 0.410$, $n = 317$, $p = 0.001$). Next is a strong, positive correlation between resilience and flourishing ($r = 0.355$, $n = 317$, $p = 0.001$). It is interesting that flourishing, a measure of self-perceived success, creates a measure of well-being that (unsurprisingly) shows a connection to their own ability to bounce back from unexpected events, but also (more surprisingly) impacts the student's relationship to the University.

Interestingly, perceived competence in the field is positively and significantly correlated to every other variable of interest.

One-way ANOVAs were run to determine whether there was a significant difference between URMs and non-URMs, as well as male vs. female students. For URMs, the only statistically significant difference was in belonging to the University ($F(1, 312) = 5.461$, $p = 0.020$) and flourishing ($F(1, 311) = 3.901$, $p = 0.049$).

In contrast, for male vs. female students, the variables which showed a statistically significant difference were flipped from the URM comparison. These included: course belonging ($F(1, 314) = 3.230, p = 0.073$), perceived competence ($F(1, 314) = 4.556, p = 0.034$), and resilience ($F(1, 315) = 5.011, p = 0.026$).

Discussion

Initial results show three interesting factors. First, is how a flourishing mindset is correlated with additional positive outcomes such as University belonging. In particular, it is interesting to note the link between perceived (not actual) competence and

Next, when testing our hypotheses, we see that URMs have a statistically significant, positive relationship with belonging to the University and flourishing – both excellent factors for this institution, which has a majority minority student population.

Finally, the results flip exactly when comparing men vs. women; in particular men are statistically significant with higher course belonging, perceived competence, and resilience when compared to the women in our sample. This is a potentially troubling initial finding and requires further review and analysis.

APPENDIX 1: SCALES AND MEASURES

Question	Scale
5. I belong at CPP.	belonging
7. I feel like CPP is a good fit for me.	belonging
10. I feel welcome on this campus.	belonging
19. I am satisfied with my experience at CPP.	belonging
4. I'm not sure if I belong in this course.	course belonging
12. I belong in this course.	course belonging
1. I lead a purposeful and meaningful life.	flourishing
2. My social relationships are supportive and rewarding.	flourishing
3. I am engaged and interested in my daily activities.	flourishing
4. I actively contribute to the happiness and well-being of others.	flourishing
5. I am competent and capable in the activities that are important to me.	flourishing
6. I am a good person and live a good life.	flourishing
7. I am optimistic about my future.	flourishing
8. People respect me.	flourishing
1. I am confident that I will do well in this course.	perceived competence
16. I expect to get a good grade in this course.	perceived competence
9. I tend to bounce back quickly after hard times.	resilience
10. I have a hard time making it through stressful events.	resilience

- | | |
|---|------------|
| 11. It does not take me long to recover from a stressful event. | resilience |
| 12. It is hard for me to snap back when something bad happens. | resilience |
| 13. I usually come through difficult times with little trouble. | resilience |
| 14. I tend to take a long time to get over setbacks in my life. | resilience |

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The Symbolism of Body Modification of the Maya Post-Mortem

Abstract:

The concepts of body modification that surround the Maya communities were deeply sacred. The symbolic nature of body modifications has techniques and rituals that are of importance to the Maya communities. While the Modern Maya are the descendants of the Ancient Maya in many ways, body modification is a concept that continues to be sacred to modern Maya communities. This study will focus on beliefs, rituals, and the importance of the body of the Maya communities. With the use of various anthropological and archaeological evidence, contexts, and approaches a holistic and contextualized perspective will be achieved to understand the importance of body modification. Utilizing the evidence of post-mortem bodies and archaeological evidence of pre-classical sites through Terminal Classical sites of Maya burials in the Mesoamerican region, the evidence will provide a comprehensive understanding of the importance of the body modification of the Maya. This Bioarchaeological approach will be viewed through the Maya practices of Cranial Modifications and Dental Modification. Cultural-historical perspective will be employed by the use of Life Course/ Life history approach that will contextualize the post-mortem bodies and sites from the Mesoamerica region. This approach will further support the understanding of the Ancient Maya class system and lives. Other cultural contexts that will be utilized will be glyphs and art. The Maya Glyphs provide a unique perspective of how the concepts of the body translate into writing and language. Art, pottery, and other material cultures depict rituals and beliefs of the concepts of body modification and the significance of the body.

Background:

The Maya are several indigenous people residing in the southeastern region of Mesoamerica. Mesoamerica includes Central America and territories of Lower North America i.e., Mexico (such as Yucatan, Campeche, Tabasco, and Chiapas), Yucatan Peninsula Guatemala, Belize, Honduras, and El Salvador. The Maya culture practiced craft production, long-distance exchange, complex cosmology and rituals, and social stratification throughout their different cultural periods. Some of these cultural periods that will be focused on will range from the Classic 200 CE – 900 CE. While the Maya at a time were a thriving civilization, the Spanish conquest and colonialism affected the different Maya groups as they were subjugated to exploitation, colonization, slavery, genocide, and other long-lasting effects that continue to affect the Maya communities that remain in Mesoamerica today. (Coe, 2015)

The Maya cultural practices and rituals are well grounded in history and significance to their civilization. Body modification and adornment are some of the most important and remarkable practices that embody their culture. From cranial modification to bloodletting to post-mortem jading, and dental modification, the body was closely related to the spirituality and rituals that the Maya practiced. The body was a vessel and a way to honor the gods and the spirit known as “wahy”, the spirits that leave the body at night (Coe, 2015). The body was a vessel that was often modified to serve a purpose and honor gods and communities. The cranial modification was the most prominent form of body modification as it represented the shape of maize and the god of maize. (Tiesler, 2010) The cranium was a distinguished part that was heavily modified from birth to death. The cranium was a part that honored the maize, the people by embodying the social stratification that is seen in elite and wealthy members of society. (Duncan and Hofling, 2011) While Body modification and adornments can be represented in a multitude of ways as each culture varies in techniques and rituals, the Maya values Body Modification as a way to honor those who have passed by providing jade in their

burials or creating post-mortem modifications in teeth, skull, or other as jade was a prestigious material for life and death. (Taube, 2005)

Methods and Approach

By taking a bioarcheological approach to the remains of the people and the materials of the past, the remains and materials can be viewed and understood from a more contextualized perspective of the modifications that have been done. The bioarcheological approach can be utilized for evidence of cranial modification of the Maya in the Meso-American region. (Tiesler, 2010) Using Life Course/ Life history approach will allow the bodies to be viewed in a more contextualized in terms of the environment, growth patterns, and morphology of the bones. (Agarwal, 2016) Cultural History Perspective can be used in royal tombs that are found in Mexico to identify why the Royals and elites practice post-mortem modification. (Duncan and Hofling, 2011) Given the different Maya communities, it is essential to view the different aspects of Maya lives from the class system, sex, and gender (Goguitchaichvili et. al., 2017), and other indigenous people of the region and nearby regions such as the Olmecs. (Tiesler, 2010)

Body Modification

The Maya community has a profound connection to body modification as it is a socio-cultural concept that demonstrates status, beauty, self-reflection, and honorable. (Whittington and Reed, 1997) Body Modification is morphological changes to the body. Morphological changes can be viewed as structural changes to the bones and alterations to the physical appearance of the flesh and teeth. (DeMello, 2007) Individual Maya communities practiced different forms of body modification. Techniques, equipment, and symbolic nature change within different groups. (Tiesler and Lozada, 2018)

Cranial Modification

Head shaping differs between different Maya groups. Binding and flattening techniques created elongated head shapes in a tubular-rounded shape or an erected-flat shape. Tools and equipment varied throughout the communities. Morphological changes to the head are done while an infant is developing and is with family at home. These practices are a rite of passage within the Maya communities. When the infant is done they join the community and are socialized. (Tiesler and Lozada, 2018)

Wood or hard material were placed parallel to each other to create a head splinter that would elongate the head and flatten the head. A cradle device would bind the head and provide a tubular-rounded shape. Each community would have variations of equipment and technique. (Tiesler and Lozada, 2018) Cranial Shaping is a way for a community member to honor the maize god by resembling the shape of maize. Shaping is a way to distinguish status, position, and family ties. (Houston et. al, 2006)

Given the resources and material available to each group had splinters and cradle devices will be unique shaping of the head can change. Communities in the highland mountains such as the Guatemalan groups had access to resources that influenced more cradles devices and techniques for more rounded shapes rather than long. While communities Northwest of the Highland area were more elongated and flat Over time the processes were refined and different periods provided different standards of shapes. Notably the Classical period provides more uniformity with head shapes and the cradle device was more prominent which saw more tubular-rounded shapes. (Tiesler, 2022) Olmec's head shape was seen as pear-shaped similar to the tubular-rounded shape later seen in Maya communities. During the middle pre-classic period, the Olmec head shape was present in lowland Maya communities, Palenque, and Tabasco. (Tiesler and Lozada, 2018)

Cranial Modification is often referred to in academic studies as Cranial Deformation, Cranial Mutation, and Cranial Malformation. The idea of deformation and mutation is prevalent in many of the works. While the idea that changing the head structure oneself is viewed negatively in modern-day Western society. We must look at the concept from a cross-cultural and non-biased perspective. Plastic surgery in modern times is done medically and cosmetically. Maya communities viewed the shaping from a similar perspective. It was done for statues, beauty standards, social, and to honor their bodies.

Dental Modification/Jading

Jade is a natural resource that is special to the Maya community. It held a place in history and legend. It was the Teeth of the Macaw from The Twin Heroes. It was used as a status symbol. It was used to honor the dead. It was for currency and exchange. (Coe, 2015) Art, funerary artifacts, pottery, tools, and jewelry all utilized jade for everyday life. In terms of body modification, Jade was the primary material used for dental modification.

Jading of the teeth allowed the display of jade pieces in the center of their visible teeth. While different techniques for jading differ from group to group. The status symbol of jade never changed. The Elites would have replaced entire teeth with jade or multiple jade pieces on the teeth. Incisors were prominently the teeth that would be jaded as it was visible and easy for dental modification. These jaded teeth of the elite are shown at Copal, Teuctuacan, and Tikal sites where jaded teeth were found located in royal tombs.(Price et al., 2010)

Jading of teeth depends on the dentistry techniques available in the time and area. Sites that were studied and had observed dental modification were during the classical period. The Classical period showed that many of the teeth were drilled in the dentine and a small jade was placed in the opening, followed by a dental white cement to hold the jade in place. (Ramírez et al, 2018)

The sites at Copan, Holmul, and Baking Pot demonstrated the different materials that were used for dental modification. (Hernández et al, 2022) Maya communities utilized resources that were present in their respective areas and create remarkable modifications. The techniques used for jading the teeth were similar to modern-day dental modification. In Western society, people would adorn their teeth with gold grills and diamond encrusted for cosmetic purposes. Medically people would have crown replacements, silver fillings, and teeth fillings. Dental modification provided a unique way to display the body as a symbol of power and status. The techniques practiced and materials used demonstrated the remarkable practices that embodied the Maya culture.

Body Adornment

While not permanent nor created morphological changes, Body Adornment provided Maya communities a way to express the body. Jewelry, headgear, ink, and piercings are examples of body adornment. Jewelry such as earrings, necklaces, bracelets, and other accessories display the status of a member. (DeMello, 2007) Headgear and external gear denote the nobility or distinction of the person. Warriors and ball players have bright plumage. Priests and holy people have distinct markings and gears for rituals. Elite members had access to more materials such as jade or feathers.

The headgear was often shaped in an elongated facial to represent the maize god and decorated with long feathly plumage similar to hair. Hair was protected as it was a symbol of power. Captives of war often had their head shaved as a sign of disgrace and failure. (Tiesler & Lozada, 2018)

Post-Mortuem

The body was a sacred concept. The Body was viewed as sacred during life and after death. Death was not the end. The afterlife was referred to as the underworld or Xibalba was described as being wet and dark. It was a system of caves and held as a sacred place for the spirits and gods. (Tedlock, 1985) While each group has different customs, when a person dies the body is buried. Elites and Royals have tombs made and offerings are placed. In Palenque royal tombs were shown to have post-mortem modification. The body was modified jades were added and offerings were given. (Duncan and Hofling, 2011) Jade Funerary masks from the Palenque site were found in tombs honoring the people. The mask was made from jade and decorated. Funerary artifacts are placed in or around the tomb to honor spirit and body (Tiesler, 2015),

With the Spanish conquest and colonization of the Mesoamerican region, many of the Spanish influences affected the rituals and funerary acts. The effects of prohibiting the rituals and the influence of Christianity changed the rituals and ways of burials. However, many groups continue to honor the dead by offering and cleanings of the bones such as the communities in the Yucatan. (Chichen Itza, 2022)

Discussion

Misinformation about the Maya community has affected the modern Maya people.

Misinformation is a long-lasting effect of a deeply rooted systematic issue that continues to affect the Maya communities that remain in Mesoamerica today. (Coe, 2015) Misinformation is utilized by governments and cooperation to justify land exploitation and unfair work practices. This is seen through the experience of Rigoberta Menchú and the Quiche people of Guatemala. (Menchú, 2009) Misinformation about the Maya communities is rooted in colonization from the Spanish and European countries that established racist ideologies such as the encomienda system that led to slavery, and genocide. Archaeologists have an obligation to stop the spread

of misinformation and produce ethical research that benefits the community they are working with. Assessing the evidence and determining the significance from a non-biased perspective is crucial, especially when assessing human remains and body modification. It is important to avoid using harmful and biased terminology such as deformation and mutation. Terminology like these is present in many articles such as Romero et. al, 2010. Viewing post-mortem bodies and funerary artifacts, archaeologists must be ethical and respectful of the community they are serving. Following standard set by the Society for American Archaeology ethics for human remains is a start. Working closely with the community is crucial to honor and respect the living and past people.

Conclusion

The concepts of body modification that surround the Maya communities were deeply sacred. The symbolic nature of body modifications has techniques and rituals that are of importance to the Maya communities. Archaeological evidence and sites of Maya burials in the Mesoamerican region show the importance of body modification. Body Modification was a way to honor oneself and was beauty standard. This is similar to how in Western society we value beauty and plastic surgery to accentuate the beauty of the body. Art, pottery, and other material cultures depict rituals and beliefs of the concepts of body modification and significance of the body. Post-Mortem Bodies are viewed as an extension of the living and the body is valued and important. Maya communities still view the body as sacred, Hanal Pixán, Day of the Dead in Yucatan is one of the ways the Maya community in Yucatan demonstrates the importance of the body. Hanal Pixán provides Food for the dead, cleaning of the dead, and honoring the dead. (Chichen Itza, 2022)

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**Soto
Gretel**

**Public Defenders: Poor Working Conditions Due To Underfunding
and Its Impact On A Client's Trial**

ABSTRACT

Under the Sixth Amendment, everyone has the right to counsel and those who cannot afford one will be provided one by the state. However, the underfunding of public defender offices creates even harsher working conditions which can have a negative impact on their clients' right to a fair trial. If the underfunding and poor working conditions are not allowing public defenders to provide a fair trial to their clients, then not only is it a violation of the clients' rights but the clients are also the ones that may have to pay the price behind bars. In order to show that low funding and poor working conditions for public defenders has a negative impact on their clients' trials, I compared four states' funding for public defender offices and looked at the cases of reported ineffective assistance of counsel and compared to see whether there was a correlation. The results of this research shows that the states where public defender offices receive more funding results in better working conditions and shows a decrease in the number of reported cases of ineffective assistance of counsel and states where public defender offices are underfunded results in poor working conditions and shows an increase of reported cases of ineffective assistance of counsel. Based on the research and results, I conclude that the funding and working public defender offices receives does have an impact on their clients right to a fair trial.

INTRODUCTION

Under the Sixth Amendment, the right to counsel is guaranteed to criminal defendants who cannot afford one. The State will appoint the defendant counsel if they cannot afford it themselves, however with the underfunding of public defender offices it brings up the topic of whether the counsel appointed is able to provide a fair trial. Public defenders are known to be some of the most overworked and underpaid type of attorney there is in the legal field, despite being one of the most important players in the legal system, very little is done to help them.

This topic is important discuss and go more into detail about because it deals with the possible violation of indigent defendant's right to effective counsel which is promised in the Sixth Amendment. Specifically, the Sixth Amendment states, "In all criminal prosecutions, the accused shall enjoy the right to a speedy and public trial...and to have the Assistance of Counsel for his defence." In the case of *Gideon v. Wainwright (1963)*, the United States Supreme Court held that a state is required to provide counsel to all indigent criminal defendants under the Sixth Amendment's right to assistance of counsel clause. This set forth a landmark decision that allowed those who could not afford counsel otherwise, be properly represented and have a chance at being found innocent.

When looking at the funding that public defender offices receive across the United States and the number of cases each public defender receives on average, the numbers don't make sense. How is it that very little funding is given to those who are in desperate need of it? Underfunding leads to a lack of resources available to public defender offices which can only worsen the already stressful work environment in public defender offices, as well as deter new attorneys from pursuing a public defender career

and quickly burns out those who do. With such a stressful environment and lack of funding, it begs the question, do the poor working conditions caused by the underfunding of public defender offices allow them to provide their clients with a fair trial?

It is not unheard that a public defender is only able to talk with their clients for a few minutes prior to the trial or even pushing them to take a plea deal for the sake of finishing one case and being able to move on to the next. Working as a public defender is not for the faint of heart as it can be extremely challenging to keep up with the caseloads, stressful workload, and pressure. The underfunding of public defender offices results in lack of resources, training, low salaries, shortage of public defenders and overworked exhausted attorneys which could result in a defendant receiving ineffective assistance of counsel, which would violate their Sixth Amendment right which states "In all criminal prosecutions, the accused shall enjoy the right to a speedy and public trial by an impartial jury of the state and district wherein the crime shall have been committed, which district shall have been previously ascertained by law, and to be informed of the nature and cause of the accusation; to be confronted with the witnesses against him; to have compulsory process for obtaining witnesses in his favor, and the assistance of counsel for his defense" (U.S. Const., VI). On average, the number of citizens who know their rights or have a good understanding of the law, are very little so more often than not they have to rely on a public defender and are more likely to blindly follow whatever it is the public defender advises.

Many of those who have received an overworked and exhausted public defender to represent them may feel unrepresented by their attorney's actions. Understandably not wanting to get thrown behind bars for something they didn't do, some people will try to

appeal their case and claim that they received ineffective assistance of counsel. There are different ways to show that a defendant received ineffective assistance of counsel and this could be through claiming their attorney had excessive caseloads, they were deprived of conflict free and independent representation, lack of continuous representation, inadequate attorney client contact and confidential communication, insufficient or no training for attorney, extreme understaffing of both public defenders and support staff, inadequate factual investigation done, and lack of parity with the prosecutorial counterparts. (Ringe, 2015)

An example of this would be the case of Peter Yepez. In 2013 Peter Yepez was charged with burglary in Fresno County, California, where he waited around a month in jail before being able to speak to his assigned public defender. Yepez spent nearly a year being assigned to nine different public defenders who kept telling him that they weren't able to take his case because they didn't have time to work on his case (Community Alliance, 2016). During the time that Yepez was being handed off between the nine different public defenders, his charges were only growing as prosecutors kept adding more and more which changed his charge up to a violent felony. Yepez was encouraged by his public defender to take a plea deal even though there was enough evidence to prove his innocence. During Yepez's time behind bars, he missed out on many life events such as his daughter's graduation and his son's memorial service. Yepez ended up pleading no contest but in 2015 a lawsuit was filed by the American Civil Liberties Union (ACLU). The ACLU filed the lawsuit on behalf of Yepez in which they claimed the underfunding of California and the harsh work conditions in the Fresno County Public Defender's office has led to the point of inadequate defense to the offices' clients.

Yepez's story shows how underfunding and poor working conditions can have an impact of a client's trial and life, despite how upsetting Yepez's story is, it is not something new or unheard of.

I argue that the underfunding of public defender offices leads to poor working conditions which negatively effects their clients' right to a fair trial and can result in innocent people being thrown behind bars and losing years off their life or end up in a plea deal that negatively impacts them. With the number of cases that public defenders have it can be difficult for them to give their all into each and every case. There isn't enough time for a public defender to look at each case in detail and come up with the best solutions for their clients. Some public defenders may start to see cases a straightforward or even repetitive and thus push the same solutions onto different defendants. Underfunding has a negative impact on both the public defenders and their clients. To begin with, underfunding causes public defender offices to have a lack of resources, lack of training for new attorneys, low salaries, low retention rates, and greater shortages in public defenders which only increases the number of cases per attorney.

All of this stress and workload results in public defenders becoming exhausted, burnt out, and overworked all while still being told they need to push out cases as fast as they can which results in them not being able to give each client and case as much attention as is ideal. The impact underfunding has on public defenders directly affects the indigent clients as well. Some ways in which they are affected would be in not being able to talk to their attorney which in turns results in a possible lack of understanding of what is going to happen in the trial. As stated before, many of the indigent defendants have little to no understanding of how the law works, what their rights are and the vocabulary

that is being used in the court, because of this they have no choice but to rely on the public defender. In the end, underfunding and its impact on the working conditions for public defenders leaves public defenders feeling unsatisfied with their performance and the clients feeling underrepresented and upset.

Literature Review

Under the Sixth Amendment, everyone has a right to counsel and those who cannot afford one will be provided one by the state. It is the job of a public defender to ensure that their clients receive a fair trial as is their right. Despite public defenders having a big role in the criminal justice system they are known to be some of the most overworked and underpaid type of attorney there is in the legal field. With the low pay, underfunding, and number of cases a public defender faces, it begs the question, do the working conditions caused by the underfunding of public defender offices allow them to provide their clients with a fair trial?

Similar questions have been asked for years and lots of research has been conducted. Studies has been written analyzing the impact that public defenders' working conditions have on them and their clients. Many of the articles discuss topics such as violations of the Sixth Amendment, not fulfilling the promise in *Gideon v. Wainwright*, underfunding, overload of cases and the impact the working conditions have on clients. This literature review will analyze literature that discusses public defenders' working conditions, possible violations of the Sixth Amendment and the right to counsel and the impact it has on the clients.

Public Defender Working Conditions

Public Defenders offices are known to be underfunded, understaffed, and have an overwhelming number of caseloads which can lead to a stressful work environment. Public defenders are meant to help protect the innocent and ensure that those who are guilty are receiving a punishment that reflects their crime, however with the lack of funding they are receiving it creates an even more stressful environment, especially for the newer attorney just starting their career (Cuff 1961). Despite how important public defenders are to the criminal justice system, little has been done to help them.

Looking at how many cases public defenders are dealing with across states provides us with an indication of how overworked public defenders are (Benner 2011). For example, in Florida the annual felony caseload for individual public defenders increased to five hundred felonies per year while the average for misdemeanors were two thousand two hundred and twenty-five (Benner). Although there is no real limit to how many cases a public defender should receive per year, the American Bar Association (ABA) and the President's National Advisory Commission on Criminal Justice Standards and Goals recommends a maximum if only one hundred fifty felony cases or four hundred misdemeanor cases for a full-time attorney (Benner).

With the working conditions that public defender's face, it can be asked what exactly do they impact and how? Part of the literature has focused on the impacts of the working conditions that public defenders face and how they must deal with it (Lefstein 2011). Findings suggest that the lack of funding and number of caseloads is too much and results in public defenders not being able to follow their profession's rules when it comes to practicing law. Their workload doesn't allow for them to interview their clients fully to gather enough information to make a solid defense nor investigate properly. Findings

additionally indicate that public defenders are also sometimes pushed by judges and prosecutors to take action despite having very little time as it is (Lefstein).

Despite these conditions, public defenders are expected to get through as many cases as possible. The lack of federal and state laws that mandates there to be adequate funding for indigent defense cases and how there is also no real limits on caseloads a public defender can get (Jaffe 2018). Similarly, the severe underfunding has not only led to unmanageable caseloads but also has resulted in multiple violations such as the American Bar Association's (ABA) standard for Criminal Justice, the Model Rules of Professional Conduct, and the Sixth Amendment (Cullen 2017). Some question whether the number of resources a public defender's office receives really impacts the outcome of a case. Studies show whether something such as public defenders having smaller caseloads decreased the amount of incarceration time a defendant got. Findings show that in counties where the caseloads for public defenders are high, the likelihood of being detained during pretrial increases and counties where the caseloads were smaller show a decrease in incarceration time (Gottlieb 2020).

With the lack of resources, indigent defendants are not the only ones tired and frustrated. There have been cases where public defenders have openly admitted to not being able to do their jobs to the best of their abilities as they would like simply because the funds that they receive do not allow for that (Hauser 2021). No one becomes a public defender to intentionally deprive a person of their rights, the resources that are available do not allow for public defenders to constantly meet one on one with their clients but instead has turned the public defender system into a more of a "meet and plead" system (Brennan 2015).

Although some public defenders may feel that they are not representing their clients to the best of their abilities, it is not common that they openly admit it as discussed in other articles. Sometimes a public defender may question the legitimacy of their work in regard to a case or even that of another colleague however, questioning the effective assistance of counsel of another colleague could cause tensions in the workplace (Henak 2009). When it comes to a client filing a complaint that their Sixth Amendment right was violated, it needs to be evaluated whether the public defender made a mistake and whether the mistake was enough to change the outcome of the case and that the mistake was something that no other lawyer would do. These claims can be tricky to prove as there needs to be some type of physical proof of the mistake such as documentation. Without any proof the client's chance of proving ineffective assistance of counsel is slim.

Sixth Amendment and the Right to Counsel

As mentioned before, the working conditions that a public defender faces can lead to possible violations of the Sixth Amendment and the Right to Counsel. With the number of cases a public defender must go through, there are times that they try to deal with cases as quick as possible which can lead their clients feeling neglected and not well represented. While analyzing the literature, many scholars discussed *Gideon v. Wainwright*, which helped declare that U.S. states had to provide attorneys to criminal defendants that were unable to afford their own. Despite the significance of *Gideon* in the criminal justice system, its' promise is unfulfilled when an indigent defendants' Sixth Amendment right is violated due to the state's public defense offices being underfunded and having a lack of resources (Heidorn 2018). There have been studies where two state public defender offices that are funded differently have been compared, one of them

being state funded while the other is county funded. Findings show that public defender office has an increased level of funding which helps attorneys have more time and resources to represent their clients (Heidorn 2018).

Bach (2009) discusses in detail how she observed a public defense attorney by the name of Robert E. Surrency, who, like other public defenders, had an overwhelming number of cases. Bach observes how Surrency neglects his clients that want to speak with him and more often than not pushes his clients to take a plea deal or to plea guilty, despite spending very little time to talk with them and understand the case properly. She also interviews some of Surrency's clients that stated they felt neglected and the way that Surrency handled their cases made everything more difficult than it should have been.

If a public defender barely talks to their client, there is no way that they can fully understand the details of the case and come up with a good defense. With this being said, how can a person be truly represented, what about those who have to wait months to even be appointed a public defender? Ciaramella (2017) touches on this by discussing the case of Shondel Church who had been told that his case was winnable but had to wait six months in jail before he would be appointed a public defender since none were currently available. Church spent three months in jail before deciding to take the plea deal, not wanting to spend the full sixth months. After, Church went ahead and became one of many people to file a lawsuit, stating that the inadequate number of public defenders were a violation of the residents' right to counsel. This shows that with the working conditions deterring lawyers from pursuing this career and causing some current public defenders to quit, it leads to a shortage of public defenders available and impacts indigent defendants' ability to exercise their Sixth Amendment right.

Underfunding has led to the appointment of "incompetent or inexperienced" counsel, lack of training for public defenders, excessive caseloads, little to no expert and investigative resources and lack of meaningful attorney-client meetings (Lucas 2018). These issues could violate the rights of indigent defendants and when they take place some clients feel the need to challenge them in court. When an attorney's performance is in question, there are many interpretations as to what affective assistance of counsel is. An example is Alabama's courts, where they are less likely to rely on guidance from something such as the ABA to determine whether the public defender's action was reasonable (Lucas 2018).

Despite the claims of lack of funding and resources violating the Sixth Amendment, very little has been done to discuss this issue and not even the Supreme Courts have acknowledged this issue despite it dealing with one of the Amendments. There is no certainty as to why little to no progress has been made in order to fix this issue, perhaps the only people who truly understand how severe the issue is are public defenders and indigent defendants (Ogletree 1995). Some have argued that there's already a test that can be used to determine ineffective assistance of counsel however, the two-prong test that was established in *Strickland v. Washington* does not focus on the underfunding and lack of resources' influence and only focuses on a lawyer's performance and the decision of the judge (Effectively Ineffective...).

Impact on Clients

In the end, the ones that must pay the price of whether or not their public defender is able to adequately represent them are indigent clients. The underfunding of public defender offices not only makes it hard to receive affective counsel but also forces public

defenders to decide whether or not a case deserves attention (Richardson, et al 2013). By forcing public defenders to pick and choose which case will receive attention, there could be signs of implicit bias influencing their decision (Richardson, et al 2013).

Similarly, there are stories of people who have had public defenders not properly represent them due to being afraid to ask for more funding and were going to allow their client to be found guilty. One specific story that is discussed is Edward's S, who had been accused of a crime and when he was assigned a public defender was found guilty (Baxter 2012). Luckily, the case got transferred to another county due to a change in residence, and with a new public defender they were able to claim ineffective assistance of counsel during the first trial. Edward's prior public defender admitted to not being able to represent him properly due to not wanting to ask for more funding out of fear of losing his job (Baxter 2012). More often than not, those who are represented by public defenders are racial and ethnic minorities and people from low-income backgrounds. Studies show how the underfunding of public defender offices results in the violation of indigent minorities' Sixth Amendment when the inadequate resources public defenders receive doesn't allow them to sufficiently represent them (Marcus 1994).

Many defendants are left in jail for weeks or even months before they are appointed counsel due to the shortage of public defenders available (Young 2013). Findings show that the majority of people who are appointed a public defender have little to no understanding of the law or their rights, forcing them to have no other choice but to depend on their public defender (Young 2013). The lack of resources impacts racial disparities in case outcomes and can be seen by looking at the data from the Census of Public Defender Offices and data from the State Court Processing Statistics and

comparing the two (Gottlieb 2021). Findings show the more caseloads a public defender the greater the Black-White disparities when it comes to pretrial detention. We also see that when it comes to sentence length, Latinx-White disparities also exacerbate when public defenders have high caseloads. This shows us the impact that issues such as overwhelming caseloads have on racial minorities clients.

Other Literature

Despite all the literature and research showing the impact funding has on working conditions and effectiveness of counsel, there are some scholars that argue that funding is not a huge factor when it comes to the poor working conditions of public defenders that has an effect on the effectiveness of counsel. Instead, many scholars argue that the fault lies within the Strickland v. Washington two-prong test and how it is vague enough that it allows many actions to go unpunished or dismissed (Primus, 2020). The Strickland v. Washington two-prong test is vague and has its fault when trying to prove ineffective assistance of counsel as there are some instances where it cannot be applied however, it cannot be said that this test is a prime factor as to the current state of the working conditions of public defenders. Other scholars argue that the reason the working conditions of public defender offices are in its current state is because there are no strict regulations or limits that states how many cases an attorney can handle per year, this allows for public defenders to be given case after case without breaking any laws (Lefstein, 2011). Although this argument is true, one of the contributing factors as to why there are so many cases per attorney is because of the shortage in public defenders available. Since public defenders are some of the lowest funded groups in the legal system, their salary does not reflect the amount of work they must do in order to make up

for the lack of resources available to them due to underfunding. With the amount of work not being reflected in the pay, many new attorneys try to deter away from the position or leave after a few years of experience.

Contribution

While looking for literature that pertains to the topic, there seemed to be mostly research done on how funding and poor working conditions can cause ineffective assistance of counsel and what needs to be done in order to fix this solution, however, there was a lack of discussion on how underfunding can cause or even worsen the already stressful working conditions of public defender offices. It is well known by many, as seen in the literature, that there is a problem in how public defender offices are treated and the difference in treatment between public defender offices and other key players such as prosecutors, judges, etc. With my research I will go into a bit more detail about how funding affects the working conditions and the number of reported cases of ineffective assistance of counsel in four states in the United States. Specifically, my research will help compare states that are funded differently, have different population sizes, different demographics, and how their working conditions such as: caseload per attorney, retention rates and the percentages of reported cases of ineffective assistance of counsel.

Methodology

In order to prove whether the conditions caused by the underfunding of public defender offices allows them to provide their clients with a fair trial, I picked four states in the United States and compared various variables as well as the number of reported cases of ineffective assistance of counsel in each state. The variable considered when choosing the four states were: population size, population demographic, political party

association and I also wanted to include two bigger states and two smaller states. This was because I wanted to see if population size mattered when it came to the amount of ineffective assistance of counsel reported. I also wanted to pick pairs of states that were similar to each other but different to the other pair. In order to determine what falls under the category of ineffective assistance of counsel I used literature and cases where it was defined. Based on this I was able to define ineffective assistance of counsel as the following: “Ineffective assistance of counsel is when a defendant’s legal counsel fails to properly represent them resulting in the deprivation of a fair trial.”

The main objective of this experiment was to see whether more funding across states reflects a decrease in complaints of ineffective assistance of counsel and violations of the Sixth Amendment. Past findings show that the states that had a higher funding for public defender offices had lower rates of claims of violations of the Sixth Amendment and of ineffective assistance of counsel, however these studies were based on comparing only two states and not multiple.

This method was the most appropriate because it allowed us to compare the funding in each state and the working conditions to see whether there is a correlation between the working conditions due to funding and the number of claims of ineffective assistance of counsel or claims of violations of the Sixth Amendment. This method also allows us to see the difference of funding between smaller and big states and how they compare. By understanding how much funding is going towards public defenders in each state we were also able to come to a understanding of the working conditions, since funding more often than not directly effects variables such as resources available, pay, retention rates of public defenders and the working environment.

The four states that were picked consisted of two big states and two smaller states: California, Texas, Iowa and Utah. The reason that these four states were picked was because California and Texas are two of the biggest states in the United States and share similar population demographics to each other and their public defender offices are funded differently from each other. Iowa and Utah are smaller states and have a close population number to each other as well as also sharing similar population demographics. Similarly to California and Texas, Iowa and Utah public defender offices are also funded differently from each other. California public defender offices receive minimal funding, Texas' public defender offices receive mixed funding, Utah public defender offices receive minimal funding and Iowa public defender offices are state funded.

To have a better understanding of the types of funding each state has for their public defender offices and how they differ from each other they can be described as follows: minimal funding states receive little to no funding from the state and relies solely on county funding, mixed funding states receive funding from both the state and county however the funding is majority from the counties, state funded states receive their funding from the state. Although California and Utah's public defender offices both receive minimal funding, I included both of them because of their difference in population.

After picking out the four states I researched the funding available in each state, this was done by looking at different websites such as the states' annual reports through any Indigent Defense Commission (IDC) programs as well as the state websites. For California and Utah where the public defender offices received minimal funding and mostly relied on county funding, I looked at their Innocent Project websites and looked

through any reports of grants given to counties as well as whether had any programs such as the Indigent Defense Grant Program in California, were set up. For Utah, I was able to find funding information through their IDC Annual defense commission annual report for 2021. Since Iowa is state funded, all their funding information was found through the state's government website under the Budget Unit Brief for the Indigent Defense Fund (IDF) for 2023. In order to find the funding information for Texas since it is mixed funding, I had to go through their Indigent Defense budget at the state and county level, this was done through the state's government website and its county website. The county website discussed how funding is distributed through the different counties.

After finding funding information for each of the four states, I had to find the average caseload public defenders had per year in each state. This was done through the Bureau of Justice Statistics as well as looking for news articles that reported the workload of public defenders throughout the year. Based on the information given through the Bureau of Justice Statistics and various news articles for each state, I was able to come to an average for each state that was consistent with the available information. Once the average caseload for a public defender per year in each state was calculated it was then compared to the American Bar Association's (ABA) recommendation for average cases a public defender should be dealing with per month. This was done by getting the average caseload per attorney per year and dividing the total number by twelve. The reason for this comparison was to show how much more cases public defenders deal with and whether states where public defender offices were better funded were closer to the average amount of cases recommended by the ABA.

When looking for the retention rates in each state there was some trouble finding more detailed information, the only information that I was able to find was through Google and instead of being specific to one state, the information given was in general for the whole United States. Along with the information about retention rates, the news articles also discussed reasons as to why the retention rates for new attorneys joining the public defender offices were low. The reasons cited discussed low salaries that left some attorneys feeling dejected that the amount of work they did was not reflected in their paycheck, the lack of resources available, overwhelming number of cases they had to go through and burnout.

When looking into the reported cases of ineffective assistance of counsel, I used WestLaw to look for cases in each state. This was done by going onto the WestLaw website from the school's database and clicking on "Cases," picking the state that I wanted to look at and clicking on the option to look at the cases at the state level. After this I used the phrase "ineffective assistance of counsel" to look at the cases, on the side I was able to filter cases down to only include criminal cases. The results showed me cases that were labeled as reported and unreported in the state, it also showed the difference between the number of cases at only the state level versus the federal level. After seeing the number of reported of cases versus unreported cases I divided the number of reported by the number of unreported and multiplied the number by one hundred to get a percentage of how many cases of ineffective assistance of counsel get labeled as reported cases in each state.

After collecting all the information regarding funding, working conditions and cases of ineffective assistance of counsel in each state I compared the information in each

state. The information was compared in order to look at whether there was any difference or pattern I could see regarding the amount of funding public defender offices received in each state and the reports of working conditions and the reported cases of ineffective assistance of counsel. The point of comparing the states and these variables is to see whether states that are better funded have less reported cases of ineffective assistance of counsel and reports of better working conditions. In order to compare the information collected, it was put into graphs so it would be easier to visually see the difference in funding, reported cases of ineffective assistance of counsel, caseloads and the retention rates. By doing this we were able to see whether the argument that the underfunding of public defender offices leads to poor working conditions which negatively effects their clients right to a fair trial can be accepted or not.

Results

Starting with the two big states, California and Texas, they were chosen because they are the two biggest states in the United States and have similar population, population demographics, different political parties, and types of funding. According to the 2022 Census, California has a population of thirty-nine million with a demographic that consists of thirty-five percent White, forty percent Hispanic, six percent Black/African American, one point seven percent American Indian, sixteen percent Asian, and point five percent Native Hawaiian. California is a Blue state, meaning that it is made up of majority Democratic voters.

There are three categories of funding a state call fall into: Minimal/no funding, Mixed funding, and State funded. Based on the research, California falls into the category of minimal funding, this means that the public defender offices in California have to rely

mostly on county funding. There are programs and grants from the state that are given to counties that apply and are eligible. The Budget Act of 2020, also known as Senate Bill 74, helped establish the Indigent Defense Grant Program which appropriated ten million dollars in funding. However, only nine point eight million dollars out of the ten million is available for grants to county public defenders and it is not given to every county in California, instead it is given to around nineteen counties in the state.

As of 2022, the Public Defense Pilot Program started accepting applications for all fifty-eight counties to receive funding for their public defender offices. The Public Defense Pilot program is a program in which its funds are used for indigent defense providers, including public defenders, alternative defenders and other qualifying entities. The funding consists of around forty-nine point four million dollars being available to given to counties that apply to the program and submit all the following materials required.

Moving on to Texas, it also shares a big population similarly to California, its population according to the 2022 Census is a little over thirty million. Its demographic is made up of forty percent White, forty percent Hispanic, thirteen percent Black/African American, one percent American Indian, five percent Asian, and point two percent Native Hawaiian. Texas is also known to be a Red state as its voters is mostly made up of Republican voters. Unlike California, Texas falls under the category of Mixed funding when it comes to where public defender offices receive their funding from. In order to be categorized as Mixed funding, public defender offices need to be receiving funding from the state and county and although this is true for Texas, less than half of its funding is from the state itself.

In Texas, the Texas Indigent Defense Commission (TIDC) funds public defender offices in all two hundred and fifty-four counties. There are three types of funding the TIDC will give a county: Improvement grants, Formula grants or Extraordinary grants. Improvement grants are meant to fund the improvement of indigent defense systems, which include new public defender offices. Formula grants is when the TIDC reimburses Texas counties for a portion of their indigent defense expenditures. Extraordinary grants help provide assistance to the counties in Texas that are in need of extraordinary indigent defense expenses that cause a county a significant financial hardship.

In 2019, Texas funded only about twenty-eight point million dollars of the total statewide indigent defense cost, while counties contributed approximately two-hundred and seventy-one million dollars, which is about ninety percent of the total cost. Since the passage of the Fair Defense Act, the indigent defense costs increased from ninety-one million dollars in 2001 to two-hundred and ninety-nine million dollars in 2019. More recently in 2021, the Texas Indigent Defense Commission awarded twenty-two million dollars in formula grants to all two-hundred and fifty-four counties.

Similar to California, Utah falls under the category of minimal/no funding from the state for public defender offices. The difference between Utah and California, however, is their population, population demographic, and political tie. Utah has a population of three point three million and is made up of seventy-seven percent White, fourteen percent Hispanic, one point five percent Black/African American, one point six percent American Indian, two-point seven percent Asian and one point one percent Native Hawaiian. Utah's Indigent Defense Commission (IDC) has a grant program that awarded more than five point two million dollars in state funding in 2021. As far as

funding goes for public defender offices, there was little information online other than what was available on the state's government website.

Iowa is similar to Utah in terms of population, population demographic but is different in the sense that it is the only state out of the four whose public defender offices are state funded as well as being classified as a swing state in recent election years. Iowa has a population of three point two million people in its state according to the 2022 Census. This population is made up of eighty-four percent White, six point seven percent Hispanic, four point three percent Black/African American, point six percent American Indian, two point eight percent Asian and zero point two percent Native Hawaiian.

From 2018 to 2022, the State General Fund Appropriations averaged around sixty-five point five million dollars that were to be split between the Office of the State Public Defender and the Indigent Defense Fund (IDF). The Office of the State Public Defender is responsible for coordinating Iowa's IDF system and the IDF received around thirty-eight million dollars out of the sixty-five point five million dollars, when subtracted, that leaves the State Public Defender Fund with around twenty-seven point three million dollars. The comparison of the amount of funding public defender offices in Iowa received compared to Utah despite being similar in size and having close demographics is quite drastic.

Comparing the funding between the two bigger states of California and Texas we can see that both states' public defender offices do for the most part rely on funding from the county despite being categorized as receiving different types of funding. The state funding that is available to public defender offices are not given to every county in California but it is given to every county in Texas as long as they submit an application

Based on the research there is also more types of funding available to the counties in Texas and there is even a grant for those counties that are experiencing extraordinary financial hardship and need help to fund their indigent services. California seems to be implementing more grants and programs to be available to help out public defender offices in different counties across the state.

For the smaller states of Utah and Iowa we can see the drastic difference in funding despite the states being very close in population size and having similar population demographics. Iowa's public defender offices are state funded and when compared to Utah's public defender offices receiving minimal/no funding, Iowa's public defender offices are better funded and have more programs in place than Utah to give extra help. The information about Utah's funding for their public defender offices were very limited and only discussed the five-million-dollar grant given by Utah's Indigent Defense Commission. The only other information that relates back to any type of funding for indigent defendants was their Innocent Project programs.

When comparing all four states to each other it seems that California and Texas receive the most funding however, this is only in perspective to the sheer size and population of each state. Out of all four states, Iowa was the only one where public defender offices were being state funded and when compared to Utah, it had a lot more resources available. Three out of the four states all still heavily rely on county funding for their public defender offices however it seems that as the years go by more and more grants and programs are being created in order to try and contribute a bit more to the public defender offices.

Next we looked at the caseloads per attorney per year in each of the four states. There are no strict guidelines that a state or public defender office must follow when it comes to the amount of cases a public defender may handle per year however there are recommendations from the American Bar Association. According to the American Bar Association, public defenders should handle around ten to twelve cases per month. According to the National Legal Aid and Defender Association, the caseload of a public defender office should not exceed the following per attorney per year: no more than one hundred fifty felonies, no more than four hundred misdemeanors, no more than two hundred juvenile court cases, no more than two hundred Mental Health Act cases, no more than twenty-five appeals.

In California, on average public defenders handle around six hundred cases per year according to the Bureau of Justice Statistics. When this is broken down to compare to the ABA's recommendation, that is fifty cases a month, almost five times the amount. Public defenders in Texas average around four hundred criminal cases per year, which is thirty-seven cases a month. Utah public defenders handle around two hundred-fifty to three-hundred criminal cases per year, that is around twenty to twenty-five cases a month. In Iowa public defenders handle an average of one hundred and forty to two hundred criminal cases per year, which is about twelve to seventeen cases per month.

Out of all the states, Iowa is the only one that is the closest to the recommendation suggested by the American Bar Association and the National Legal Aid and Defender Association. With the number of cases public defenders handle per year, there is no way that they are able to go through each case in great detail or meet with each client individually. Since Iowa is one of the most well-funded out of the four states, this shows

that states where public defender offices receive a higher amount of funding have lesser case loads per attorney per year on average. Also, being state-funded most likely decreases the stress put onto the county and also the public defender offices as the budget is set every year and is adjusted accordingly.

With the number of caseloads public defender attorneys handle in each state and the amount of funding received, we move to look at the retention rates of public defenders in each state. While looking up the statistics of retention rates in each state, there was very limited information available that had any type of detailed information. However, based on news articles and a few journals on the internet, there were reports of the average retention rates across the United States being around one in three working public defenders leave their positions within two years due to the low salary and stressful work conditions. Many of the reasons for low retention rates cited in news articles was due to a lack of career opportunities, burnout and finding dissatisfaction in their work.

In California the average salary for a public defender was anywhere from \$58,455 to \$73,339, with an average of \$64,464 while in Texas the average range is from \$51,389 to \$64,473, with an average of \$56,672. The average salary depends on where the public defender is located, and this is true for all states however since Texas and California are two of the biggest states in the United States and have a good economy their salaries are higher than most states in the United States. When looking at the smaller states such as Utah, the average salary for a public defender is anywhere from \$49,581 to \$62,205, with a median salary of \$54,678. For Iowa the average salary is \$50,082 to \$62,834 with an average of \$55,230. For the amount of work it takes to be a public defender, for it not to

be reflected in the pay can be disheartening and can deter freshly out of law school attorneys away from applying to the public defender office.

When talking about the different types of attorneys, something that always get discussed when the topic of public defenders is brought up is ineffective assistance of counsel. When it comes to proving that a defendant received ineffective assistance of counsel, the Strickland test is used to determine whether the public defender's actions were unprofessional and whether the public defender's actions influenced the outcome of the trial.

To look at the cases of ineffective assistance of counsel, I used WestLaw to look up reported cases in each state. Once I inputted the information, I was looking for I got the results that showed that California had in total had 8525 cases regarding ineffective assistance of counsel in total. When breaking the 8,525 cases, 6,367 of the cases were at the Federal level while 2,158 cases were at the state level. Looking at only the state level, 1,896 of those cases were labeled as unreported and 262 were labeled as reported cases. Dividing the total cases by the cases labeled as reported, it shows that only 12% of the total cases brought in as ineffective assistance of counsel are able to be labeled as reported.

Using the same method, I looked at Texas and the number of cases of ineffective assistance of counsel. For Texas there were a total of 9,738 cases in total but 5,086 of those were at the state level and 1,139 were labeled as reported cases and 3,974 as unreported. Out of the total cases at the state level, only 22% are labeled as reported cases of ineffective assistance of counsel.

Looking at Utah, there were 7022 cases in total dealing with ineffective assistance of counsel and 1,284 of those cases are at the state level. 1,028 of those cases get labeled as reported which is about 80% of the cases. With 80% of the cases being labeled as reported cases of ineffective assistance of counsel it shows that 80% of those case had sufficient evidence that the counsel received was indeed ineffective assistance of counsel.

Moving onto the last state, Iowa's number of cases totaled 9,673 of ineffective assistance of counsel in total with 5,929 cases at the state level. Using the same method, I got 14% of the total cases were labeled as reported, meaning that only 14% of the cases brought as cases of ineffective assistance of counsel were valid and had sufficient evidence. It could be argued that Iowa has one of the lowest percentages of reported cases of ineffective assistance of counsel due to it having the smallest population out of the four states however, it also had one of the highest numbers of total cases of regarding ineffective assistance of counsel. So although, its small population Iowa it has nothing to do with the number of reported cases of ineffective assistance of counsel.

This also shows that the out of the four states, Iowa and California have the lowest rates of reported cases of ineffective assistance of counsel. The states with the largest and smallest population out of the four both yield similar results and although California's public defender offices receive minimal funding from the state, they are still able to uphold their client's right to a fair trial and their right to effective counsel as promised in the Sixth Amendment. Texas and Utah both had high cases reported cases showing that the amount of attorneys who were not able to represent their client to the best of their ability in each state is high.

When comparing everything together and how everything relates to each other we were able to see that states that had a good amount of funding for their public defender offices regardless of their type of funding had lower reported cases of ineffective assistance of counsel reported. On the other hand, as we are able to see in the state of Utah, which had 80% of their cases go through as reported cases of ineffective assistance of counsel showing that there indeed were problems when it came the client's right to a fair trial. For a better visual understanding of the data collected, refer to Table 1.

Conclusion

Based on the information gathered in this research we are able to come to the conclusion that states in which public defender offices are underfunded are more likely to have reported cases of ineffective assistance of counsel. This is especially the case if the state has a smaller population and doesn't have a big economy. As we saw with California, despite it being a state where public defender offices receive little to no funding from the state, it had one of the lowest percentages of reported cases of ineffective assistance of counsel. Overall, we can come to the conclusion that underfunding does have an impact on the working conditions of public defender offices which in turn can deprive indigent defendants from their right to a fair trial and their right to effective counsel.

With the underfunding having an impact on the working conditions for public defenders by limiting the resources available for them to use for their client's trial, as well as deterring more lawyers from joining the public defender offices and workforce this can hinder a defendant's right to a fair trial and right of effective counsel as promised

in the Sixth Amendment. If indigent defendants are unable to rely on public defenders to represent them and help them present their case then it shows how the legal system still divides people from different races, ethnicities, and social economic status. Those who can afford a private lawyer seem to be the only ones in the United States that have all their rights that are promised in the Constitution.

This once again shows that there is a problem in the legal system where indigent minorities are victims and have to deal with how broken the system is. No one becomes a public defender because they want to purposefully throw innocent people behind bars or force them to take a plea deal that has a negative impact on them. However, when they are given overwhelming caseloads while simultaneously being told they need to get through their cases as fast as they can by their superiors, it can cause them to become burnout quick to the point where they are so exhausted and are falling asleep during their client's trial.

There also needs to be an improved method on ways to decide whether a defendant received ineffective assistance of counsel as the Strickland test does not cover every base possible. When the two-prong test is not met then it cannot be categorized as ineffective assistance of counsel and the defendant's appeal gets overturned, leaving someone who believes their Sixth Amendment right was violated.

There were some limitations to this study as only four states within the United States were analyzed. For future researchers that would like to explore this topic, there should be an analysis on even more states. If time and resources were not limited then a good way to try and evaluate whether underfunding and poor working conditions have an impact on a client's right to a fair trial and effective counsel would to go observe criminal

courtrooms across multiple states as well. This would allow the researcher to get a better firsthand understanding of what is happening in these courtrooms with these clients and their public defenders. If able to, the researcher should also try to and ask indigent defendants for an interview and ask them about their experience with their public defender.

Another way to gather data would be to try and reach out to people who have been freed through the Innocence Projects in different states since sometimes the appeal of ineffective assistance of counsel doesn't always go through. Since these people would be able to discuss how these issues cost them years off their life and the psychological aspect of how it is to be locked up for a crime that they did not commit.

Overall, this study shows that public defenders need to receive more assistance somehow and there needs to be a limit on how many cases they can take per year per attorney. If this does not improve, then the number of reported cases of ineffective assistance of counsel will only continue to grow and the caseloads for public defender offices will only continue to grow as the number of public defenders continue to shrink. The way that things are currently going there is a chance that in the near future, everything will become too much and no one will have an idea on how to fix it, change needs to happen now while there is still time to get everything under control.

Underfunding does have an impact on the working conditions that public defender offices have to deal with and the more funding they have allows them to hire more support staff, hire more public defenders, have access to more resources which can help clients in their cases and help take the load off of things. Instead, many public defender offices have to make due with all that is available to them.

Something that was not discussed in this paper that is also a problem and impacts a client's outcome in a case however is the workplace culture that all attorneys face while in the legal system. Specifically, it is the failure to hold each other accountable for their mistakes and a lack of checks and balances. As I did my research there were a few articles and books that mentioned how toxic the workplace culture is and how all that matters to some people in the legal field, is winning even if they know that they are wrong.

For many a good attorney is one who wins a lot of cases because it shows that they are going to defend their client as best as they can but for others, they are willing to allow an innocent person to be thrown behind bars. This is common not only with attorneys but also with other key players in the legal system such as judges, cops, and prosecutors. When it comes to a case where there is a lot of public attention, this is especially true because now they have this pressure from society to catch the person who did the crime. However, more often than not the public just wants someone to blame and direct their anger at, a type of scapegoat, and because of the overwhelming pressure all that matters is finding someone who is easy to blame. My research did not touch on this topic however, I think that this would be interesting for future researchers to go into more detail about.

[Table 1]

State	Funding	Caseload per attorney per year	Reported cases Ineffective assistance of counsel (IAC)	Unreported cases Ineffective assistance of counsel (IA)	Reported cases of IAC in percentage
California	~\$10 Million	~ 600	262	1,896	12%
Texas	~\$22 Million	~450	1,139	3,947	22%
Utah	~\$5.2 Million	~250-300	1,028	256	80%
Iowa	~\$65.5 Million	~140-200	840	5,089	14%

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Tercero Ana*

I entered the McNair Scholars program at the end of the fall semester of 2022, which means that I didn't really get into working on my research project until the spring semester of 2023. Once spring semester began, my faculty mentor, Dr. Autry and I, focused on following the initial research proposal submitted to McNair which consisted of developing the study, finalizing and submitting the formal version of the research proposal, determining and gathering the necessary materials, and presenting my research proposal at the McNair Scholars Symposium.

To break it down further, this semester we used the time to really finalize the study so that it will be ready for data collection in the Fall semester of 2023. We went over the materials which were already a part of a previous study, and determined what materials would need to be purchased or are needed in order for me to formally start gathering data. We also went over the previous IRB protocol, procedure, and materials we still need to get to ensure that any changes or supplies that are necessary, will be made/purchased come the Fall semester.

Trejo Alexis*

Comparing Aspects of Performance Between DLI Programs Across LAUSD

Dr. Morales

Abstract

When it comes to learning a second language academically, schools can use a variety of approaches. Dual-Language Immersion are programs that immerse students in two languages-- one being the primary language and the other being the secondary language. This study is designed to benchmark all immersion programs in Southern California so that any one individual programs can adequately determine how their own program compares. This helps the general improvement of programs across the region. An online survey was developed and approved by the institutional review board. The components of the survey are based on findings from past research on Dual-Language Immersion. Program directors will be asked to provide information about the program they run. Currently, due to circumstances out of our control, there is a roadblock to contacting the programs. The data we would collect is program-level and non-invasive in nature. However, the district would still like us to seek their approval before commencing data collection. Unfortunately, this would extend too far into the future to work with the McNair timeline. Consequently, we instead collected archival data from the district. This data is currently being analyzed. The data will provide insights into dual language immersion programs in southern California. These insights can provide historical context for comparing survey data collected in the future.

Introduction

In education, the learning model has mostly stayed the same. Children are usually introduced to a foreign language once they reach high school, or if they are migrating from a different country. This results in students gaining a year or two of a foreign language, but once they graduate, that might be the only time they experience learning a second language. Two years is not enough for a child to learn how to read, write, and speak. Learning a second language needs to start early on and progress with the child as they also learn English. A Dual Language Immersion program, if done right, can be beneficial to a child in acquiring a second language. The purpose of this paper is to provide further evidence of the effectiveness of a DLI program from currently run programs in the LAUSD school district.

Literature Review

When it comes to learning a second language academically, schools can use a variety of approaches. Immersing students in the language being learned is one such way. Dual-Language Immersion programs are programs that immerse students in two languages. These programs tend to use one of two types. They are referred to as one-way and two-way programs. "In the United States, student population demographics determine whether a DLI program is classified as one or two way" (Watzinger-Tharp et al., 2018, p. 576). Two-way programs are designed to serve native speakers of both languages, whereas one-way programs primarily serve students who are new to the target language (Li et al., 2017).

There have been studies that have found two-way dual language programs are associated with higher student outcomes for English learners, heritage language learners, and native speakers of English (Li et al., 2016).

One-way programs are defined as demographic contexts where only one language group is being schooled. One-way programs must make their curricular decisions to meet the needs of their student population, and due to this the resulting program will be different from that of a two-way program. The basic principles are similar between both, a minimum of six years of bilingual instruction or eight years in case there are no English-speaking peers enrolled in the bilingual classes. Two-way programs have demographics that involve native-English speaking students joining bilingual and ELL (English Language Learners) peers in an integrated bilingual classroom. Two-way programs do well in resolving sociocultural concerns that have resulted from segregated bilingual classes. This program does well in helping students from each language group learn to respect each other in the learning process and teach one another (Collier & Thomas, 2004).

The goal of these programs is to achieve bilingualism between native-English speakers and non-English speakers. These programs are meant to last at least six years, in order to have a quality enrichment bilingual program. Two longitudinal studies by Thomas and Collier provided evidence on the effectiveness of bilingual education. "Quality, long-term, enrichment bilingual programs that are well-implemented, give LM (Language Minority) students the best chance to succeed academically in English into the high school years." (Cobb et al., 2019, p. 30). In their second study they found that the more primary language schooling received, the higher L2 students would achieve. They also found that "it takes four to seven years of dual language schooling to begin outperforming other bilingually schooled students in all subject areas." (p.30).

Various models of dual-language immersion exist, but the most common options involve a 90:10 or 50:50 ratio. If the minority language was Spanish, then in a 90:10 model it would begin with 90% instruction in Spanish and 10% in English (Brannon, 2019). The 90:10 model provided intensive instruction in the minority language, and would gradually increase academic time in English to 50% of the instruction time by 5th grade (Collier & Thomas, 2004). An example of this is City Elementary that followed this format starting with a 90:10 model. They began at a 90:10 model in kindergarten and would shift downward from 80:20 and so on till they reached 50:50 in 5th grade. They had their students take a TAKS (Texas Assessment of Knowledge and Skills) test during their 5th grade year in English reading, English mathematics, and science. The results were the same; their students consistently outscored their peers across the district and the state (Alanís & Rodríguez, 2008).

At times there can be issues in deciding which model is the most appropriate to implement due to the class demographics. L. Gómez and R. Gómez created the 50-50 Content Model in order to work around this issue. This model has been implemented in schools where almost all the students were Latinos. It is unique in the way that it divides languages by subject rather than time. This reduces the issues that come from alternating languages by days of the week because teachers are able to extend on the material they taught one week versus having to teach the material in the target language (Gómez et al., 2005).

The main success of these programs do not solely come from the students but their teachers and how they are trained. See, an independent international school in Hong Kong, give their Chinese and English teachers time every week to plan together so that children can experience complementary themes and activities across classrooms. Building vocabulary is very important and to continue growth in this area, their teachers receive additional training in effective strategies to do so at each age level (Soderman, 2010). "Teachers in dual-language immersion programs combine the natural process of language learning with the instructional process of acquiring knowledge by integrating the [L2] (Second Language) throughout various content areas. Thus, students gain knowledge in the target language and learn new material in their native language" (Brannon, 2019, p. 121). "One commonly prescribed instructional practice in dual immersion models is to separate the two languages by teacher and / or classroom in order to encourage and foster parallel developments in the two languages." (Lee et al., 2008, p. 75). At City Elementary they supported the notion of equal status of languages, and so they made sure not to promote one language over the other (Alanís & Rodríguez, 2008). The purpose of this was so that native Spanish speakers could have a stronger learning environment and for native English speakers to appreciate the value of acquiring a second language and be able to engage in conversation with their Spanish-speaking classmates (Alanís & Rodríguez, 2008).

Although dual language immersion programs have had much success, there are still challenges that can impact the quality of these programs. One issue that is faced is the amount of time given to each language. It is believed that with more exposure to English it will lead to better understanding of the language, but this is not the case. Some studies have shown that students in 90:10 and 50:50 programs have had similar progression in their academics.

Research Question

The original research question was: What is the current state of affairs regarding characteristics of Language Immersion programs in Southern California? The goal was to compile the data from the survey responses and see how other Dual Language Immersion programs compare to one another.

Methods

Participants

When it came to finding participants I used purposive sampling. I found an online PDF document that had a list of schools in LAUSD that offered DLI programs. I then created an excel spreadsheet to transfer the data from the PDF of schools that still were running a DLI program. We also used snowball sampling in order to find additional schools that offered a DLI program. Due to the circumstances with our online survey, our "participants" have come from past archived data regarding DLI programs in LAUSD.

Materials and Measures

A survey of 27 questions was created in order to ask our participants about the characteristics of their program. Majority of the questions had a definite answer, but some questions were open ended so that we could gain more personal responses about their program. Some of the questions that were present asked about the type of program they were using, model type, languages offered, questions about the training within their staff, and much more.

Procedure

From the list of schools that offered a DLI program, an excel sheet was created to input which schools were still currently offering the program. Once that was done, all emails were sent to participants from my personal email. If participants knew of schools that offered DLI programs outside of LAUSD they were encouraged to list them out at the end of the survey.

Study Complications

After sending emails out to participants, I was notified early from participants that LAUSD has a research branch that one must go through in order to conduct research. The deadline had already passed, and rather than risk the possibility of more participants mentioning the LAUSD research branch, we decided to close the survey and find alternative data that was publicly accessible.

Alterations to Methods

My mentor shared with me screenshots of data from LAUSD dashboards from the academic school year 2022. They also shared with me two excel spreadsheets that contained a list of different schools from LAUSD that offer a DLI program.

Results

An excel chart was created from the screenshots of data, the categories that were present were: model type, program type, target language, and home language. In the excel spreadsheets, school type, school configuration, years immersed, and local district were put into SPSS and created tables for each.

Table 1 (Model Type)

Model Type	Total
50-50	15,900.00
70-30	1,490.00
90-10	870.00
Secondary DLE Students	1,980.00
Two or more Instructional Models	248.00
Total	20,488.00

Table 2 (Program Type)

Program Type	Total
Dual Language One-Way Immersion	988.00
Dual Language Two-Way Immersion	18,368.00
Two or More Program Types	661.00
World Language Immersion	471.00
	20,486.00
Total	20,486

Table 3 (Target Language)

Target Language	Total
Arabic	45.00
Armenian	554.00
French	319.00
Korean	753.00
Mandarin	1,424.00
Spanish	17,335.00
Total	20,430.00

Table 4 (Home Language)

Home Language	Total
Armenian	414.00
English	7,911.00
Korean	419.00
Mandarin	220.00
Spanish	11,080.00
Total	20,044.00

Table 5 (School Type)

		Frequency	Percent
Valid	Elementary Schools	160	71.1
	Middle Schools	37	16.4
	Option Schools	6	2.7
	Senior High Schools	15	6.7
	Span Schools	7	3.1
	Total	225	100.0

Table 6 (Local District)

		Frequency	Percent
Valid	Central	49	21.8
	East	68	30.2
	Northwest	20	8.9
	Northwest	13	5.8
	Option Schools (Central)	5	2.2
	South	36	15.6
	West	35	15.6
	Total	225	100.0

Table 7 (School Configuration)

		Frequency	Percent
Valid	Grades 1-2	1	.4
	Grades 1-5	1	.4
	Grades 2-2	1	.4
	Grades 2-3	1	.4
	Grades 4-12	1	.4
	Grades 6-8	33	14.7
	Grades 8-12	5	2.2
	Grades 7-8	4	1.8
	Grades 9-12	14	6.2
	Grades K-1	7	3.1
	Grades K-2	22	9.8
	Grades K-3	34	15.1
	Grades K-4	21	9.3
	Grades K-5	57	25.3
	Grades K-6	8	3.6
	Grades K-8	3	1.3
	Grades K-K	7	3.1
	Grades K-12	5	2.2
	Total	225	100.0

Table 8 (Years Immersed)

		Frequency	Percent
Valid	1	8	3.6
	13	5	2.2
	2	13	5.8
	3	60	26.7
	4	44	19.6
	5	22	9.8
	6	50	24.9
	7	13	5.8
	9	4	1.8
	Total	225	100.0

Discussion

When it comes to model type a 50-50 model is the most popular type in LAUSD. A two-way immersion program is the most popular type. In LAUSD Spanish is the most common and popular language for students to learn and is also a home language for students.

Limitations

I was not able to gather data using my survey, because we did not realize that in order to conduct research in LAUSD, an application must be submitted before the deadline to LAUSD's research branch. The LAUSD dashboards did not provide much detail on language immersion details that are relevant.

Future Directions

In the future, I will make sure to do more front end research when working with organizations in order to plan procedures and timelines better. I would like to do this project again using the same survey questions, the results could have led to different areas being explored. I would also like the chance to do this type of project in an actual school that has experience with a DLI program, so that I could see first hand the progression with students in learning a second language.

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Wang
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Ligand Effects in Molybdenum Catalyzed Oxidation of Alcohols

Prof. Alex John

Abstract:

Conventional reagents used in alcohol oxidation reactions pose severe economic and environmental consequences. Nevertheless, such reagents are heavily relied upon due to the fundamental role of alcohol oxidations in the chemical processes used by various industries, such as the pharmaceutical and biofuel industries. With sustainability in mind, this project evaluates an alternative method of alcohol oxidation using novel dioxomolybdenum catalysts. Due to a lack of literature surrounding molybdenum catalyzed alcohol oxidations, the role of each component will be thoroughly investigated through the assessment of a diverse range of alcohols including primary and secondary benzylic as well as aliphatic alcohols in oxidation reactions. A comprehensive understanding of ligand effects in the context of these oxidations will also be developed. Under our optimized conditions, the oxidations can be achieved over a 24-hour reaction time at 120°C using 2 mol% molybdenum catalyst in dimethyl sulfoxide, which acts as both the solvent and the oxidizing agent. As a result, the conversions and yields in these catalytic alcohol oxidation reactions vary from 20% to >99% based on the alcohol substrate used, and there is an evident efficiency linked with the use of the novel catalysts. The reaction is chemoselective and yields aldehyde as the sole oxidation product from primary alcohol substrates. A competing dehydration pathway has been observed with certain electron-rich benzylic alcohols, resulting in the formation of corresponding olefins. With further optimization, these catalysts can be assessed for large-scale industry applications with the goal of pushing industrial processes to become more environmentally friendly.

Major Objectives:

1. Successfully synthesize and characterize novel molybdenum catalysts
2. Optimize reaction yields and conditions for alcohol oxidation reaction

Background research with analysis and summary of literature review:

Alcohol oxidation is the conversion of alcohols to their corresponding carbonyls. As simple as this transformation is, this reaction is fundamental to a vast number of industries, such as pharmaceutical and petroleum, due to the versatile reactivity of carbonyls that positions them as important precursors or intermediates for complex organic molecules. Despite efforts to provide catalytic alternatives to traditional stoichiometric methods, issues with over-oxidation of primary alcohols, selectivity with multiple alcohol groups, cost of the catalyst, and sustainability still persist with the current catalytic options.^{1,2} Prior literature indicates the use of dioxomolybdenum complexes in epoxidation reactions, demonstrating a potential application towards other oxidations.³ However, limited research has evaluated molybdenum catalysis for alcohol oxidation, especially with consideration towards aliphatic compounds.⁴ Molybdenum is a valuable transition metal to utilize because it is abundant and cheap, has low toxicity, and is resistant to sulfur poisoning.⁵ *In this respect, this project intends to evaluate an alternative method of alcohol oxidation using novel dioxomolybdenum catalysts.*

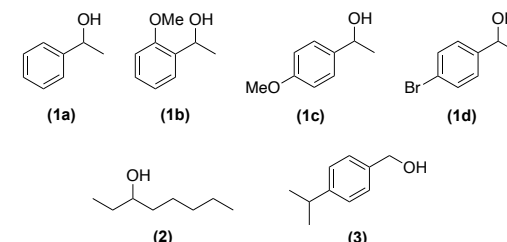


Figure 1. Alcohol substrates used in catalysis reactions

Due to a lack of literature surrounding molybdenum catalyzed alcohol oxidations, the role of each component was investigated through the evaluation of a diverse range of alcohols including primary and secondary benzylic as well as aliphatic alcohols in oxidation reactions [Figure 1]. Substrates **1a-1d** presents insight into 2° alcohols, while substrate **3** presents a 1° alcohol. Substrate **2** assesses aliphatic alcohol oxidations. Expanding further, **1b-1d** are variations of substrate **1a**: **1b** places methoxy-substituent in the *ortho* position to consider electron donating and inductive effects, **1c** positions the same substituent *para* to the alcohol thus eliminating the induction, and **1d** includes a *para* bromo-substituent to evaluate an overall electron withdrawing effect. This range of substrates provides insightful comparisons between conjugated and non-conjugated alcohols while also evaluating the electronic and steric effects. **Figure 2** summarizes the array of catalysts investigated in this study. Prior research identified that a catalyst with a phenyl backbone was superior in this oxidation reaction.⁶ Catalyst **A** serves as the control catalyst, while catalyst **B** introduces an electron-withdrawing group and catalyst **C** assesses steric hindrance and electron donating groups.

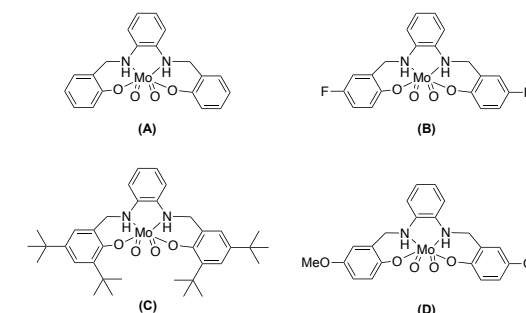
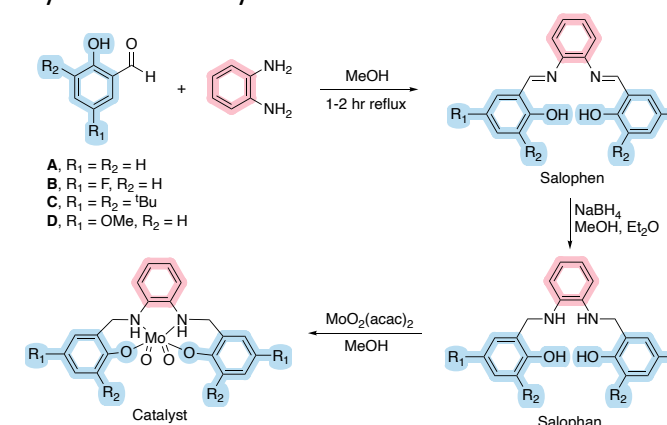


Figure 2. (A) Mo catalyst with salophen ligand, (B) Mo catalyst with fluoro-substituent, (C) Mo catalyst with ditertbutyl-substituent, (D) Mo catalyst with methoxy-substituent

Methods:

1. Synthesis of molybdenum catalysts

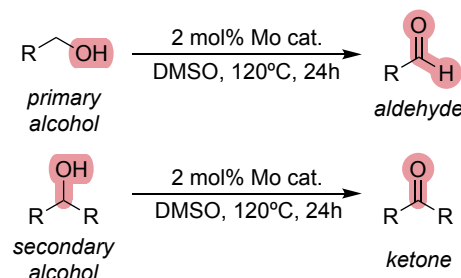


Scheme 1. Reaction scheme for the synthesis of novel molybdenum catalysts

To synthesize the novel catalysts, a substituted salicylaldehyde reacts with 1,2-phenylenediamine to form the corresponding imine ligand or salophen. This step will be approximately 92% yield. The salophen undergoes a reduction using sodium borohydride to form the amine ligand or salophen, with a ~86% yield. This salophen is then complexed with MoO₂(acac)₂ to create our final dioxomolybdenum catalyst. The last step will have the lowest yield that varies from 10-50%. Different catalysts can be made by varying the structure of the salicylaldehyde at R₁ and R₂ to create the unique imine ligand. Depending

on the substituents on the salicylaldehyde, catalyst formation may be more or less favorable, as observed with the yield range of the catalyst formation.

2. Alcohol oxidation reactions



Scheme 2. Reaction scheme for proposed alcohol oxidation using molybdenum catalyst

The alcohol oxidation reactions consist of adding 2 mol% of the catalyst to the alcohol substrate using DMSO as a solvent and leaving the reaction at 120°C for 24 hours. As shown (**Scheme 2**), primary alcohols, substrate **3**, will only form an aldehyde and this reaction does not over-oxidize the primary alcohol to a carboxylic acid. The secondary alcohols, substrates **1a**, **1b**, **1c**, **1d**, and **2**, will synthesize a ketone.

Please describe progress made this period towards your project's stated goals and objectives:

One goal was to successfully synthesize catalyst **D** and apply it towards alcohol oxidation reactions. Imine synthesis has been achieved at 93% yield, but there were obstacles when attempting the reduction to the amine. Difficulties with solubility were observed, resulting in the loss of approximately 400 mg of imine product as well. After re-evaluating the ratio of diethyl ether and ethanol solvents in solution, the correct ratio was determined and the amine was properly achieved, but at low yields.

Oxidation reactions using catalyst **C** was performed and results are summarized in **Table 1**. With substrates **1a**, **1d**, and **3**, reactions achieved high yields despite the hypothesis that catalyst **C** would cause a decrease in yield due to the bulky substituents. This occurrence may be due to the preferable structures of the substrates itself, allowing them to successfully carry out oxidation reactions regardless of the catalyst. Moreover, this observation corresponds to a crystal structure of catalyst **A** that indicates a less planar conformation of the general catalyst model. With substrate **1c** and **2**, lower yields were observed. Similar to the previous catalysts, two products were observed with **1c**, but also at higher yields than using catalyst **A** alone.

Table 1. Alcohol oxidation and dehydration yields and conversions

Substrate	Catalyst	Yield		Conversion
		C=O	C=C	
1a	C	>99%	-	-
1c	C	31%	26%	-
1d	C	94%	-	-
2	C	36%	-	53%
3	C	98%	-	-

Table 2. Alcohol oxidation for 1 mol% reactions

Substrate	Catalyst	Yield (C=O)
1d	A	92%
3	A	>99%

Table 3. Alcohol oxidation for 5 mol% reactions

Substrate	Catalyst	Yield (C=O)
2	A	40%

Table 4. Alcohol oxidation for 140°C reactions

Substrate	Catalyst	Yield (C=O)
2	A	12-65%
2	B	10-25%
2	C	12-22%

The above tables, **Table 2**, **3**, **4**, demonstrate the modifications to the original reaction that were made to better assess the specific optimized conditions. For the 1 mol% reactions conditions (**Table 2**), it was found that the high yielding products, the *bromo*-substituted (**1d**) and the primary benzylic alcohol (**3**) did not have much change in yield after reducing the catalyst amount by half. This points towards the high efficacy of the novel catalyst in this scenario. In **Table 3**, the low yielding 3-octanol (**2**) substrate was assessed against a higher catalyst loading to see if increasing the catalyst amount in proportion to the mixture would improve yield. The yield increased by 4% compared to the original 2 mol% conditions, which shows that the catalyst loading did not significantly impact the yield. This aspect is reaffirmed by the margin of error associated with proton NMR, which is greater than 4%, meaning that the two yields are, in essence, the same values. **Table 4** shows the same substrate at higher temperatures instead of higher catalyst loading. The higher temperatures could have had better impact on yield, as demonstrated by the higher end of the range, but the reaction yields are unreliable because there were experimental errors associated with the measuring of the catalyst in the mixture. Otherwise, two of the novel catalyst became less effective (**B** and **C**) in the higher temperature, which potentially suggests that the catalyst is less stable at those temperatures.

If your project has not advanced the way you had planned, identify the impediments to progress you encountered during this period? What steps have you taken to move your project forward?

This project experienced some impediments that are related to troubleshooting and adapting to unforeseen circumstances. An example is evident in the synthesis of catalyst **C** as progress was stagnated when the solubility of the imine was drastically different from other catalysts. Moreover, the busy nature of this semester with graduate school visits and other courses has hindered my availability for being in the lab. With decision day past, I will aim to move forward with the project through completing formal write-ups and wrapping up remaining reactions to run.

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