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Spatial Boundaries and Social Interactions in Queer Women's Spaces: An Ethnographic Snapshot*

Abstract

This study explores queer women's spaces created at events in gay bars in Southern California. This study utilizes assumptions of self-presentation in everyday life by exploring how queer women negotiate spatial boundaries linked to front and back stage behavior and identity. By conducting an ethnographic study in Los Angeles and Pomona, this study argues that queer women do not have specially defined spatial boundaries connected to status and sexual identity. Instead queer women's spaces are less concretely defined or negotiated within other spatial boundaries. Suggestions about the usefulness of spatial boundaries for queer women are presented.

Introduction

In Sociology of Space, Simmel argues that space can be utilized for social purposes and framed in boundaries (see also Fearon 2004). The social boundary is "not a spatial fact with sociological consequences, but a sociological fact that is formed spatially," referring to boundaries that provide special arrangements of experiences and interactions (Fearon 2004, p.2). Departing from Simmel's assumption of space, space can also refer to the physical boundaries, such as a bar, club, coffee shop, or community center that typically stimulate social interactions or involve experiences of interactions through socializing with one another. These types of physical spaces or spatial boundaries can be found in just about all our neighborhoods.

Now, what about spaces for queer folks? In Southern California, for example, gay spaces can be found in West Hollywood, Long Beach, and San Diego. From my experience of exploring these areas, I have realized that these gay spaces are not always mixed with males and females. I have observed that gay men more likely dominate these spaces, and thus, I argue, leaving less "space" for queer women.

In this study, I examine ethnographically public spaces, specifically night clubs for queer women. I focus on spatial boundaries connected to social interactions among queer women to investigate the potential significance of designated queer spaces compared to gay or heterosexual spaces. This study also looks at how queer women's spaces are created and negotiated by spatial boundaries and social interactions among people at given events.

Compared to gay bars, lesbian bars and clubs are less visible or non-existent in Southern California. Instead, some bars, primarily gay bars, offer "lesbian nights" – an alternative space created for queer women. This study draws on observations of selected gay bars in Los Angeles and Pomona to illustrate descriptively the dynamics of women in queer spaces and their interaction within the space and with others.

Methods

Although research on queer women's identities has become more prominent in research (Fingerhut et al. 2005), we still know very little about how queer women utilize their space and interactions with 'strangers' in finding comfort and acceptance in their front and/or back stage behavior.

In contrast to gay men, research has shown that it can be difficult for queer women to find and interact with other queer women (Forstie 2019). I argue, because queer women's spaces are less concretely defined and found, queer women do not utilize specially defined social and spatial boundaries connected to their status and sexual identity.

In terms of the role of appearance, queer women present themselves in different ways that can vary in hairstyles, makeup/no makeup, and clothing. Research has identified queer women's characteristics ranging from 'butch' to 'femme' or something in between these two terms (Forstie 2019). Butch lesbians may present themselves in a more masculine manner, often seen in their clothing and hairstyle. In comparison, a femme lesbian might present herself in more feminine ways, such as, choosing more feminine clothing and longer hairstyles. The role of appearance may or may not be relevant to queer women.

The next section explores the underpinning of spatial boundaries connected to queer women's spaces and the role of these spaces for queer women's identity. Afterward, I describe the methodological approach and present the preliminary findings. The conclusion addresses the findings, limitations and future research.

Theoretical Background

Identity and Public Spaces

Social psychologist Erving Goffman is best known for his publications about Asylums and The Presentation of Self in Everyday Life. Goffman introduces vocabulary commonly found in the theatre known as the dramaturgy approach. This approach refers to social interactions in the form of a front stage and a back stage. According to Goffman, "the front is part of the individual's performance, which regularly functions in a general or fixed fashion to define the situation for those who observe the performance" (p. 544). The front involves a person who may not show his or her true self because of nervousness or intimidation in social interactions. The front stage is divided into two parts, known as the setting and personal front. The setting consists of the scenery and the props that make up the physical space where performance is conducted. The personal front refers to the items of "expressive equipment" or characteristics that the audience identifies with the performer. According to Goffman, on the back stage, "the performer can relax; he can drop his front, forgo speaking his lines, and step out of character" (p. 545). The back stage involves a person showing his or her true self because there is no fear to actively engage or being part of a social interaction. Goffman's theatre terms have been used to understand how individuals present themselves in public spaces (Willis 1997). For example, researchers conducted a study in a bar in a rural and primarily white neighborhood in Ohio. The bar hosted a "Latino/a" night involving Spanish music (Willis 1997). For a Latino/a person, the commonly "white" bar "space" might have been experienced as a front stage because not many people interacted with one another because fewer people were familiar with Spanish (Willis 1997).

The language barrier for some visitors might have created an unconscious barrier and thus let to a front stage behavior among those who felt less comfortable with the spatial boundaries of the event. On Mondays, the bar 'space' was recreated to provide community and personalized space for the Latino/a population. Thus, the bar might have become a back stage area where Latino/a people felt comfortable speaking Spanish and were able to bond with people of their culture (Willis 1997).

Before the Covid-19 pandemic, our everyday lives were dominated by socializing with others, meeting and interacting in public spaces such as restaurants, bars, and clubs. In spite of these social interactions with others, we may not always show our true selves when interacting in these public spaces. According to Goffman’s approach, there is a strong possibility that a person will display a front stage behavior when introduced to new people. Typically, when we meet people for the first time, we want to impress others by displaying our best behavior. This is especially the case when two people are romantically interested in one another or who are at the beginning of an intimate relationship.

However, if two best friends are eating together at a restaurant, we could argue that they display their back stage behavior because they might not need to impress each other because of their degree of comfort with each other.

My ethnographic snapshot tries to elaborate on the assumptions of Goffman's self-presentation by examining the social interactions of queer women in gay and heterosexual spaces. I propose that the experiences of queer women going out to heterosexual and gay spaces can be interpreted in the framework of Goffman's front stage and back stage behavior. For instance, people are known to feel most comfortable in places where they fit in and feel less judged by others (Willis, 1997). As a queer woman, student, friend, one may feel more relaxed and comfortable in gay and lesbian spaces than heterosexual spaces. This means a person's back stage and front stage behavior might potentially unite in a setting that identifies with queer women's experiences and habitus.

In comparison, heterosexual spaces might generate more a spatial atmosphere in which queer women tap into a front stage and back stage behavior to adapt their experiences to the habitus of the heterosexual space. This separation of stages in a heterosexual space is potentially the result of certain expectations in these environments (Rooke 2007). For example, for interpersonal interactions in heterosexual spaces (i.e., bar), queer women might display a front stage behavior when approached by heterosexual men who depart from their heterosexual assumptions, that women are typically in such a space to hook-up with men. Thus, the social interactions between queer women and men in heterosexual spaces might trigger queer women's discomfort due to the nature of heterosexual assumptions. Queer women's identity and habitus may most likely collide with heterosexual men's expectations when men display flirting or romantic expressions. In a heterosexual space, queer women might go "in and out" from one stage to another to maneuver their emotions and habitus and protect their identities.

Identity and Lesbian Spaces

Eves (2004) draws on Queer Theory to examine how lesbians perform gender in social spaces. The two central lesbian/queer identities for women are butch and femme (Eves 2004). Butch lesbians may be comfortable presenting themselves with short hair, tattoos, and dress in more masculine type clothing (Eves 2004). In comparison, femme l esbians may be comfortable presenting themselves by wearing long hair, dresses, and makeup (Eves 2004). Eves (2004) argues that style represents pride and attitude for lesbians. However, butch and femme lesbians want to be queer women no matter how they present themselves. For example, most of the women Eves (2004) interviewed were proud of their queerness, although the process of acceptance took some time. Eves (2004) discussed how lesbians experienced spatial boundaries, comparing gay and heterosexual spaces. The female respondents expressed frustration and anger because their spaces no longer felt like a "safe space" (Eves 2004). Safe spaces were vital for queer individuals because they allowed them to be themselves without judgment and fear. The findings revealed that especially queer women felt less safe around straight men because of the potential threat of violence and harassment (Eves 2004).

In contrast to Eves (2004), Rooke (2007) draws on Bourdieu's assumptions of social capital and habitus to study lesbian spatiality. Rooke (2007) defines lesbian habitus as "a site where forms of lesbian cultural resources and capitals are incorporated, performed, and rendered with the appearance of being inherent" (p.232). The lesbian bar is an example of where lesbian habitus occurs (Rooke, 2007). A group of queer women took a day trip with Rooke to a popular lesbian bar in the United Kingdom. The study participants expressed their frustration with spaces that ignored queer women's habitus by displaying more heterosexual cultural capital (Rooke 2007). Rooke (2007) also notes that venues identified as queer women spaces change frequently because they were less sustainable businesses (Rooke 2007).

Rupp and colleagues (2014) connect queer theory and identity theory to examine women's sexual identities within the "hookup scene" of two college campuses in California. The authors found that it was socially acceptable to see two females kiss each other (even if they were straight) than seeing two straight males kiss one another (Rupp et al. 2014). Kissing was especially prominent at college parties where alcohol was involved. The findings of the semi-structured interviews suggest that college is a time for women to explore their sexual identity (Rupp et al. 2014). Many female respondents confirmed that they would eventually identify as lesbian, bisexual, fluid, queer, or pansexual after having had their first sexual experience with women. Rupp et al. (2014) elaborate on the ease of women feeling more comfortable in the presence of other women to explore their sexual identities and the absence of confined sexual orientation.

Thus, the analysis of spatial boundaries connected to queer women's habitus is vital. To what extent do commonly "borrowed" gay spaces compared to heterosexual spaces matter in the cultivation of queer women's front and backstage behavior? Furthermore, will space, solely defined by queer women, allow for the merging of spatial boundaries?

The current study aims to explore the following research questions: (1) Do queer women feel more a fit (display a back stage behavior) in spaces that display representations of queer women's habitus or identity? And (2) Do queer women display both, front stage and back stage behavior when in queer spaces?

Methods

To examine queer women's interactions and 'behavioral' response to spatial boundaries in gay and heterosexual bars, my qualitative study focuses on observations. I conducted observations in two different locations in Southern California. The first location of my observation was the 340 Nightclub in Pomona, California, also known as a trendy place of the Inland Empire. The second space I observed was The Lash, a popular nightclub in Los Angeles.

Overall, I conducted over 20 hours of observations of interactions and structural, spatial boundaries as they emerged in these two nightclubs.1 In my first methodological approach, I chose observations for this study to explore the dynamics between people's social interactions and the use of spatial boundaries based on the nature of the nightclub. For the second phase of my research, I wanted to conduct in-person interviews to fully understand how spatial boundaries – in these selected nightclubs – affect queer women's identity and social interactions, separating behavior by front and backstage behavior or allowing for a more fluid experience between these two stages. Because I could not complete the interview component of my study, I only describe my study observations.

In the conducted observations, I became a patron of the nightclubs, engaging in my own way in the social interactions and responding to the bar and event's spatial boundaries. I begin to first describe my visit to the 340 Nightclub for one of the Thursday nights "Girls Locker Room" events. As for the spatial boundaries, the 340 Nightclub can hold about 1000 people.1 According to the club's website, 340 is known as the "Inland Empire and San Gabriel Valley's #1 gay and lesbian nightspot". This club typically attracts people from a wide range of ages, social class, and different ethnicities and racial backgrounds. Every Thursday night, the club hosts a lesbian night called "The Girls Locker Room." For a lesbian night, the venue offers performances of female DJs and go-go dancers, and various drink specials are also part of the night.

The space cultivated at these Thursday nights is specifically created for queer women. Although I was a patron while observing visitors to the club and event, I also kept my distance, observing from the corner of the club, to view the interactions between other patrons and the space dominated by the event – a once a week lesbian nights in a gay space. I was able to see who entered the club, see the performances, the dance floor, and the actual bar area. This view allowed me to almost have a 360 degree view to observe the wide range of (causal or romantic) social interactions. The 340 nightclub is originally a gay bar, and on Thursdays, the club focuses specifically on queer women.

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[1] It is important to note that the Covid-19 pandemic has brought the observations and scheduled interviews to a hold. The observations presented in this study draw on observations before the pandemic (February – March). For follow-up details, I also rely on information from event websites after March 2020.

Thus, at the Thursday event, I also looked for the visit of gay men or heterosexual people. As people may not feel confined to boundaries based on the night's event, I also wanted to see if a gay bar would attract gay men no matter the focus of the event.
By observing the interactions between people at the Thursday event, I tried to decode the meaning of social interactions to understand how or whether queer women redefine their stages of interactions depending on the boundaries the space and events offer. I am aware that simple observations limit the conclusions about 'meaning of social interactions'; however, specific reactions or behaviors I was able to interpret, which I refer to in the preliminary findings.I chose to compare the Thursday nights "Girls Lockers Room" a queer event at a gay night club with a gay event at a heterosexual bar in downtown Los Angeles. The Lash is a heterosexual bar that hosts monthly gay nights. The event I attended was called "The Saddest Spiral." DJs, drag queens, and singers from the LGBTQ+ community came to the event. Not surprising, this night was visited by more gay men than queer women. The Saddest Spiral event brought out people who dressed fluidly and creatively, such as wearing pieces that included leather, cowboy hats, and flashy jewelry. Overall, the space was small and included a front room and back room with one bar in each area. The lighting in the Lash was very dim, which made it hard to see other party-goers.

The similarities observed at these two events, both clubs were primarily visited by Latinos and Latinas. Also, patrons extensively used their phones for recordings of people in the crowd, having fun, and interacting with one another.

Despite these similarities based on my explorative work, in general, both spaces and events were more different than similar. One, the Lash is a heterosexual bar on most nights. Thus visitors to the club include locals, tourists, various ethnicities, and racial backgrounds but primarily heterosexual people. Based on my observation, I drew these conclusions by seeing intimate encounters between women and men, at times married couples (based on a wedding ring, for example).

The bar located in Los Angeles was more expensive than in Pomona. In LA, the prices for drinks were higher, and there were no drink specials, while the bar in Pomona offered drink specials at their queer women's night. The type of music played was underground reggaeton and hip-hop, which is less heard in gay spaces. The majority of observed social interactions was dancing and talking in pairs and groups, and involved heavy drinking. As an observer myself, I felt more comfortable at "The Girls Locker Room" event because I was surrounded by women all night.

The event in Pomona created an event for queer women in a gay space, while the LA club created a gay night in a commonly heterosexual space.

Preliminary Findings

The 340 Nightclub is a fairly large space with two stories with multiple bars, tables, stages, televisions, and vibrant lighting. The top floor was only open with Top-40 music blasting through the speakers. Right away, I saw that more women than men attended that night. This club is 18+ so I observed many people without drinks in their hands. I also observed two female go-go dancers performing. One was dressed in masculine and the other in feminine clothing. It was interesting because it is rare to see a female go-go dancer

who presents herself in a more masculine style. At the DJ booth was a butch female who played music, typically found in gay spaces. Based on the social interactions, I found that more women visited or met a friend at the bar. Fewer people were couples.

The 340 nightclub was visited primarily by Latinas. The majority of women were dancing and drinking. Based on the smiles and laughter of women and their body movements (leaning in, holding each other) I interpreted these interactions as people being happy in the space. A woman right next to me was recording herself and her friends on her phone. This appears to be a more typical behavior at such events because nowadays, young adults are used to posting their daily activities on different social media platforms (Hutson, 2010).

I also think it was fair to assume that the majority of women who attended the event in Pomona were queer, either butch or feminine. I observed more couples dancing, based on their interactions and romantic involvement with one another, I make these assumptions.

The bar offered drink tickets and the average price for a drink was 5 dollars. The rather low price for drinks might also have attracted the large crowd. About 50 people visited the venue and both dance floors were quickly filled with people after they opened the space.

Overall, the night at "The Girls Locker Room" was a positive and uplifting experience. As an observer and patron, I was happy that I was surrounded by queer women. It appeared that everyone in attendance was generally happy and having a good time with their friends or partners. Relating these visible emotions and interactions to Goffman, I would argue that the majority of queer women at the Pomona event engaged in a fluidity of front and backstage behavior due to the spatial boundaries the specific event created for queer women. When being around other women who are similar to yourself, one could have the tendency to drop the front stage behavior. Queer women might feel more comfortable especially at events that nurture a community outside of normative gender constructions and thus generate identity formation intertwined with emotional openness and fewer boundaries.

The 340 nightclub is a well-organized and accessible wide space that includes numerous televisions and colorful lighting. It is not just like any other nightclub because they include performances of queer DJs, go-go dancers, and drag queens for example. Heterosexual people did too attend the event at the nightclub. I made the assumption they were heterosexual because I observed male and female couples who publicly displayed affection for one another. From what I observed, they respected the space and did cause any trouble or harassment to the queer people in attendance.

Compared to the gay men's event in LA, the queer women's event in Pomona was more affordable and offered various drink specials. This is important because many queer women of different social class backgrounds can afford to join the event, unlike Rooke's (2004) Candy bar study where high prices limited the access and comfort of women enjoying the space. As a patron, I appreciated that the 340 nightclub choses to have a weekly lesbian night, generating a space where queer women can come together and socialize.

Conclusion

I conclude that even though 'lesbian spaces' are limited in Southern California, created events in gay bars or other places attract many queer women. These spaces offer queer women an opportunity to socialize, building community, culture and identity and having fun in a more judgment-free zone. In my view, these events or momentary spatial boundaries allow queer women to express themselves while unlocking a back stage behavior commonly hidden from others or strangers. To further understand the negotiating of spaces for queer women, interviews would clarify the display of behaviors at specific events compared to regular bar visits.

Considering the nature of this study, two limitations have to be acknowledged. First, while I conducted about 20 hours of different observations, I was not able to conduct more observations of similar nights due to the Covid-19 pandemic. Second, this study only focused on observations. Future research would benefit from including in-depth interviews to better understand the relationship between spatial boundaries and their effects on queer women's identity and self-reflected behavior. Recognizing the dynamics between space and behaviors will further inform how queer women places over queer women events matter for queer women's wellbeing compared to gay and heterosexual places.

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Prosodic Patterns of L2 Speech Acts: A Research Proposal

Abstract

Prosody provides life to linguistics constructions which otherwise would simply be sequences of words placed in a particular order. Prosodic features of the speech stream refer to properties of intonation, sentence prominence, word stress, loudness, pausing, and speech rate (often interchangeable with the term "suprasegmentals"). Research has revealed that non-native English speakers use prosody in different ways from native-English speakers, sometimes causing a lack of focus or speaker intent, and at other times, causing speakers to sound more accented or reducing their comprehensibility or intelligibility. At the same time, previous research on this topic has mostly been gathered from monologic tasks as speakers interact with computers. The purpose of this study is to make comparisons between non-native and native speakers of English and their use of prosody. We will analyze how these two groups (approximately 15 native speakers and 15 non-native speakers) use prosody across speech acts (e.g., invitations, requests, negotiations, refusals, compliments, sympathy, and apologies). Speech data will be collected from the conventional computerized task but also through a dialogic interview. By comparing the two groups of speakers in a realistic, interactive context, we predict that there will be differences in how these two groups use prosody, in addition to how they use prosody in these two contexts. While this is a work in progress, the implications are expected to assist educators and practitioners in teaching and assessing second language prosody.

Keywords: Prosody, speech acts, intonation, discourse completion task

Prosody provides life to linguistics constructions which otherwise would simply be sequences of words placed in a particular order. Prosodic features of the speech stream refer to properties of intonation, sentence prominence, word stress, loudness, pausing, and speech rate (often interchangeable with the term "suprasegmentals"). Prosody is important in everyday communication because it provides the musical tone that carries over words into everyday conversations. David Brazil (1997) explains how intonation patterns in English affect the communicative value of speech through the use of falling and rising tones along with changes in pitch. Since pragmatic meaning is communicated through tone, when choosing a particular tone, the speaker expects the listener to understand the value of that choice (Chun, 2002). The emphasis of prosody in this research is important to the field of applied linguistics since we are studying the role it plays in second language (L2) learning. The prosodic features such as intonation, sentence prominence, word stress, loudness, pausing, and speech rate contribute to the second language learning process and determine the success of communicative interactions.

One issue that arises when collecting data from participants is the authenticity of responses that are acquired through computerized data collection tasks. This can lead to an incomplete understanding of how prosody is used by non-native speakers. Researchers are faced with the challenge of assessing L2 prosody in authentic contexts, or contexts which mirror typical, everyday interactions. The current study uses an interactive task to evaluate

L2 prosody across several speech acts. One other issue is that an analysis of native vs. non-native prosody across a range of speech acts is also limited. This study implements various speech acts toaddress these gaps.

The purpose then of this study is to compare speech patterns between native English speakers (NSs) and non-native English speakers (NNSs) across different scenarios (i.e., speech acts) including invitations, requests, negotiations, refusals, and apologies in high imposition situations (with a professor as the intended interlocutor) and in low imposition situations (with a classmate as the intended interlocutor). Such a study will contribute to more informed pedagogical strategies for teaching prosody in the language classroom in addition to more valid methods for acquired speech act data.

Literature Review

Prosody in L2 Speech

Prosody plays a key role in the communicative success of second language learners' speech. This is because prosodic features convey meaning beyond the linguistic construction of a sentence. However, prosody, especially intonation, is not intuitive for L2 learners (Levis, 1999). Pike (1945) explains that intonational meaning modifies the lexical and grammatical meaning of a sentence by adding the speaker's attitude towards the contents of that sentence. In this study, each of these factors is important. Levis (1999) expresses that intonation should always be taught in a context because its contribution to meaning cannot be properly defined or learned in any other way. Couper-Kuhlen and Selting (1996) suggest an interactional perspective on prosody based on a complex interaction of verbal forms with contextual and situational factors.

Speech Acts

Speech acts are a method of categorizing a speaker's intent or meaning. These spoken utterances are called acts because many types are intended to result in action (Levey, 2019). Levis (1999) expresses that speech acts contribute to the situational context of the meaning. Speech acts used in a more conventional context can result in more natural results. The most influential speech acts in the study of prosody typically are questions. Kang and Kermad (2019) explain how most prosodic work on speech acts has been conducted on the topic of directives. These involve wh-questions that can be answered as "yes" or "no." However, these speech acts are not very effective for a holistic understanding of L2 learners. Speech acts, which involve a speaker's communicative intention or purpose, rely heavily on prosody for their transmission of meaning (Archer, Aijmer, & Wichmann, 2012). Searle (1969) established a taxonomy of speech acts and grouped them in five major classes: representatives, directives, commissives, expressives, and declaratives. Our study makes use of directives and expressives. Speech acts, such as invitations, requests, and refusals fall within the class of directives while negotiations and apologies are expressives.

Prosody and Speech Acts

Prosody enables speakers to signal the structure of meaning, importance, contrast, and emphasis in addition to speaker emotion and affect. Furthermore, the perception of intonation suggests that fundamental frequency, or pitch, plays an important role in how hearers perceive prosody in speech (Chun, 2002). Therefore, once prosody is combined with speech acts, the effect on communicative success is quite significant. Research on prosodic patterns of speech acts has been extremely limited and has focused largely on yes/no and wh- questions, which are the common speech acts to appear in L2 textbooks (Kang & Kermad, 2019).

The relationship between speech acts and prosody function together to give insight to the situational context of interaction. The prosody of a language can provide cues about the organization of the utterance and its relation to the context in which it occurs (Tonhauser, 2019). Prosodic research on the suprasegmentals pitch, length, and loudness has suggested that listeners use a combination of these components in order to make optimal perceptual judgments, especially in speech acts (Chun, 2002).

Current Study

The current study employs all of the aforementioned elements of speech acts and prosody. In order to investigate the prosody across speech acts, our research consists of setting up various scenarios that learners may face in different levels of imposition. The method for this approach is both face to face, expected to ensure the most realistic results in the participants' answers, along with the conventional computerized speech act task. Pickering and Kang (2013) point out the lack of adequacy in testing the communicative competence of candidates. It is an ongoing concern that is faced with automatic sound recognition. This research attempts to evade this discrepancy within our research with interactive discourse completion tasks.

Research has shown preliminary patterns showing that non-native English speakers use prosody differently than native speakers, sometimes with consequences leading to communicative breakdown or negative impressions about the speakers (Pickering, 2018). Prosody, especially intonation, is not intuitive for L2 learners (Levis, 1999). This is exemplary of everyday applications since second language learners must perform speech acts in their target community. Using more target-like prosody of speech acts will improve the overall communicative success between the speaker and the listener.

This design employs a more authentic approach to traditional data collection since the participants will use their English pragmatics in real-time interaction and across a range of speech acts. Implications will reach to areas of L2 pedagogy and research. The prosodic patterns of speech acts will provide teachers with more common patterns of performing a select number of speech acts. The implications will also help future researchers have clearer deliberations on the most valid method for collecting authentic data. In efforts to provide these implications, the current study will respond to the following questions:

RQ1: To what extent do speech patterns differ across speech acts for native andnon-native English speakers?

RQ2: To what extent do speech patterns differ in different levels of imposition (high vs.low) for native and non-native English speakers?

RQ3: To what extent do speech patterns differ in interactive and computer-based tasks for native and non-native English speakers?

Methods

Participants

In order to compare native speaker prosody to non-native speaker prosody, two groups of speakers will be collected. The non-native speakers will be recruited from a four-year university on the Pacific West Coast. They will be second language speakers of English aged 18 and older. They are expected to have a range of first language backgrounds.

In order to compare the non-native speakers to native-speakers, approximately 30 native speakers will be recruited. The native speakers will also be recruited from the same four-year university. They will be native (or bilingual) speakers of English.

Approximately 30 native speakers and 30 non-native speakers will be recruited in efforts to place 15 of each speaker group in each task situation (communicative and computerized tasks).

Materials

Computerized Discourse Completion Task

Before answering any discourse completion tasks (DCTs), the speakers will complete a questionnaire that will ask for their English experience and language abilities. The computerized discourse completion task asks participants to read a scenario and record the response to the scenario (see Appendix A). This method does not involve a human interlocuter. The computerized discourse completion tasks were adapted from Taguchi, Xiao, and Li (2016).

Interactive Discourse Completion Task

The second way data will be collected is through an interactive task with the research team (see Appendix B). In this task, one researcher will play the part of the "professor," and the other researcher will play the part of the "classmate." The interactive discourse completion tasks were adapted from Taguchi, Xiao, and Li (2016). The data will be collected in real-time, which will render this task interactive/communicative.

Materials

Once participants consent via Qualtrics and provide their bio, they will be provided with the script for the computerized discourse completion task. The speakers will complete the Qualtrics computerized DCT on their own time. They will then provide their own recordings to the research team.

Participants will meet face to face with the research team for the recorded interactive discourse completion task. In this task, the research team will play the parts of the professor and student in a semi-scripted dialogue. When participants have responded to all scenarios, the data collection will be complete.

Data Analyses

Speech Analysis

Once all speaker data is collected (see the two scenarios above), the speech samples will be analyzed via speech visualization software for segmental (consonants/vowels) and prosodic/suprasegmental (intonation, sentence prominence, pitch, speech rate, and pausing) properties. The speech will be analyzed via PRAAT (Boersma & Weenink, 2016).

Statistical Analyses

Statistical analyses will be used to respond to the research questions of this study. That is, these statistical analyses will be performed to compare differences across speech acts for native and non-native speakers in addition to differences between levels of imposition. Additional analyses will be conducted to compare how the speech act performance differs between computerized and interactive tasks. Descriptive statistics will be provided for all research questions.

Anticipated Results

In response to the first research question concerning the extent to which speech patterns will differ across speech acts for native and non-native English speakers, prosodic patterns are expected to differ between the two groups, exemplifying common differences between NS and NNS prosody (that is, NNSs are expected to use more falling or level tones and a narrower pitch range where NSs would use more rising tones and a wider pitch range.)

For the second research question which explores to what extent do speech patterns differ in different levels of imposition (high vs. low) for native and non-native English speakers. We anticipate that in higher levels of imposition, we expect that NSs will use extended discourse and a combination of falling and rising tones along with more level tones for strategic purposes, while NNSs will be more likely to use shorter discourse with more non-target-like intonation patterns.

Our third research question answers the extent to which speech patterns differ in interactive and computer-based tasks for native and non-native English speakers? It is expected to that NNSs will respond more realistically to the interactive DCT than the computer-based tasks, perhaps eliciting more target-like prosodic patterns than previous research has captured when using computer-based tasks.

Anticipated Implications

The implications are expected to assist educators and practitioners in teaching and assessing second language prosody. Second language learners must perform speech acts in their target community on a regular basis. Using more target-like prosody of speech acts will improve the overall communicative success between the speaker and the listener. Teachers should not be hesitant to include training of linguistic features into their intonation instruction (Levis, 2005) The implications will also extend to researchers in this line of study. This design employs a more ecologically valid approach to traditional data collection since the participants will use their English pragmatics in real-time interaction. Implications will help future research decide which is the best method to collect authentic data.

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Appendices

Appendix A: Computerized Discourse Complete Task (adapted from Taguchi, Xiao, & Li 2016)

SPEECH ACTS in a high imposition:

INVITATIONS

Your class is presenting their final papers at the Cal Poly Research, Scholar ship, and Creative Activities Conference. You want your professor to come. What do you say to your professor?

REQUESTS

You are traveling for summer break, and you booked your flights a week earlier because you accidentally forgot about your finals schedule. You want to ask your professor if you can take your final exam a week early. What do you say to your professor?

NEGOTIATION

You want to meet with me to discuss your grade in the class. Your current grade is 88%, and you want to get an A. You want to bring up the topic of extra credit to see if you can raise your grade. What do you say to your professor?

REFUSAL (to an invitation)

I have created a study group for our class. The study group will meet on a Sun day to study for the final exam. I have asked you if you are attending. You cur rently have a B in that class and would prefer to study for another class in which you have a C; therefore, you cannot attend. What do you say to your professor?

APOLOGY

I am a stern professor, who counts tardiness more than 15 minutes as an absence, but you were caught in traffic for 20 minutes. How do you apologize for being 20 minutes late to your professor?

SPEECH ACTS in a low imposition:

INVITATIONS

You and a group of classmates are going to study for your upcoming grammar test. You want to invite a classmate to join. What do you say to your classmate?

REQUESTS

You forgot your notebook at home, and you want to ask me for a sheet of paper to take notes in class. What do you say to your classmate?

NEGOTIATION

I have invited you to study at the Bronco Student Center, but you think that the library is better because you can reserve a study room. What do you say to your classmate?

REFUSAL

It's been a busy semester and I am inviting you to the campus Starbucks to chat about life in general. You would rather spend that time working on an as signment for your English class. What do you say to your classmate?

APOLOGY

You are in a group for one of your classes. You forgot to turn in a part of your assignment on time. How do you apologize to your classmate for being late?

Appendix B: Interactive Discourse Completion Task (adapted from Taguchi, Xiao, & Li 2016)

SPEECH ACTS in a high imposition:

INVITATIONS

o Your class is presenting their final papers at the Cal Poly Research, Scholar ship, and Creative Activities Conference. You want me to come. What do you say to me?

o (Anticipated answer) Hello Professor, my class is presenting the Cal Poly Research, Scholarship, and Creative Activities Conference soon, would you like to attend?

o (Response) I would love to. Thank you.

REQUESTS

o You are traveling for summer break, and you booked your flights a week earlier because you accidentally forgot about your finals schedule. You want to ask me if you can take your final exam a week early. What do you say to me?

o (Anticipated answer) Is there any way to take my final a week early? I booked my flight during finals week.

o (Response) Yes, I could do that but, in the future, please consult the syllabus.

NEGOTIATION

o You want to meet with me to discuss your grade in the class. Your current grade is 88%, and you want to get an A. You want to bring up the topic of extra credit to see if you can raise your grade. What do you say to me?

o (Anticipated answer) I was wondering since my grade is nearly an A, if there is anything I could do for extra credit.

o (Response) Maybe I could offer some extra credit points on the next quiz.

REFUSAL (to an invitation)

o I have created a study group for our class. The study group will meet on a Sunday to study for the final exam. I have asked you if you are attending. You currently have a B in that class and would prefer to study for another class in which you have a C; therefore, you cannot attend. What do you say to me?

o (Anticipated answer) I am sorry, but I cannot attend the study group on Sunday

o (Response) That's okay. Just be sure to contact a classmate for notes.

APOLOGY

- o I am a stern professor, who counts tardiness more than 15 minutes as an absence, but you were caught in traffic for 20 minutes. How do you apologize for being 20 minutes late to me?
- o (Anticipated answer) Sorry for being so late, professor I was caught in traffic. I hope I didn't miss much.
- o (Response) Well you didn’t miss much.

SPEECH ACTS in a low imposition:

INVITATIONS

- o You and a group of classmates are going to study for your upcoming grammar test. You want to invite me to join. What are you going to say for me to join your study group?
- o (Anticipated answer) Do you want to join our study group?
- o (Response) Sure thanks for inviting me.

REQUESTS

- o You forgot your notebook at home, and you want to ask me for a sheet of paper to take notes in class. What do you say to me?
- o (Anticipated answer) Can I have a piece of paper?
- o (Response) Yeah, of course.

NEGOTIATION

- o I have invited you to study at the Bronco Student Center, but you think that the library is better because you can reserve a study room. What do you say to me?
- o (Anticipated answer) I think the library is a better place to study. The Bronco Student center is too loud.
- o (Response) Yeah, you’re probably right. Let’s head over there instead.

REFUSAL

- o It’s been a busy semester and I am inviting you to the campus Starbucks to chat about life in general. You would rather spend that time working on an assignment for your English class. What do you say to me?
- o (Anticipated answer) No thanks. I think I should go to work on my assignment instead.
- o (Response) Okay, that’s fine. We can meet after finals.

APOLOGY

- o You are in a group for one of your classes. You forgot to turn in a part of your assignment on time. How do you apologize to me for being late?
- o (Anticipated answer) Sorry for being late on our project.
- o (Response) It's okay we finished it already.

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The Growth Effect of a Commercial Diet versus Calcium-Dusted Blaptica dubia and Carica papaya on Juvenile Correlophus ciliatus

Abstract

Background: Reptiles and amphibians are increasing in households across the United States. Pet owners are struggling to maintain their well-being due to lack of proper husbandry and nutrition, resulting in a poor quality of life and a reduced lifespan. This study was conducted to provide more information on nutrition to reptile owners, breeders, herpetologists, veterinary professionals and more. The goal is to provide dietary information for increased growth in Correlophus ciliatus, the crested gecko.
Materials and Methods: A food trial was conducted for 5 weeks with 60 juvenile crested geckos, 30 of which were fed a diet of calcium-dusted cockroaches and fresh papaya and the remaining 30 were fed Pangea ã crested gecko diet. Their environments remained controlled and measurements were taken once a week, on their fourth feeding day. IACUC Approved: 19.006
Results: Before and after the food trial, the geckos had the same behavior, activity and appeared healthy, therefore their welfare was not compromised. Upon conducting a two-way repeated measures ANOVA and a paired t-test examining weight and length, the geckos of the insect/fruit diet group on average gained more weight and showed increased growth compared to the commercial diet group. The data analysis on length did not demonstrate any significant difference. Statistically, from Week 1 to 5, the insect/fruit diet and commercial diet groups had a total body percent increase of 24.13% and 13.07%, respectively.
Conclusions: Based on the study conducted, the juvenile crested geckos tested exhibited increased growth on a diet comprised of fruit and insect rather than a commercial diet.
Clinical relevance: With this data and analysis, crested gecko nutrition is better understood and statistically available for establishing better nutritional standards and procedures.

Introduction

Pets are a crucial part of society. Consequently, reptiles and amphibians are moving up the list of common household pets. According to the American Pet Product Manufacturers Association, more than 3.9 million households in the United States contained one or more pet reptiles or amphibians in 2000. This is a 44 percent increase since 1998. According to wildlife biologist and medical scientist Clifford Warwick, 75 percent of reptiles die during their first year in a domestic home environment [1]. Unfortunately, there is not a plethora of research supporting their biological needs, compared to canines for example. All reptile species demand a complete and balanced diet including calcium, vitamin D3, vitamin A and fiber. Yet it is known that a common factor of the high mortality rates in households is poor nutrition [2].

This study is conducted to help enhance the welfare for household reptiles. With the volume of food products in the market and brands that do not have research showing successful growth, development and lifespan with the feed, it is difficult as a pet-owner to decide what brand to feed their reptile or what type of diet to choose. To better understand reptile nutrition and development, we tested the effects of a commercial, Pangeaã crested gecko diet, on juvenile crested geckos-Correlophus ciliatus-versus a fruit/insect diet consisting of

calcium-dusted juvenile cockroaches and pureed papaya. These two options for feed were chosen specifically, as they are a reasonable replication of what is expected to a natural diet for the species in the wild [3]. This species is particularly prone to developing Metabolic Bone Disease (MBD) due to lacking minerals, such as calcium, in their diet. Vitamin D deficiency is a leading cause of MBD, as Vitamin D is the necessary agent for calcium absorption [4]. By having results of growth in groups treated with a homemade diet and a commercial diet, consumers of all backgrounds can better understand the demands of a reptile and invest in feeding a diet that will prolong their lifespan and enhance their well-being. Prior to beginning the 5-week food trail, we hypothesized that the commercial diet fed group will have grown more than the insect/fruit diet fed group. We hypothesized that a commercial formula is more complex and contains more essential nutrients and minerals than a basic insect/fruit diet. For example, the commercial diet contains riboflavin, folic acid, vitamin B12, vitamin A, folic acid and sulfur, all considered essential in gecko nutrition [5]. Therefore, the commercially treated group will ideally show the best growth results.

Materials and Methods

The crested geckos used for this food trial experiment were obtained by the permission of one breeder and the experiment the use of the animals was approved by the Institutional Animal Care and Use Committee (19.006). The crested geckos used for this food trial experiment ranged from 3-4 months at the start of the food trial period. Exactly 60 geckos were used for this experiment, 30 in the insect/fruit diet fed group and 30 in the commercial diet fed group. The geckos were genetically related but were randomly categorized into the two groups for the experiment. Prior to beginning the trial, they were all on Pangeaã. A humidifier was set in the room at all times, with humidity set to remain between 50-90%. The room remained between 70 and 73 Fahrenheit at all times. The humidity and temperature monitor brand was Govee Home©,purchased from Amazon©.

Each crested gecko resided individually in a labelled, hole-punched individual plastic container, measuring about 33 cm in length, 20 cm in width and 15 cm in height. The container brand was Rubbermaid© and they were purchased from WalMart© and Target©. Each container was furnished with a paper towel base, plastic green plant, egg carton piece, plastic food dish and plastic water dish. The paper towel brand was Bounty© and they were purchased from WalMart© and Target©. The plastic plants were purchased from Pangea© Reptile, manufacturedby Zoo Med©. The egg cartons were obtained from Uline© and cut into 10 cm by 10 cm sections. The scale used for all measurements of feed weight and gecko weight was AC Pro-200 (200 g x 0.01 g) ©, purchased from Amazon©. The geckos were fed 4 times a week, therefore every other day and one consecutive day. Data was collected once a week, every Sunday. On feeding days, each gecko had a clean water dish replaced, a new paper towel and misting of its habitat and itself.

Prior to beginning the food trial, the three feed samples (cockroaches, papaya and Pangeaã) were submitted to a nutrient analysis laboratory according to their sample size guidelines and shipping instructions. This tool was utilized to provide more information on the macronutrient content, testing for percent fat, protein, moisture, ash and fiber. The laboratory used was Cumberland Valley Analytical Services, Inc.

The commercial feed used was Pangeaã Fruit Mix with Insects Complete Gecko Diet (as shown on the manufacturers website). The package itself calls it Pangeaã Gecko Diet "With Insects." This was originally in powder formula, therefore each week a new paste was reconstituted with water, placed in a wide-mouth dispensing bottle and refrigerated. The paste was reconstituted following the instructions on the commercial diet "Directions" Label. A 1:2 ratio of paste to water, respectively, was stated, therefore we used 100 milliliters of paste and 200 milliliters of water. The mixture was added into the dispensing bottle immediately and shaken for 30 seconds. The geckos in this food group were given 2 grams paste, on an inverted clear plastic cup that measured 2 cm height and 2 cm diameter.

The insect/fruit group was fed a diet of roaches and papaya. The roaches used were juvenile cockroaches, Blaptica dubia, obtained from www.dubiaroaches.com. The roaches were gutloaded with Pangea© Superpig and Nature Zone© Total Bites. Approximately 2-3 roaches were fed to each gecko in the commercial diet group. The total weight of roaches fed to each gecko was 1 gram and sizes of each individual roach was decided based on size of the respective gecko. The protocol used was crude examination of the head of the gecko: roaches were given that were smaller than the size of the respective gecko head. The roaches were placed in a clear plastic cup (2 cm height and 2 cm diameter) and dusted with 0.1 gram of calcium powder. The calcium powder brand used was ReptiCalcium© with D3, manufactured by Zoo Med©. The ingredients were precipitated calcium bicarbonate and cholecalciferol (source of vitamin D3). The papayas were purchased from Sprouts Market© and the peels and kernels were discarded with each use. The papaya used was blended and placed in a wide mouth dispensing bottle, then refrigerated. The papaya was used up within the week and replaced with new blended papaya at the end of the week for optimal freshness. Each gecko was given 1 gram of the papaya, placed on an inverted clear plastic cup (2 cm height and 2 cm diameter).

On data collection days, a protocol of minimal handling was set in place, to prevent gecko stress and loss of tail. The gecko was removed from its habitat, and first placed on a scale and weight in grams was measured. Following this, the gecko was placed on a l aminated grid paper, parallel to the lines and a photo was taken directly above the gecko, 90 degrees to the table. The grid paper used had the following measurements: 5 squares=1 centimeter. This photo was then used to manually count and measure the total length of the gecko in centimeters.

At each data collection date, the geckos were physically evaluated for soundness and health. The following signs were looked out for as indications of poor health: jaundice (yellowing of eyes, mucous membranes or scales), dryness of scales, appearance of spine, loss of tail and reduced motility.

For data, the values used were body weight and total length. To test the variation in the data for the values collected, a t-test, paired t-test and a two-way repeated measures ANOVA were used.

Results

Uponphysical examination from Week 1 to Week 5, there were no evident negative health differences in the geckos from both groups. No tails were lost and all geckos appeared healthy based on physical examination findings and lack of poor health signs stated above.

A two-way repeated measures ANOVA (one factor repetition) was conducted comparing live weight from week 1 to week 5. The data failed the normality test (ShapiroWilk) and equal variance test (Brown-Forsythe). There is a statistically significant interaction between diet and week (P= <0.001).

A two-way repeated measures ANOVA (one factor repetition) was conducted comparing live weight from week 2 to week 5. The data failed the normality test (ShapiroWilk) and passed the equal variance test (Brown-Forsythe). There is a statistically significant interaction between diet and week (P= <0.001).

An all pairwise multiple comparison procedures test (Bonferroni t-test) was conducted comparing insect/fruit diet versus commercial diet. By week 5, there was a significant weight gain (P<0.050) in the insect/fruit diet group compared to the commercial diet group.

A t-test conducted on change in weight and percent change in weight of the two groups by week 5 demonstrated a statistically significant difference (P= 0.016). A t-test conducted on change in live weight demonstrated statistical insignificance.

Time was a significant factor and showed growth over time in lengths. Figure 1 shows that the crested geckos started at approximately the same mean weight at Week 1 and at approximately Week 2-3, the commercial diet group plateaued while the insect/fruit diet group continued to increase. After Week 3, the commercial diet group resumed a steady growth pattern.

According to Table 3, by Week 5, there was growth exhibited in both groups, but the insect/fruit diet group averaged 4.055 grams and the commercial diet group averaged 3.684 grams. Table 2 demonstrates that the average weight gain in the insect/fruit diet group was 0.813 and in the commercial group the average weight gain was 0.4263. The percent increase for the insect/fruit diet group and the commercial diet group was 24.35% and 13.07%, respectively. Figure 2, comparing mean length of the groups from Week 1 to Week 5 demonstrated growth and change but no significant difference between the two groups.

Discussion

Based on the results from the t-test and the ANOVA, we can conclude that the ANOVA results are more significant and credible. The insect/fruit diet group had a significant increase in weight compared to the commercial diet group. We can reject our hypothesis and state that the insect/fruit diet group, over a five-week span, has shown greater average weight gain, therefore greater average growth, than the commercial diet treatment group.

Upon consideration of the nutrient content of each feed, it is evident as to why the insect/fruit diet group exhibited more growth and higher weights. The fat percentage of the cockroaches and papaya combined were 8.6%, compared to the commercial diet value of

4.6%, shown in Table 1. Furthermore, the protein percentages were 30.4% and 25.5% for the natural diet combination and the commercial diet, respectively. There is significance in considering dry matter, mineral content and prey size, as it alters digestibility per individual [6]. The roaches were dusted in calcium and were kept at a small size, possibly increasing the overall digestibility in the insect/fruit diet group.

The sex of the geckos was not determined during the study, as they cannot be distinguished until they have reached sexual maturity. For the nature of this experiment, the sex was deemed insignificant, considering the sample size was 30 per group and randomized.

The length of the geckos showed growth over time but they did not demonstrate a difference in groups, therefore it is not a significant factor when evaluating growth on a dietary basis. Measurement of body composition and width or girth to see what tissues are accounting for the increase in weight will also be a goal, to help understand the change in body composition and have more solid results.

A future direction would be for only one individual to conduct data collection and statistical analysis for less percent error and greater consistency.

For future studies, we would like to conduct the food trial for over 5 weeks. It would be ideal to monitor growth until the geckos were no longer juvenile and became sexually mature. This way the geckos can also be sexed and data can be collected comparing males and females as adults.

As part of the nutrient analysis, it would have been more complete to have specific mineral content percentages. For example, phosphorus, calcium and magnesium, as these are essential in any reptile diet to prevent Metabolic Bone Disease and to ensure healthy growth and development. For future studies, a micronutrient analysis will be conducted along with a macronutrient analysis.

Testing the fecal output to compare dry matter versus wet matter would also further conclude the data and provide stronger support. Another crucial part for any feed study would be recording the amount consumed quantified by deducting feed refusals. For example, we know that 2 grams of commercial diet was offered, but we did not quantify how much was consumed. For future projects, this is essential information to account in statistical analysis. It is possible that there is difference in taste of the diets and each gecko has difference in palatability which is a factor to consider [7].

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Figure Captions

Fig. 1. Average group weight per week from week 1 through week 5. The average weights of the insect/fruit diet and the commercial diet groups were approximately the same in the beginning of the study. At week 2 a deviation was seen, where the commercial diet group plateaued while the insect/fruit diet group continued weight gain. After week 3, the commercial diet group resumed growth and by week 5, the insect/fruit diet group exhibited increased weight gain compared to the commercial diet group.

Fig. 2. Average group length from week 1 through week 5. The insect/fruit diet group averaged with greater lengths throughout the food trial compared to the commercial diet group. The lengths gradually increased in the insect/fruit group. Whereas in the commercial group, between week 1 and week 2 a slight decrease in length was exhibited. The same pattern was seen from week 3 to week 4. There was no significant difference between the groups was exhibited by week 5.

Table 1:

Nutrient Analysis of *Blaptica dubia, Carica papaya* and Pangea© Diet					
Feed (Fresh)	Fat (%)	Moisture (%)	Protein (%)	Ash (%)	Fiber (%)
Blaptica dubia (as fed)	6.1	71.5	21.4	1.3	2.6
Carica papaya (as fed)	2.5	92.7	9.0	0.6	15.8
Pangea© (dry matter)	4.6	7.4	25.5	7.4	1.9

Table 2:

Comparison of Crested Geckos' Mean Starting Weight, Mean Weight Gain and Totally Body Percent Increase in Insect/Fruit Diet vs. Commercial Diet Groups				
Group	N	Mean Starting Weight (g)	Mean Weight Gain (g)	Total Body Percent Increase (%)
Insect/Fruit Diet	30	3.24	0.81	24.35
Commercial Diet	30	3.26	0.43	13.07

Table 3:

Comparison of Crested Geckos' Mean Group Weight per Week in Insect/Fruit vs. Commercial Diet Groups		
	Insect/Fruit Diet (g)	Commercial Diet (g)
Week 1	3.24	3.26
Week 2	3.41	3.36
Week 3	3.58	3.46
Week 4	3.85	3.48
Week 5	4.06	3.68

Table 4:

Comparison of Crested Geckos' Mean Group Length per Week in Insect/Fruit vs. Commercial Diet Groups		
	Insect/Fruit Diet (cm)	Commercial Diet (cm)
Week 1	10.25	10.16
Week 2	10.61	10.15
Week 3	10.78	10.77
Week 4	10.9	10.72
Week 5	10.98	10.84

Figure 1:

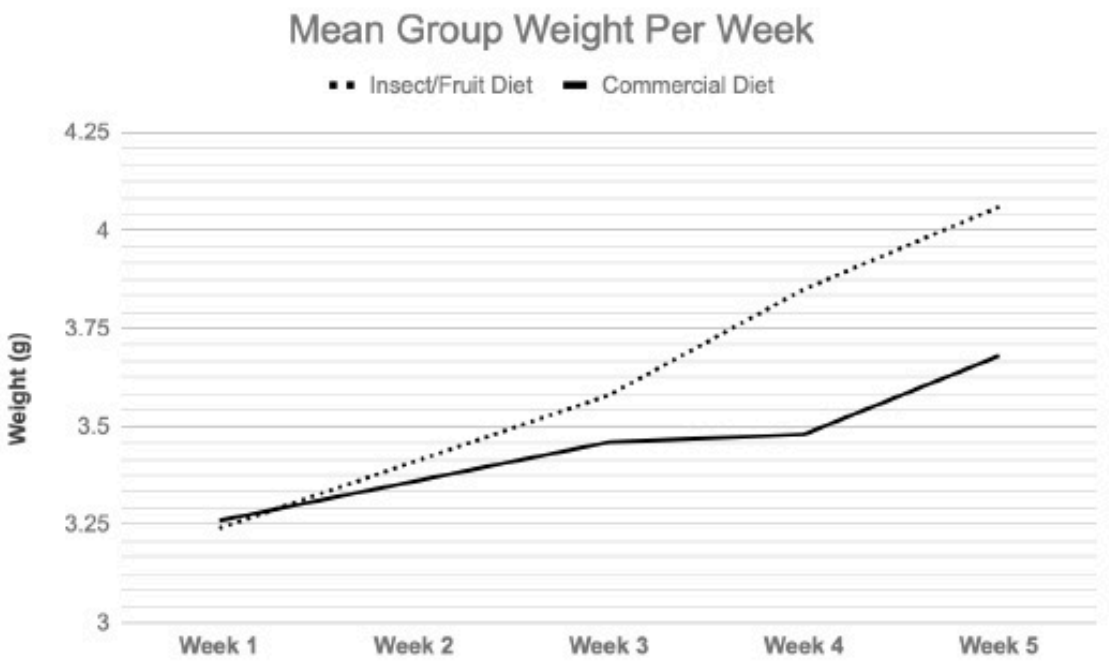
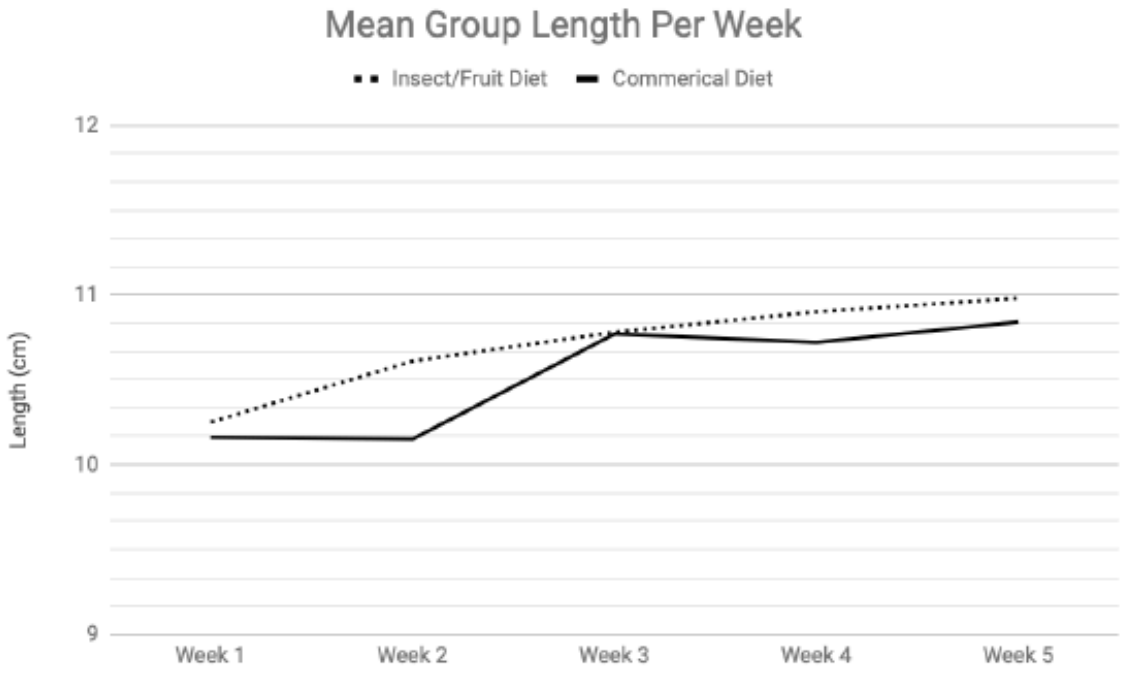


Figure 2:



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Paving the Pathway: A Look at One University's Steps to Develop a Teaching Pathway for High School Students Interested in a Teaching Career

Abstract

California has a teacher shortage and is in need of qualified teachers to enter the teaching field. In fall of 2017 80% of districts in California reported a shortage of qualified teachers. (Darling-Hammond, 2018). This paper is a case study of a university and the steps it took to begin developing a teaching pathway with local high schools to prepare high school students to enter the university's teacher education program, and to ensure high school students that want to become teachers are adequately prepared to succeed in college and eventually in the workforce. This study reports the work of a university's college of education's Teacher Academy program's steps to create a teacher pathway in cooperation with local high schools.

Problem statement

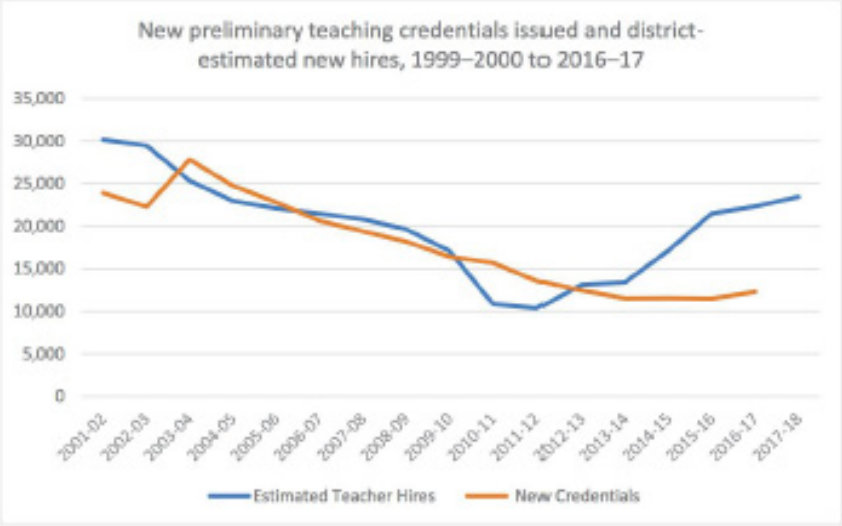
California is facing a shortage of qualified teachers. In 2015 California examined the state of their shortage and identified Special education, science and math, inner-city and low-income schools as areas of significant shortage (Aragon,2015). This study looks at and addresses the current teacher shortage in the State of California and discusses how several schools came together with the guidance of a College Dean to create a teacher pathway. This paper focuses on one of those schools and the steps taken by leadership at the high school and college level to develop relationships that address the shortage. The hypothesis being tested is whether a successful partnership between local universities and high schools can create strong pathways for high-school students who want to enter the teaching field to successfully transition to the college that is supporting the pathway. This study provides a perspective of how the relationships between one high school and one college developed and how that relationships supported their partnerships to create a pipeline of teacher education candidates to address the state's teacher shortage of a diverse and well-prepared workforce.

Teacher Shortage in California

There are many studies addressing teacher shortages. In fall of 2017 80% of districts in California reported a shortage of qualified teachers. (Darling-Hammond, 2018). The shortage of teachers in our country is not new. It was predicted to occur by education leaders decades ago and a variety of factors contribute to the shortage we have today (Howard, 2003). A 1967 publication of the California Management Review stated that if leaders don't take the time now to understand the balance of supply and demand in education they predict that the shortage in California will continue to worsen (Hirsch,1967). Unfortunately, the article successfully predicts the consequences of teacher demand we see today listing "pupil-teacher ratios and teacher roles and qualifications" (p27) as possible ramifications. The shortage we face today is far past what could have been predicted. This is directly due to the unexpected Great Recession of 2007-2009, and the layoffs that resulted because of it.

During the time of the Great Recession Stanford research reports that over 10,000 pink slips were given to teachers and programs were reduced or eliminated all together (Darling-Hammond, 2018). As a direct result of this, enrollments of teacher preparation programs took a steep fall. Data from the California Commission on Teacher Credentialing reported a 70% decrease in enrolment between 2002 and 2014 (2016). The teaching profession is still paying the price of this publicised mass layoff. Students who saw their teachers laid off or experienced consequences of reduced programs, were less likely to see teaching as a possible career. When schools were able to hire again the new teacher candidate pool was desperately low. Coinciding with decreasing enrollments of teacher preparation programs, the number of public elementary and secondary students had been quickly increasing (Howard 2003). Data from The National Center for Education Statistics shows a 14% increase in enrollments from 1990 to 2000 (2005). The latest data from the NCES shows another increase of 7% between 2000 and 2017 in public elementary and secondary schools (2020). This brought the national total to 50.7 million students in fall of 2017 (NCES, 2020). As a result of these circumstances a growing number of emergency credentials, intern credentials, short term staff permits, and waivers were issued (Darling-Hammond, 2018). This can be interpreted as a sign of a teacher shortage because substandard credentials are only awarded when no credentialed candidates are available. Researchers at the Education Commision of the United States have identified that teacher shortages are prevalent in “Urban, rural, high-poverty, high- minority and low-achieving schools” (Aragon, 2016). Each of these characteristics can be found in schools in california depending on the region which is why California's shortage is critical (Sutcher,2016).

Figure 1:



Note: New credentials are preliminary credentials issued to newly prepared teachers. 2016–17 data are preliminary. Source: California Commission on Teacher Credentialing, 2002–2015. *Teacher supply in California: A report to the legislature.* Data available at http://www.ctc.ca.gov/reports/all-reports.html; Credential data from 2016–17 provided by the CTC by request; District estimated hires come from the CDE, 2002–2018. http://data1.cde.ca.gov/dataquest/.

Figure 1 was published in a technical report titled “Teacher Shortages in California: Status, Sources, and Potential Solutions” (2018). It depicts the disproportionate supply and demand of credentials issued and vacant teaching positions in California.

During the years following the recession from 2010 to 2012 the mass layoffs created a surplus of teachers. This quickly shifted with the passing of proposition 30 in 2012. Proposition 30, titled Temporary Taxes to Fund Education, provided additional funding for state schools in California prompting them to reopen positions and programs once lost. As illustrated, after the 2012-2013 school year the proportion of credentialed teachers to vacancies shifted and the shortage steeply increased in the years to follow. The graph has remained steady in its projected course and predictions show no intention of slowing any time soon. In fact, in 2025 the number of teaching positions in the nation is expected to reach 316,000, while the projected supply of teachers will be slightly above 100,000 (Sutcher, 2016; Garcia 2019).

Solutions: Teacher Recruitment

There is no denying the critical state of the teacher shortage. The question education leaders face now is how to bring a healthy balance in the supply and demand of quality teachers. A technical report from Learning Policy Institute summarized policy recommendations by stating "Given that much of the teacher shortfall appears to be the result of steep declines in the production of new teachers as demand has increased, a key policy strategy may be the expansion of high-retention pathways to teaching that will both recruit and retain teachers" (2018).

The beginning of the teacher shortage cycle starts with teacher preparation program enrolments. According to the Education Commission of the States, the number of students interested in a career in education is decreasing (2016). In the United States 15% of high school students found an interest to pursue general education majors in 2010. Since then that number has dropped, and in 2014 it was reported that only 12% of students thought about an education profession (ACT, 2015).

One of the biggest decision making factors high school students consider when thinking about their future career is job salary. Currently this does not play in favor of the teaching profession which has a reputation of low status and low pay (Podsky, 2016) . According to a collection of studies there are two distinct reasons students might be drawn to teaching, the aspiration to serve their community and passion for social justice in low-income areas[1].

The Education Commission of the United States reports in 2016 that individual states have created teacher shortage task forces to help combat and understand the shortage they are facing. The task forces identified their specific shortages and also gave recommendation to policy makers of how to address their situation. Significant data from the report show that three out of seven states suggested a pathway program for teacher leadership and four recommended mentoring programs (Aragon,2016). A pathway is a unique opportunity that offers employees or students a plan to progress upward in their area of interest. This type of program is utilized in high schools to give students career and technical experience. High school pathways normally work in partnership with universities with the goal to guide all students into college with a career focused path through career education and hands on learning mentorship (Symposia Series, 2018). Because studies show a lack of teaching interest in high school students, pathway programs at that level would be an effective tool. Mentorship from career veterans or experts in a pathway is

necessary especially for teaching pathway programs. Dr. Milbrey McLaughlin, Professor of Education and Public Policy Emerita at Stanford University found that incorporating hands on learning through mentorships in academic instruction proved most effective for pathway programs in California (Symposia Series, 2018). Knowing that mentorships are key to a successful pathway and that pathways are recommended by education leaders to bridge the shortage gap, partnerships between schools may be the answer leaders are looking for. McLaughin supports partnerships stating systemic issues can be better addressed when leaders work together (Symposia Series, 2018). What makes the teacher shortage so detrimental to California's education system is that it does not have one solution. It is complex and involves intertwining areas of education. For this reason, partnerships between schools and universities are an effective part in the teacher shortage solution.

It should be noted that California acknowledges the shortage and the importance of teacher recruitment as a solution. In 2018 Caifornia made an investment of $50 million for “local solutions” specific to special needs recruitment and retention (Darling-Hammond,2018) . In the same year $4.4 million was invested in the Center on Teaching Careers, a resource for students considering a teaching career (Darling-Hammond,2018). These financial contributions will aid the shortage in California, however bigger strides will still have to be made in the coming years in order to avoid the predicted course of the teacher shortage.

Methodology

A qualitative study design format is used to establish a framework to explore the thinking, feelings, and beliefs of college and district leaders about their roles in creating and implementing teaching pathways. In order to gather a richer understanding of how this high school and college worked together to create and develop a pathway for high school students to enter the university, 6 educational leaders were interviewed to interpret their perception of their role in creating and implementing a teaching pathway between the high school and the university and how these participants reflect upon and understand their role in the process. In a (basic) qualitative study, Creswell (2014) and Merriam and Tisdall (2015) explain that knowledge is accessed by engaging in a participant's experiences and then interpreting their experiences in order to make meaning of how they are ascribing to a problem. Creswell (2014) further explains that social constructivists process the interactions among participants’ specific context and settings and believe that the participants and their experiences have complex views. In addressing their views, they can generate a pattern of meaning. The benefit to participants is their ability to participate in a reflective process and add to the body of knowledge regarding the development of teaching pathways. Research questions were designed and used to explore the participants' perceptions and beliefs about their participation in the pathway development and relationship between the college and the high school.

By employing qualitative methods to produce needed data, the study provides the experiences of the participants for creating teaching pathways and looks at how districts and colleges can work together to strengthen the relationships between organizations to prepare students to enter college prepared for college-level coursework focused on teaching. In order to gather an understanding of how the educators participating in this study felt about the creation of a pathway, educators from all levels were interviewed to interpret their perception of their role in creating the pathway.

Analysis

The Teacher Academy Pathway created a class called Intermediate Education at the partnership high school. This class is a two year pathway program that is a-g approved. From the perspective of the class teacher, being a-g approved provides additional purpose to the class that they are proud to offer. This program first began in Fall of 2019 and next school year, Fall 2020, they will welcome a new level one class and the first session of the level two students will begin. Having a two year program offers them the chance to cover the different areas of education in detail. The class curriculum is centered around the textbook "Teaching" from G-W publisher. Research was also done by the class teacher and the vice principal of other pathways to identify the type of program they felt was most appropriate for their school. The teacher of this class stated in an interview that she also integrated campus events into the curriculum when she saw fit. For example, the students were able to attend school staff development meetings and trainings. This demonstrates the support the program has from the school and their desire to see it succeed. In her interview the teacher went on to say that the goal of her class is to expose her students to every profession they could achieve with this pathway as well as what they can expect from a college education program.

A large part of the class incorporates hands-on learning from mentor teachers at the local middle school. In an anonymous survey students were asked about their experience at the local middle school. Their responses were overwhelmingly positive and many students seemed to realize that although a good experience, the middle school age group is not the direction for them in education.

Challenges

From the high school's perspective two major challenges were found. The first being articulating their vision and making sure everyone's goals were aligned. This pathway involves many moving parts requiring communication and trust between schools. The university's teacher intern and administrative programs coordinator addressed this challenge too by admitting that listening to the ideas and taking input from the schools they are partnered with was key to getting schools on board. Although communication was shown to be a challenge it also shows that this pathway is developing in the correct way. A complex shortage requires education leaders to come together from all different levels. However this is obsolete if the leads are not all on the same page.

The second challenge the Vice Principal mentions facing was selecting the "right" master teacher. The high school's vice principal was aware of the potential influence the mentor master teachers could have on the students. These master teachers were from the local middle school and he wanted to be sure that they understood the purpose of the high school students in their classroom. His vision involved students gaining a meaningful experience with their master teachers and encouraging their passion for teaching. He feared that master teachers also had the ability to give students a negative experience and drive them away from teaching based on the master teachers own opinions. For this reason he put a lot of thought into ensuring the master teachers were there for the right reasons and understood the purpose of the Teacher Academy. The vice principal's efforts were rewarded by the students' positive feedback and experience with their master teachers.

Importance of The Pathway

The interviewees speak about their first hand account of why this program is important from the point of view of their school and students.

The coordinator of teacher interns and administrative programs at the university, views the Teacher Academy program as a vehicle for opportunity. During his interview, he mentioned that his father was a first generation college student and that his family history motivated him to work with high need students. For that reason he feels the Teacher Academy is valuable and can make a difference in many students' lives. He views the Teacher Academy as a benefit to new college students and comes from a desire to give all students equal opportunity to enter college with a focused direction on teaching. He went on to say that the Teacher Academy not only brings quality teachers into their education program, but teachers that exit the program will impact many future generations of students. The coordinator adds that the shortage is something that cannot be ignored. The Teacher Academy acknowledges the shortage and provides a solution that works to support and prepare new generations of teachers.

The Vice Principal of the high school that participates in this pathway, shares that their school has 7 other successful pathway programs. The Principal and Vice Principal felt that they have a school with quality teachers and that a teacher pathway would be a natural fit. The vice principal also relayed in his interview the feedback he has received from master teachers and parents about the program. The master teachers have expressed pride in passing on their knowledge/experience to students and appreciate the impact it has on future children that extend past their career. Feedback from parents and have reassured him that the pathway program is essential to continue. It is comforting to parents to know that their child has a career plan and to see their enthusiasm for it. He believes that the Intermediate Education class has given the students irreplaceable social capital that will put them at an advantage in their college careers.

The Dean of the College of Education and Integrative Studies believes it is the university's responsibility to support and serve its community. In his experience many people possess the qualities to be a good teacher, but are discouraged by others to go into the profession. Teacher Academy provides an opportunity for students to make an informed decision about their future careers. Oftentimes students don't fully explore a career until college and in turn have to change their majors to find their right fit. He strives to continue and improve the program because it opens doors for students to university programs that can impact their surrounding districts.

High School Student Perspectives

The goals of this program from all of the education leaders have focused on the benefit to the high school students. To analyze this program, high school student participants completed anonymous surveys given to them by their high school teacher that were developed by the researchers.

From the perspective of the university they hope to build relationships with the participating students. To do this they held an on campus event that gave the students a campus tour, lunch, and seminar with guest speakers from the College of Education and Integrated Studies. The two graphs below depict the percentage of students interested

in attending the university from the Intermediate Education class at its partnered high school. Figure 2 charts the opinions of the students prior to visiting the university's campus and Figure 3 graphs their responses post their on campus visit.

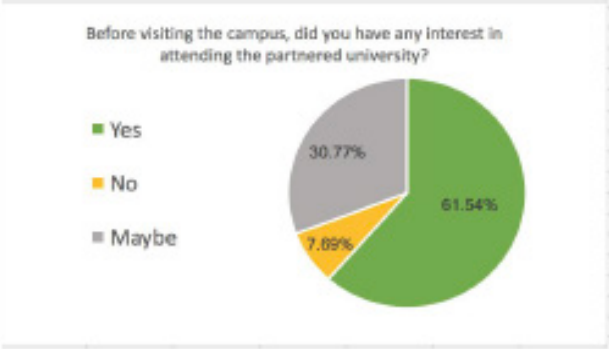


Figure 2

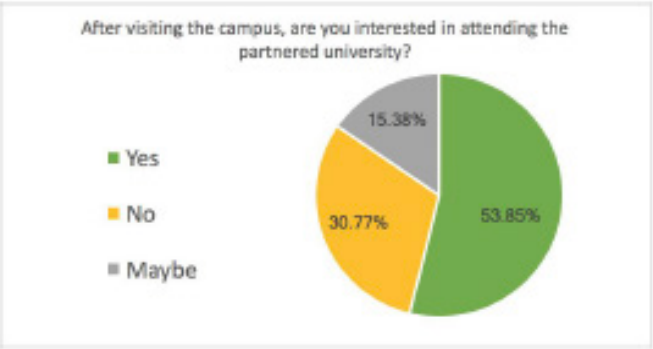


Figure 3

What we can pull from this data is that a campus visit did have an impact on a student's decisions. 23% of the students changed their answer based on the campus visit. In this sense the on campus event held by the university can be deemed as a success. Its goal was to give students an opportunity to explore the campus and the education program to be able to identify if it is the right path for them. This was shown to be a valuable experience for all students because it helped students come to the right decision for themselves. As a result of the on campus event many students were reassured of their interest in the university and their enthusiasm for their future there grew.

The second goal of the partnership is to generate interest in a teaching profession and recruit those interested into education/teaching programs. In the same anonymous survey, students were asked on a scale from 1 to 5 (1 being not at all and 5 being yes), "Are you interested in studying education/teaching in college?". 53.85% of students selected the answer 5. Meaning yes, they are interested in pursuing education/teaching in college. The remaining percentage was a mix between selecting 2 or 3. This question was asked at the end of their semester and a majority of these students also stated that their opinions of the teaching profession had changed during the course of the class. One student commented saying "I did not realize how much work goes into teaching. It's not just a job, it's a lifestyle". Another student reflected on their overall experience stating " it just made me want to become a teacher more". Students were thankful for the opportunity to explore teaching before college. One student discovered, "I am not interested as much as I used to, my interests have changed". Students' responses like this demonstrate the success of the program when compared to the goal of its leaders.

Future of The Teacher Academy

The first year of Teachers Academy was a success, but both the university and high school want to continue to grow the program. In the near future they hope to get CTE approved by the state. Through this they hope to offer students a way to receive college credit for the class. This will be through either an articulation model or dual enrollment model. Whichever model they move forward with, they feel that this will be a greater opportunity for students that will affect their near future. One thing that everyone involved in this project expressed was the importance and pride of district areas working

together. High schools, middle schools, and universities working for the benefit of all of their students. The point of education is to impact students and their future. By focusing on creating quality teachers through preparation programs, the Teacher Academy is directly impacting the lacking supply of teachers. The high school also stresses their plan to constantly improve and adapt their pathway program. Both schools hope to continue their relationship and expand their number of Intermediate Education classes at the high school. In the upcoming years the university plans to get more schools involved with Teacher Academy. They will continue to work to create a stronger connection to the university by organizing more on campus events for students.

COVID 19

Although the university is eager to move forward and bring Teacher Academy to more schools, expansion is on a pause due to the COVID-19 pandemic. The Dean of the Education College understands that schools will be hesitant to start a program in these uncertain times. However, during this time they will look for more funding to add on schools in the future. COVID- 19 will not prevent the high school from continuing with the program in Fall 2020, however they are faced with the question of how to motivate and impact their students digitally. The vice principal relayed that their school is embarrassing technology and using this period as a time to learn a new way of teaching. COVID-19 did prevent the class from visiting local elementary schools in the second semester, but their teacher reported that they will continue to learn in discussion and from videos until they can safely enter classrooms.

Data is not available yet, but we are seeing another mass retirement in the teaching field due to COVID-19. The education field is experiencing a shift that some teachers are not comfortable with. The Vice Principal believes that education from this point on will rely more on technology then it has before. This has resulted in veteren teachers taking their retirements earlier than expected. The Vice Principal mentioned some districts offering Golden Handshakes to their teachers. Golden Handshakes gives teachers compensation for retirement at a rate that is substantially higher than it would have been if they decided to continue working through their planned retirement dates. This has been offered as a result of COVID-19 and drastic retirements are expected.

Conclusion

The Dean of the Education and Integrative Studies College believes that the University can play a big role in battling the shortage and that this shortage is due to preventable causes. The Dean is supported in his efforts by the coordinator for the teacher intern program and preliminary administrative services credential program. The coordinator states that “it is the University’s role to support the need of teachers in our area”. They believe that this is not only an opportunity for the university and its future students but the education system in their area as a whole. This is the driving force of the program and why leaders across the program are willing to work together for the greater good of their district.

This pathway currently utilizes as well as provides benefits to three learning levels; middle school, high school, and at the university level. The university’s role is to build a relationship with the students and introduce the different programs their school has to offer as well as educate those students once they arrive on campus. This pathway promotes the university and gives students more information about the school to make informed college

decisions. The high school students who are participating in the pathway are tutoring students at the local middle school, allowing an opportunity for them to practice teaching and provides an opportunity for the middle school students to gain additional support with acquiring skills that will be needed throughout their academic career. The university's efforts will lead to more students enrolling in the college and into the career of teaching by supporting the high schools administration and teachers through the pathway partnership and relationship development. The Dean of the Education College states "Even if students don't go into our program specifically they have built a relationship with our school".

The high school principal had a desire to begin a pathway in the best interest for his students. The school's vice principal sees and understands the difficulty students have knowing what major to pursue in college. The purpose of the Intermediate Education class is to help students determine if the education field is right for them. There are so many different areas of education and often students don't get the chance to explore them until they are already in a program in college. The Vice Principal explained that quality teachers have a passion for what they do. The university and high school partnership is working to support and encourage that passion in prospective teachers. The high school also understands that discovering what you don't like is just as important to know before fully diving into a program.

The challenges that the program has faced have been overcome by the positive communicative relationship between the schools and the university. The individual schools understand they are a part of a greater solution to bring balance to the supply and demand of quality teachers. Together they are setting an example and paving the way for other programs while also paving the pathway for future teachers.

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Analysis of Equine Gaits to Optimize English-Specific Discipline Assignments

Abstract

There are over 400 different breeds of the domestic horse (Equus ferus caballus), each selectively bred for a purpose. Breed differences frequently result in a distinctive gait, or body movement. Individual horses may also have gait variations that differ from other members of that breed. When put under a saddle, these gait movements result in an altered experience for the rider; with some gaits causing increased jostling or rider movement. The utility of a horse in a specific discipline is dependent, in part, on the impact, or bounce, factor experienced while riding that horse. The gait of horses (n=10) was analyzed and an evaluation technique was created to predict, based on the trot gait, the degree of bounce factor that would be experienced on a particular horse. This technique will allow breeders, riders, and trainers working with a horse to quickly and objectively select the discipline best suited for that horse without needing to ride, and subjectively assign the horse to an English-specific discipline.

Keywords: bounce factor, horse gaits, horse training, impact factor

Introduction

Since horses were first domesticated over 6,000 years ago, man has specifically bred the next generation of equines to be better suited for man's needs [8]. Because man's needs vary across the globe, different breeds were produced with various capabilities. These breeds were categorized into three main categories: hot bloods, cold bloods, and warmbloods with ponies as a separate and distinctive category. Hot-blooded horses are generally of light or saddle-type build and used for various riding disciplines [1]. They can have a spirited temperament and possess speed and endurance [4]. Cold-blooded horses are used for slower paced work that involves heavy loads such has plowing and pulling wagons. This category can also include some breeds of ponies [3]. These horses frequently have a calmer temperament and have great strength due to its larger frame and build [4]. The last category is a combination of hot and cold types, hence the term: warmblood. Warmbloods were created by crossing certain breeds from the hot and cold types and breeding for specific traits from each. This new type developed into specialized riding horses that excelled in various performances of equine sports including dressage, jumping, or western riding [6]. With over 400 various breeds, each breed has an individual purpose and thus differing ways of using energy to produce the physical action of movement.

Horses are non-stationary animals that use bodily movements to travel from one location to the next location. These bodily movements are referred to as gaits. Most horses have four main natural gaits: walk, trot, canter, and gallop [7]. There are some specialty breeds that have be trained to exhibit modified gaits called "ambling" gaits that are faster than the walk but slower than the canter, or pace gaits where the same side legs hit the ground simultaneously. These modified gaits produce distinctly different movements than regular gaits and many benefits such as smoothness and ease of riding [10]. Each gait has a different speed but the most commonly used gaits in horseback riding are the natural

gaits. The walk is a four-beat gait and is the slowest at about 4 mph. The next fastest gait is the trot, which averages about 8 mph and is a two-beat gait. Then the three-beat canter is the next fastest gait at about 10-17 mph. Finally, the four-beat gallop is about 25-30 mph [2]. Since each gait is physiologically different, it can be expected that each gait will feel different when being ridden under saddle. These different feelings are what make each horse suitable for various riding disciplines.

Research Hypothesis

In horseback riding, the horses go through the three most common gaits: walk, trot, and canter. The gait is created through movement of the horse's limbs and pelvis. When the horse shifts its weight, this creates the movement. To determine how much a horse moves, an evaluation of the displacement from the horizontal is needed. The horizontal will be determined with an invisible line drawn across the horse's back. Any movement above or below the horizontal line is seen as a displacement. Because a variety of horse breeds are used for various equestrian sports, it can be assumed that some horses are more suitable to certain disciplines due to this difference in displacement.

Materials and Methods

Animal Science

In the process of measurement, the horses were documented anonymously. Their age, breed, gender, and height (using an equine height stick) were recorded as well as the discipline/disciplines the horse is currently performing. The horse was warmed up using the "join up" technique and was trotted several times before asking to exhibit the trot for the video. If the horse was not eager to move forward or was excited and jumping forward, they were warmed up until a natural trot was performed. Then, in front of a stationary video camera, the horse was asked to perform the trot in hand. The horse was approximately 3 meters from the camera. The location of the performance was in an arena approximately 68.5 meters long by 45.7 meters wide and had metal railing with the rails 49.5 centimeters apart. The trot of each equine subject was recorded using a steady video camera for approximately ten seconds each. After downloading the video to a computer, the video of each movement was broken down frame-by-frame and three points in a complete movement cycle were isolated: high point (where the horse's wither was at its greatest peak), low point (where the horse's wither was at its lowest peak), and middle point (the average between the high and low point; presenting as the reference, or horizontal point.). The frame-by-frame breakdown was then given to a civil engineer for analysis to determine displacement values for each horse. Through interviews with the horses' owners, riders, and trainers, it can be determined if a correlation in displacement values is found within horses of a specific discipline.

Civil Engineering

During this research process CAD technology was used to find and analyze the displacement of a horse's trot. The process started by taking close up pictures of the horse. These pictures were then imported into AutoCAD. This software is used to determine the displacement of the trot by using the fixed value between the metal railings as a standardized measurement. When finding the displacement, it can be visually shown that the displacement of the trot on three different pictures by including the green line and using the red line as a reference point. The process was repeated for each individual horse's three points of movement. The subsequent pictures were then used to create an analysis of the

displacement of each horse's trot and were compared to horses of similar disciplines to observe a correlation.

4. Results

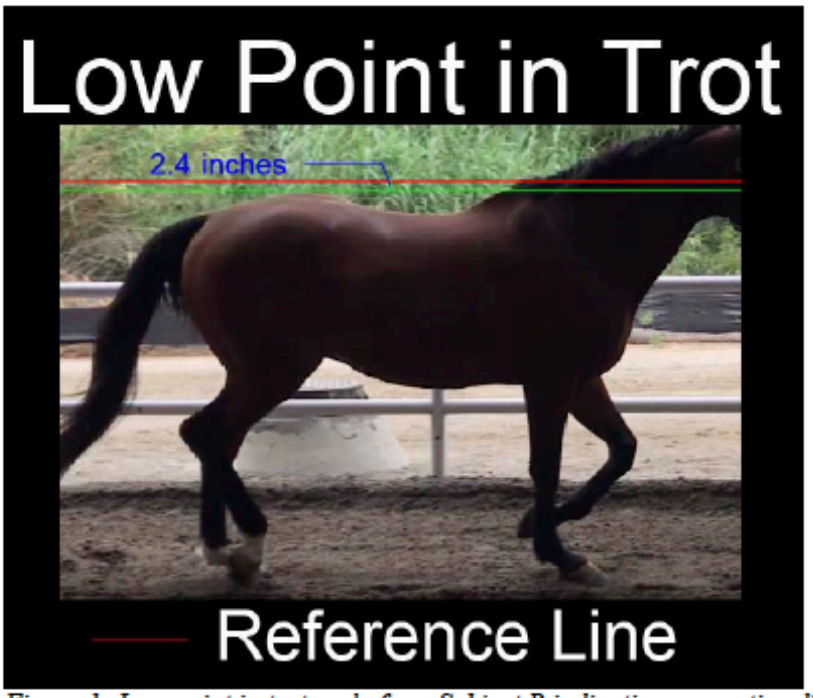


Figure 1: Low point in trot cycle from Subject B indicating a negative displacement

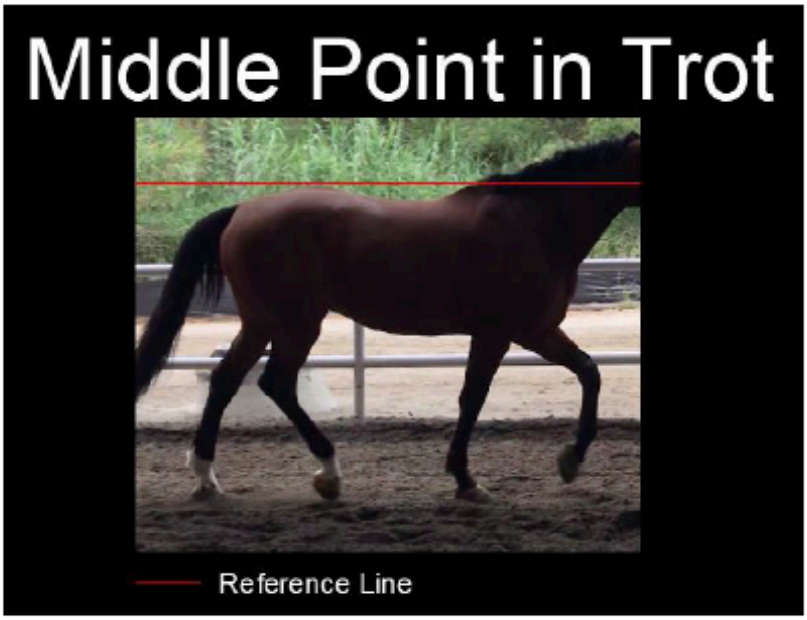


Figure 2: Middle point in trot cycle from Subject B which is used as reference line

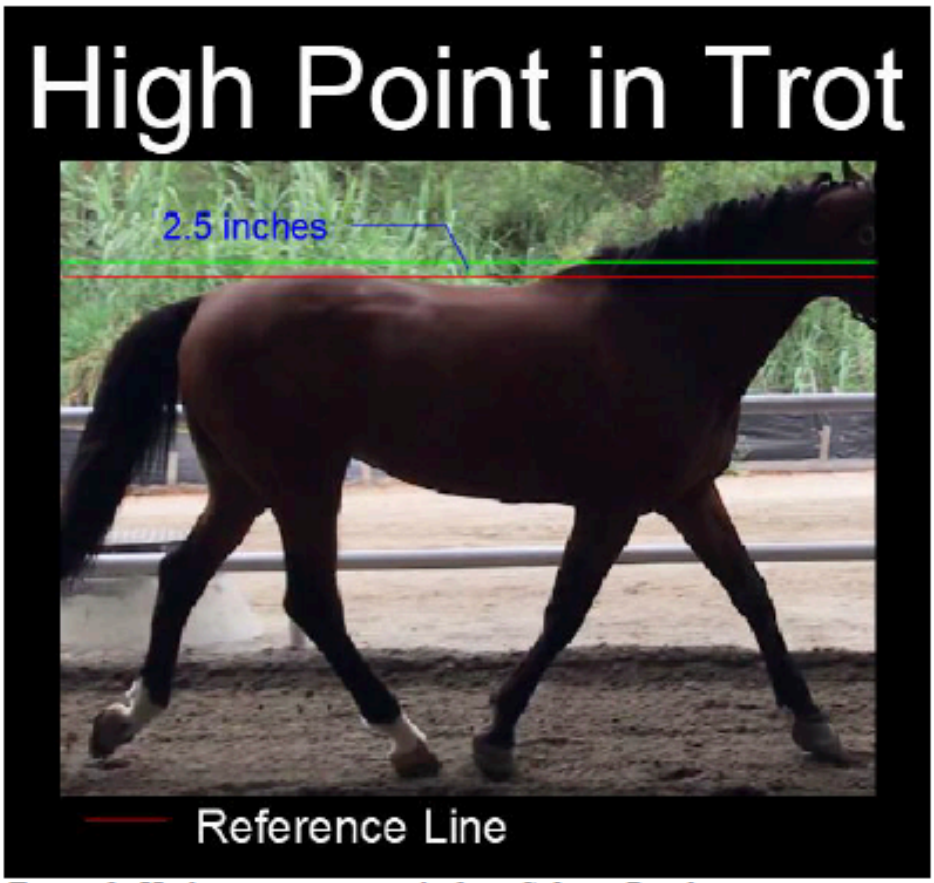


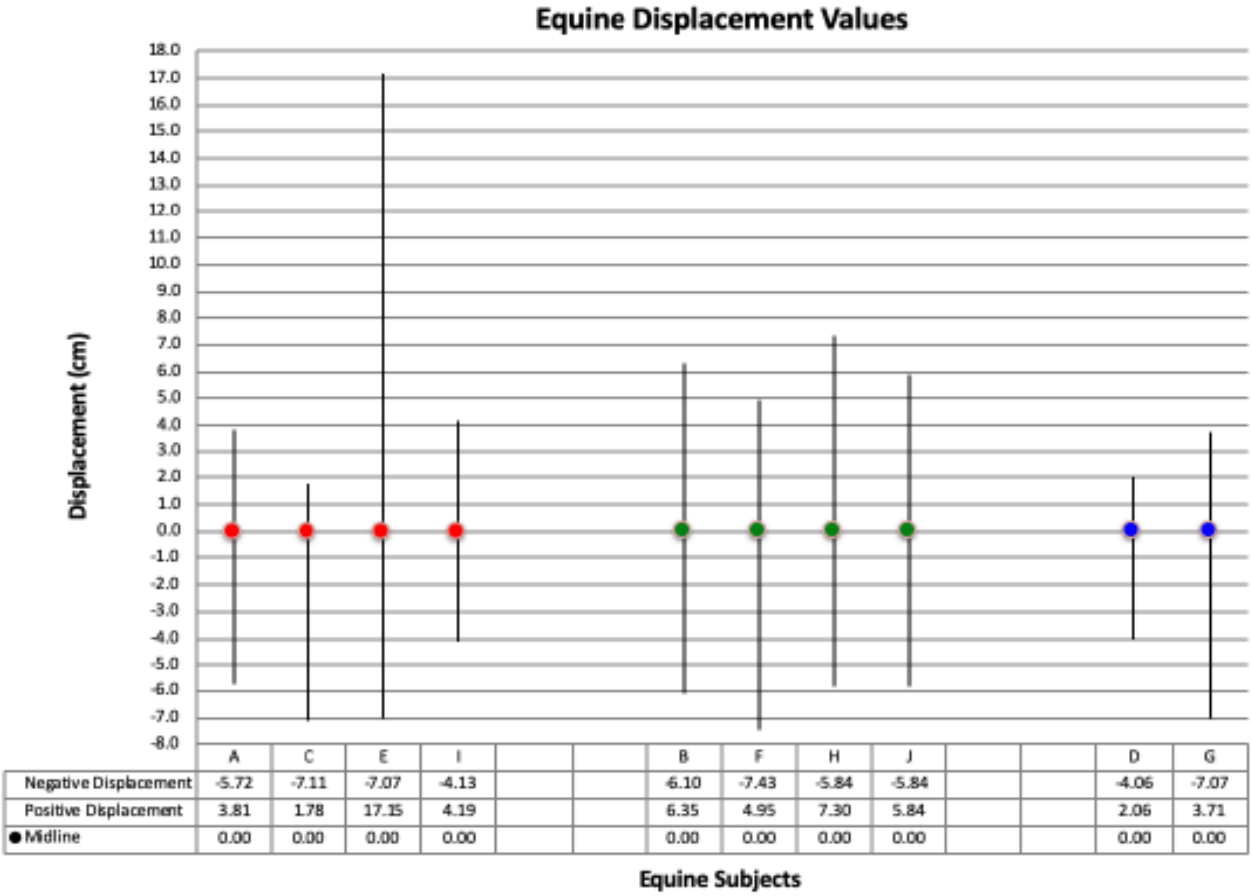
Figure 3: High point in trot cycle from Subject B indicating a positive displacement

Figures 1-3: Representative Subject B demonstrates a complete trot cycle with displacement analysis using AutoCAD software

Equine Research Data Date: Sunday, 29 July 2019

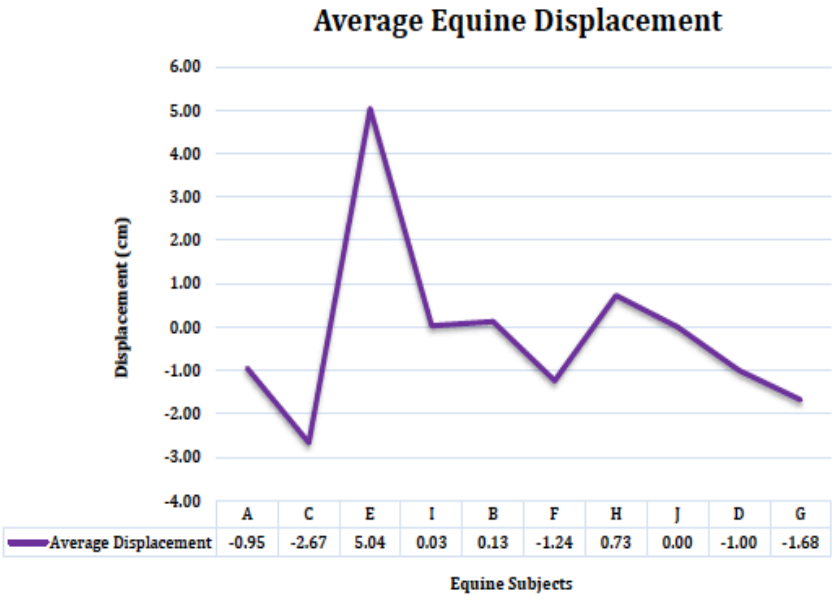
ID	Gender	Age (years)	Height (hands)	Breed	Disciplines Performed	Negative Displacement from Midline (inches)	Positive Displacement from Midline (inches)	Negative Displacement from Midline (centimeters)	Positive Displacement from Midline (centimeters)
A	Gelding	12	17.1	Dutch Warmblood (KWPN)	hunter/jumper/equitation	2.25	1.5	5.72	3.81
B	Gelding	13	16.1	Zangersheide	hunter/equitation	2.4	2.5	6.10	6.35
C	Gelding	10	17	Dutch Warmblood	hunter/jumper/equitation	2.8	0.7	7.11	1.78
D	Gelding	11	16.1	Danish Warmblood	hunter/jumper	1.6	0.8125	4.06	2.06
E	Gelding	10	16.2	Canadian Warmblood	hunter/jumper/equitation	2.785	6.75	7.07	17.15
F	Gelding	10	17.1	Hanoverian	3'6" equitation	2.925	1.95	7.43	4.95
G	Mare	13	17.1	TB/Dutch Warmblood	jumper/eventer	2.785	1.4625	7.07	3.71
H	Gelding	11	16.1	Westphalian	hunter/equitation	2.3	2.875	5.84	7.30
I	Gelding	29	13.2	Welsh Connemara	hunter/jumper/equitation	1.625	1.65	4.13	4.19
J	Gelding	14	15.3	Holsteiner	hunter/equitation	2.3	2.3	5.84	5.84

Chart 1: Chart of equines used in experiment with corresponding color-coded information



	A	C	E	I			B	F	H	J			D	G
Negative Displacement	-5.72	-7.11	-7.07	-4.13			-6.10	-7.43	-5.84	-5.84			-4.06	-7.07
Positive Displacement	3.81	1.78	17.15	4.19			6.35	4.95	7.30	5.84			2.06	3.71
● Midline	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00			0.00	0.00

Graph 1: Equine displacement values (positive and negative) exhibiting all equine subjects with disciplines indicated with colors from Chart 1



Graph 2: Visual depiction of average displacement for each equine subject tested; subjects are represented in same order as Graph 1

Discipline	Total Average
hunter/jumper/equitation	0.36
hunter/equitation	-0.10
hunter/jumper	-1.34

Chart 2: Total displacement averages of all equine subjects in each discipline(s)

5. Discussion

In this experiment, the subjects (n=10) were evaluated to determine possible displacement values using high point, low point, and middle point. All subjects are considered to be warmblood type horses that perform disciplines in English-specific riding disciplines. The three data points were individually exhibited when the horse went through a complete trot cycle. While every horse is specific, which accounts for outliers, there is a general trend that is shared between horses of the same discipline. Once analyzed, the best outcomes were in the hunter/jumper category. This was due to a general consistency of the data points and less variation of range compared to Subject E, the outlier, which was in the hunter/jumper/equitation category. Subject E had the greatest variation out of all ten subjects because the subject was most likely versatile in all English disciplines. Upon interview with Subject E's owner, it was discovered that Subject E was originally trained in dressage, an equine discipline that requires large and bold movements from the horse. This may explain the large displacement value for Subject E. However, another possibility for this broad range is there could conceivably have been recording or measurement errors in some part of the analysis.

It can be determined which individuals have a greater value to this study by looking into their show records. While all subjects have well-documented show records, several subjects in the hunter/jumper/equitation category stood out as ideal horses in their disciplines. Subject C has an extensive show record with results including top 5 ASPCA Maclay and USHJA National Derby as does Subject I who has taken young riders to numerous champion shows both locally and nationally. Furthermore, Subject B from the hunter/equitation category has shown in multiple hunter derbies with respectable placings. Therefore, when evaluating new horses, a higher importance should be placed on the values of subjects that perform exceptionally well in their selected disciplines. Overall, when using the completed analysis of the data and condensation of the data into a graph, a correlation in discipline and displacement values is observed.

Additionally, the data for each discipline set was averaged to determine average displacement values for each discipline for applications in future projects. As shown in Graph 2, there is a significant amount of variation in average displacement values for the equine subjects across the hunter/jumper/equitation discipline especially with Subject E. The equine subjects whose average displacement value is closer to zero indicates that horse performs the trot gait with an equal amount of positive and negative displacement. While the advantages or disadvantages are currently unknown, having a horse that performs a gait with equal displacement values might indicate a smooth ride for the rider and more appealing visual observation of the horse at work. By investigating a greater number of equine subjects, the average displacement values will be more useful for the public in choosing a specific horse for a certain discipline.

Conclusion and Justification

By discovering what riding discipline a horse might excel in at a younger age, producers can better select their next generation of horses for breeding. Prospective horse buyers can also determine whether a horse suits the discipline or disciplines that they wish to ride in either leisurely or competitively. Lastly, trainers can use this application of displacement to determine what riding discipline they should begin training the horse in. Early identification of a horse's movement can help breeders in the equine industry isolate specific horses to be used for breeding and riders/trainers can select horses to be used for competitive purposes to further advance the breed. Additionally, the horse owner can decide what type of training to put their horse in. This can help save the owner money by not paying a trainer to teach a horse a discipline that the horse will never excel at due to improper body movements for that discipline. Generally, using a displacement of movement application can save everyone invested in a horse, time and money.

In the upcoming months, the equine subject types used will be expanded across all disciplines. Initially, the project will start with including evaluations of dressage horses. It is expected that they will exhibit larger displacement values since that discipline requires more expression in the movements. Additionally, it will be expanded to western horses. Within the western discipline, it is expected that those equine subjects will have lower displacement values since western disciplines generally require smoother movements. In the future, cold-blood horses (draft breeds) and hot-blooded horses (Arabian and Thoroughbred-type breeds) can be included to complete the displacement analysis across all horse breeds.

A future end goal of this research application is to have the displacement analysis set up for equine-assisted therapy centers. Therapy horses go through a long and vigorous process including a health screening, training in the new environment, and evaluation of temperament. If the horse passes the initial screening, the horse is ridden under saddle by a trainer associated with the therapy center to determine what type of movement the horse exhibits. While experienced trainers can feel subtle movements during rides, a mathematical analysis of a prospective horse's movement can help identify what types of horses are missing in a therapy program. Since different types of movement is more or less suitable for certain conditions, a therapy center needs to have a variety of equine movement types to best suit the client's long-term goals. Isolating which horses can fill these needs can provide well-rounded and patient-specific care to enhance current and future equine-assisted therapy treatments.

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Romantic Relationships Without Borders: Understanding the Experiences of Undocumented

Abstract

The citizenship status of a romantic partner plays a significant role in a romantic relationship. Laura E. Enriquez (2017) conducted a study in which she explored how citizenship status influences experiences in romantic relationships among undocumented Latina/o immigrants. The results of the study showed that undocumented immigrants faced risks associated with fear of deportation, legal employment, driving, and travel. In addition, the study's results demonstrated that due to the financial limitations associated with citizenship status, heterosexual men stop dating or delay marriage because they fear not meeting the traditional role of being the family's primary financial provider. Previous research has not focused on the community of undocumented college students. Further research on the experiences of undocumented college students will bring more awareness to the challenges that they face on a day-to-day basis. The purpose of this qualitative study is to explore the experiences of undocumented college students in romantic relationships. The questions that will be examined through this study are: how do undocumented college students navigate through romantic relationships? what kinds of challenges do they experience? and how do they cope with these challenges? In this study, I anticipate to recruit ten (N=10) undocumented (DACA or AB-540 student), undergraduate students who identify as Latina/o and are in a romantic relationship. Participants will be recruited through the university's Dreamer's Center. They will take part in a one-on-one semi-structured interview. The interview questions will pertain to the participants' experiences in romantic relationships. Interviews will be audio-recorded, transcribed, and analyzed. One expected finding for this study is that men's decision-making in romantic relationships will be more significantly influenced by their citizenship status in comparison to women. In addition, I expect to find that participants will share similar experiences associated with the limitations they face in romantic relationships. This study's findings will give an insight into how undocumented college students behave and feel in their current or past romantic relationship(s) given their citizenship status. Also, the study's findings will allow members of this community to further identify with and support one another.

Researchers found that there are different factors contributing to the effectiveness of a romantic relationship or potential relationships (Stephanou, 2012). Emerging adults attribute romantic love, effective communication, and honesty-loyalty to a good relationship (Stephanou, 2012). Couples who attribute the effectiveness of their relationship to their own and their partner's positive dispositions, like honesty, love, and effective communication, increase the possibility of having a good romantic relationship (Stephanou, 2012). Perceiving and displaying acceptance, respect, listening, trust, and care is highly important in maintaining a good relationship (Stephanou, 2012). Self-disclosure is also associated with relationship satisfaction (Sprecher and Hendrick, 2004). Talking to one's romantic partner about intimate feelings, attitudes, and experiences is what is considered another key factor to reaching a good quality romantic relationship (Sprecher and Hendrick, 2004). College students in committed romantic relationships engage in less risky behaviors and experience fewer health problems (Braithwaite, 2010). Relationship satisfaction among immigrant Latino couples is often influenced by the risk factors associated with legal status (Falconier, 2013).

Immigration laws create economic and social restrictions that affect the social interactions of undocumented immigrants (Enriquez, 2017). The current literature about romantic relationships excludes the experiences of non-citizen college students. The purpose of this study is to explore the experiences of college students in romantic relationships based on their citizenship status.

Emerging adults experience higher levels of happiness when they are involved in high quality romantic relationships (Demir, 2010). Being in a romantic relationship has certain benefits for college students. Reports show that college students who are in a committed relationship engage in less risky behaviors compared to single college students (Braithwaite, 2010). Individuals who are romantically committed to a single person are more likely to dedicate their time to their significant other than engage in risky behavior, such as binge drinking or having multiple sex partners (Braithwaite, 2010). Engaging is less risky behaviors also help college students avoid any stress that could potentially lead to health problems (Braithwaite, 2010). The social support that the students perceive from their romantic partner may be a significant contributing factor to their well-being (Demir, 2010). The quality of romantic relationships is an influential factor to consider. Romantic partners are at the top of the hierarchy of individuals' close relationships (Demir, 2010).

Women are naturally more concerned about the future of their relationship than men (Sakalli-Ugurlu, 2003). For men, the possibility of a future long-commitment is based on their feelings of satisfaction with their current relationship (Sakalli-Ugurlu, 2003). Men are expected to play the role of decision-makers and initiators (Sakalli-Ugurlu, 2003). They are mostly concerned with the present happiness, enjoyment, and satisfaction in their romantic relationships (Sakalli-Ugurlu, 2003). Men must meet gender expectations and be happy with their relationship before they begin to think about a potential future with their romantic partner (Sakalli-Ugurlu, 2003). Individuals with high relationship self-efficacy report stronger beliefs of being capable of meeting the demands of their relationship (Riggio et. al, 2013). Feelings of self-efficacy in romantic relationships are associated with relationship commitment, happiness, and investment (Riggio et. al, 2013). Individuals who feel capable of meeting the task demands in their relationship are likely to be satisfied with their relationship and expect commitment (Riggio et. al, 2013). Besides meeting these expectations, there are many couples constantly battling other expectations presented by society such as the challenges that come with interracial dating.

Interracial dating continues to be a challenging phenomenon in our society. A study reports that professional heterosexual Latina and Black women prefer to date someone of their same race (Garcia, 2015). A same-race partner may represent someone who has gone through similar experiences (e.g. racial discrimination) and who can be of emotional support. Latina women demonstrated to be most likely to engage in interracial dating, in comparison to Black women (Garcia, 2015). Most women of color express that they would rather date a man of color than a white man (Garcia, 2015). Further, Latina/o's may preference Latina/o partners because they share their same cultural background and may possibly be more understanding of their immigration status (Enriquez, 2017).

For many couples living in the U.S. today, citizenship status represents a big conflicting component of their relationship. About 16.6 million people are members of

mixed-status families composed of documented and undocumented immigrants and U.S. citizens (Enriquez, 2015). Undocumented immigrants face an array of risks due to fear of deportation, legal employment, driving, and travel (Enriquez, 2017). In addition, most undocumented immigrants who are employed face exploitation, minimum wage, and inconsistent and limited hours (Enriquez, 2017). Traditionally, men carry the role of financial provider. Many negotiate this role while dating, but when they begin to consider marriage or forming a family their strategies are no longer effective (Enriquez, 2017). For this reason, some men stop dating or delay their marriage (Enriquez, 2017). This is the contrary for women. The financial limitations that women encounter do not disrupt their dating life or transition to marriage (Enriquez, 2017).

Before forming their own family, young undocumented immigrants must keep in mind all the legal limitations they encounter in their everyday lives and how these will affect their potential future family (Enriquez, 2015). Children of undocumented parents are dependent of their parent's economic instability and limitations (Enriquez, 2015). Among first-generation immigrant Latino couples, the male partner tends to hold on to more traditional gender roles, which often leads to higher psychological aggression (Falconier, 2013). When males follow the more traditional role of primary financial provider they often increase their own psychological aggression and create relationship dissatisfaction (Falconier, 2013). Latinas hold the traditional role of the family's emotional supporter. Latino couples could reach relationship satisfaction when both partners put common effort to cope with stress and cooperate for the common good of the family (Falconier, 2013).

The previous literature shows that relationship satisfaction is influenced by different factors that come from within the romantic partners and other external influences. However, there is limited research on relationship satisfaction among undocumented college students. This study will aim to bring attention specifically to the population of undocumented college students in this area of research. The questions that will be examined through this study are: how do undocumented college students navigate through romantic relationships? what kinds of challenges do they experience? and how do they cope with these challenges? The purpose of this study is to explore how citizenship status influences the romantic relationships of undocumented college students.

Method

Participants

The participants in this study will be Latina/o non-citizen college students. All participants will have to be in a romantic relationship. The researcher will contact and request authorization from the coordinator of Cal Poly Pomona's Dreamer's Center. Upon receiving authorization, participants will be recruited from the Dreamer's Center via email and flyers. Emails will be sent to all members of the Dreamer's Center. The email will indicate the requirements that must be met to be able to participate in the study. The requirements will be: being an undergraduate student at Cal Poly Pomona, be Latina/o, non-citizen (DACA or AB-540 student), currently in a romantic relationship, and romantic partner can be citizen or non-citizen. In addition, flyers will be posted inside the Dreamer's Center. Both the flyer and email will contain a brief description of the study, a list of the requirements for participation, and the researcher's contact information.

Data Collection

Demographic Questionnaire. A qualitative method will be used in this study. For data collection, the researcher will conduct interviews. Participants will be asked to fill out a consent and demographic form and be a part of a one-on-one semi structured interview. The demographic form will request information about the participant and the participant's romantic partner. Some of the information requested will include: age, ethnicity, class status, country of origin, parent's citizenship status, how long they have been dating with current partner, current partner's gender and occupation, etc.

Semi-structured Interview Protocol. All participants will be asked a total of 10 questions. The following are some of the questions included in the interview protocol: "What are the benefits of being in a relationship in the same/mixed citizenship status? Could you provide specific examples?" "Tell me about your thoughts and feelings about romantic relationships in college." "Where do you see your relationship going in the next 5 years?"

Procedures

The interviews will take place in laboratory room located in the College of Letters, Arts, and Social Sciences building on Cal Poly Pomona campus. This room is under the supervision of a faculty member. Participants will first be asked to read and sign the consent form. Once each participant has read, understood, and signed the consent form, the researcher will pick up the form and the study will begin. To begin the study, each participant will be asked to fill out the demographic form. Once the participant is done filling out this form the researcher will collect it. Before starting the interview, each participant will be asked if it is okay for the researcher to record the interview. Each interview will last 45-60 minutes. In addition, during the interview the researcher will take notes using pencil and paper. All the recordings and notes taken during the interview will be kept safe in the researcher's computer.

Findings

Data Analyses

In this study, eight participants of Guatemalan and Mexican nationality, ages 19 to 29, were interviewed. The study incorporates both males and females with college-level education. Table 1 displays the participants' demographics, including, their age, gender, country of origin, major, sexual orientation, and length of the relationship they are currently in.

Table 1.

Participant	Age	Gender	Country of Origin	Major	Sexual Orientation	Length of Relationship (in years)
1	21	Female	Mexico	Business Administration	Heterosexual	2
2	21	Female	Mexico	Political Science	Heterosexual	1.4
3	21	Male	Mexico	Business/ MHR		2
4	29	Female	Mexico	Architecture	Heterosexual	1.7
5	21	Male	Mexico	Computer Engineering	Heterosexual	3
6	19	Male	Guatemala	Plant Science	Heterosexual	7 months
7	26	Female	Mexico	Psychology	Heterosexual	4
8	25	Female	Mexico	Sociology	Heterosexual	1.6

All the participants are involved in heterosexual relationships. Most reported that they met their romantic partner in college. A few participants stated they met their partner through social media and dating apps. In addition, seven out of the eight participants are currently dating an individual who identities as Latino/a. One participant is dating an individual that identifies as White. Also, seven out of the eight participants are in a relationship with an individual of a different citizenship status, meaning their partners are U.S. citizens. Six of the eight participants reported they had at some point dated someone of the same citizenship status as them. All the participants identified as DACA.

The semi-structured interviews that were conducted lasted an average of 30-50 minutes. Thematic analysis was done by transcribing each interview verbatim, coding each transcript, and developing themes based on the codes. The themes found show many similarities in the experiences between genders.

Travel Limitations

All participants stated that the aspect of traveling was a challenge to them as an individual and in their romantic relationship. A female participant mentioned, "The challenges right now that me and my boyfriend have is that he has a lot of family in Mexico…I'm not able to go to Mexico, …he and I like struggle a lot." Participants mentioned that they have to limit themselves on the places where they can travel to. If they travel outside the U.S., they put themselves at risk of not being able to return. They mentioned how they experience fear even traveling inside the country. A male participant stated, "…whenever I tell my parents, oh, I want to go to San Diego, and they're instantly, no, that's too dangerous."

Marriage is not for papers

Participants reported that they are aware that marrying a citizen would help their citizenship status. However, they stated that that is not the reason why they want to marry someone. A male participant said, "…I'm not one to really just get married for a paper. Like I actually want to feel the whole works of the term love." Participants also mentioned that many people around them often mention that they should marry a citizen so that they can fix their situation quicker, but, again, they do not seek marriage to become U.S. citizens. A female participant said, "…not partners of mine, but friends, they think that you're like trying to get with someone that is a citizen because you want to like get hitched for their citizenship, which is not true."

Supportive romantic partner

All participants mentioned that their romantic partner provided them emotional/ academic support. They stated that through difficult situations and in moments of accomplishment their significant other gives them support. A male participant said, "…then there's, yeah, the, definitely the support. Like she tells me how proud she is of me and that feedback is like, so important." Besides providing emotional support, their romantic partners also support them in their academics. A female participant stated, "It goes from him being my partner into my tutor."

Status conversation with partner

Participants stated that having the conversation about their undocumented status with their partner was a challenge. They stated it is a challenge to know when it is the right time

to talk about it and how to do it. A male participant mentioned that he reached out to someone, going through a similar situation, for advice. He said, "Um, I remember before I told her, I asked one of my friends who is also undocumented, who is also dating someone…how did you even tell her?" Participants also fear how their romantic partner will react. A female participant stated, "There are people who will purposely try to like, um, harm you using that…so it didn't come up until like, …maybe like a month or two." They fear that their partner's reaction to finding out about their undocumented status will be negative.

Identify with undocumented partner

The participants who dated an individual with the same citizenship status said that they were able to identify with them more. They mentioned that because they were going through a similar situation, they understood each other better. A male participant mentioned that while he dated an individual who shared his status, he felt like he was able to be more himself around her. He said, "There's like that connection, … I think you feel more like at home you feel more liberty to be yourself in a way." A female participant stated it was easier to communicate with the individual who shared her same citizenship status, "Like it was really easy to talk to him because he understood like…he knew he had the same struggle as me."

Uncertain future

Given their citizenship status, participants stated that their life here in the U.S. felt uncertain. They said there was that continuous fear that any given day their life could completely change if for any reason they had to go back to their home country. A male participant said, "… I just didn't know what was going to happen in my life either, you know, because it's a possibility that like I could leave one day." The uncertainty of their situation could potentially affect their relationship too because if they were sent back to their home country it would lead to a forced separation between them and their significant other. A female participant stated, "…you're never sure that the next two years are going to be a guarantee… And of the conversations that came up is like 'oh, well if you go to Mexico, then I'll go visit you'… but it's not the same."

Discussion

Undocumented immigrants face many obstacles and risks in their day-to-day lives. The community of undocumented college students is a small community that shares some of the same experiences in their romantic relationships. One of the limitations encountered in this study is that all the participants identified as heterosexual, which could have limited the variance in the participants' experiences in romantic relationships. Future studies could incorporate participants in homosexual relationships to expand the knowledge on their experiences. Another limitation is that all participants identified as Latino/a, which narrows down the data to this specific cultural group. Future studies could focus on other ethnicities to see the different experiences of different cultures.

The findings of this study show that both male and female face similar obstacles, challenges, and have a similar support system. Their citizenship status has a great influence in their daily activities and their future. Their status creates fears, doubts, and instability that are brought into their romantic relationship and they have no choice but to learn to live with them. Despite the many barriers that their undocumented status sets, these individuals hold on to persistence, hard work, and optimism to overcome these barriers.

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Teacher Self-Efficacy: Teaching Dual Language Learners in Different Early Childhood Settings

Abstract

It is critical that early childhood educators receive professional training and resources to support multilingual children, since about 60% of dual language learners under the age of five are in California (Zepeda et. al., 2020). Unfortunately, planning and guidelines for DLLs differ depending under which agency the ECE program falls under, which contributes to the regulations an educator has to follow. (Nemeth, 2012). The purpose of this comparative study is to evaluate teacher self-efficacy and beliefs across 5 different early childhood programs, including (1) family childcare, (2) head start, (3) center-based care, (4) Dual language kindergarten classroom, and (5) a mainstream kindergarten classroom. A mixed-method analysis which included a survey, questionnaire and observation were used to understand the beliefs of educators and their competency when teaching DLLs. A teacher disposition framework was used to guide the analysis of this study to look at educator's attitudes, perceptions, and beliefs, when working with DLLs. We found that early childhood education (ECE) teachers believe language and culture, especially family engagement, was crucial for a DLL's development. Despite these beliefs, our analysis found that ECE teachers would benefit from professional development as they continue to advocate for DLLs, by reflecting it in their practices. The findings from this study emphasize a need for policy and institutional support for ECE teachers to continue obtaining professional development to be better able to support multilingual children and their families.

Key terms: Dual language learners, teacher self-efficacy, teacher dispositions, funds of knowledge

Dual Language Learners (DLLs) are defined as "children, birth to age five, learning two or more languages simultaneously or learning a second language while developing their home language (Office of Head Start, 2008)." In California alone, "60% of children, age 5 and under, are dual language learners (Zepeda et al., 2020, p 1). According to the U.S Census Bureau, there will be a rise of DLLs' from 20-40% by 2030 in kindergarten, yet even higher in early childhood programs due to immigration and birth rates. Both language and culture define a DLL's life, that promotes a multilingual identity and successful education and professional paths (Zepeda et al., 2020). Although, many districts offer dual language immersion or bilingual programs for K-12 classrooms, there is a lack of early childhood programs offered to young dual language learners. Research demonstrates that failure for early exposure "Pre-K settings that do not support home language maintenance and development can have a negative impact on DLL"s Even though there is a rise in multilingual children in the classroom, there is still a lack of professional training for early childhood educators that discusses the importance of bilingualism (Magruder et al., 2013). Additionally, there is a lack of state requirements for ECE educators who work with dual language learners and their families, such as training and college coursework (Whitebook et al, 2006). It is important that ECE teachers build their practices to "reflect the fact that language and culture are intertwined and are fundamental" to the child's learning (Zepeda et al., 2020, p 3). The more opportunities DLLs have to express themselves in their home

language in the classroom, while also learning English, it will help them process and comprehend the information more effectively (Fillmore, 1991; Shanahan & Shea, 2012.) By supporting the child's oral language, this will lead to higher literacy skills and higher self-confidence to participate and share ideas (Spira et al., 2005; as cited in Shanahan & Shea, 2012).According to Dual Language Learner Policy Platform, educators can further support DLLs by using "an intentional language approach, appropriate child assessment, and a prepared workforce (Zepeda et al., 2020, p 5)."

Due to the broad programs available to families in early childhood, it is important to take a closer look at each program individually, including preschool, center-based childcare family childcare, and elementary settings, to be able to qualify them as high-quality programs for DLLs. By doing so, one can understand teacher self-efficacy in teaching dual-language learners and implementing appropriate strategies to further enhance their learning, in an early childhood education setting. Additionally, by looking at teacher competencies, it is important to understand how dispositions correlate with the educator's ability to "effectively interact and instruct DLLs. Dispositions apply to the educators "attitudes and reactions" in relation to his or her daily experience working with children (Lopez et al., 2012)." Therefore, a teacher disposition framework was used to understand how educators reflected on their past experiences and interactions, and how that strengthened their knowledge and skills when working with DLLs. The study primarily focused on the educational and professional training of the teachers, instructional strategies and tools used when working with DLLs, and beliefs on language and culture pedagogy. The purpose of the study is to capture early childhood teacher's competency in supporting the dual language learner's learning experience, as well as the possible professional development that could help them create high-quality programs for their students.

The comparative study will focus on the following research questions:

(1) How do early childhood educator's beliefs influence how they support their dual language learners?

(2) How has professional training expanded their knowledge on effective practices with DLLs?

Preschool/Head Start Setting

Children who are DLLs, tend to be ethnic minorities and from a low SES, and are observed to be in classrooms that are not high-quality programs. Data from the State of Preschool Report, states that 8% of 4-year-old are enrolled in head-start programs, 32% are in state-funded public preschool programs, and 3% are enrolled in federally funded special education programs (Baker & Paez, 2018). Research shows that preschool teachers implement "basic or low-quality language and literacy instruction," especially when implementing linguistically supportive practices. According to the Office of Head Start and its Program Preference Standards, it can be used a resource to improve DLL learning, yet many teachers continue to struggle in adapting the curriculum to fit the child's needs (Baker & Paez, 2018). It is important to for an educator to reflect on their beliefs in language in culture because it plays a big role in creating the classroom environment (Sawyer et al., 2012). Furthermore, a challenge that is observed in preschool settings, is that policies and guidelines vary from program to program (Baker & Paez, 2018).

Center-based childcare

Research demonstrates that due to a high number of DLLs to come from poverty, children whose home language was Spanish, had low enrollment in center-based ECE than children whose families used English as their primary home language. Therefore, home language influences the choice of care (Liang et al., 2000). In addition, studies have shown that early childhood teachers have a greater knowledge in literacy practices than family-based care, yet do not show change with professional development (Neuman & Cunningham, 2009; Peisner-Feinberg et al., 2014).

Family Child-Care

Family child-care is a popular choice for certain families due to lower costs and is critical for children because longer care hours are needed due to the parent's high work demands (Austin et al., 2011; Ota & Austin, 2013). According to the California Department of Education, Early Learning and Care Division (2019), 60,176 children are in family childcare settings, with 14, 661 infant and toddlers being the largest group. Therefore, looking at California's demographics of children, such as the infants and toddlers, DLLs make up a large portion in home-based settings (Blasberg et al., 2019) . Research shows that it is important to create connections between the home and child-care literacy environments, to improve a child's language and literacy development. In addition, teacher-interactions promote cognitive skills, including communication, especially if there is exposure to language opportunities (Bryan et al., 1994; Weigel et al., 2005). Although family child-cares have the potential to promote language development, there are failing factors due to poor language stimulation, and lack of professional training to enhance the linguistic environment. (Dowsett et al., 2008; Ota & Austin, 2013).

Elementary Setting: Kindergarten

Studies demonstrate that there are high achievement gaps between Hispaninc DLLs, compared to non-Hispanic White children when looking at reading, language, and math screenings in kindergarten. Yet, more importantly, immigrant Hispanic DLL's struggled the most compared to native-born Hispanic DLL's (Garcia, 2015). This stresses the importance that educators need to support both native language and enhance academic language. Through the outcome of home language surveys and English proficiency assessments, children are then classified in order to be given the appropriate language support, such as structured English verbal instruction or entering a bilingual program. The problem arises when reclassification, placed into mainstream classroom or being given a different language support, occurs. In mainstream classroom, educators tend to favor English-only instruction or challenge DLL students before they are ready by misinterpreting proficiency in oral language rather than in academic language (Williams, 2014).

Elementary schools have established certain bilingual education models to encourage native language and English acquisition, such as dual-immersion. These programs are offered in a 90/10 model (90% instruction in language other than English/ 10% instruction in English model) or the 50/50 model. Research shows that DLLs work better in a program that both supports their home language and is exposed to English. Educators in dual immersion settings tend to express the importance of family involvement and home language to create real-life connections and promote vocabulary (Williams, 2015).

Variation in Early Childhood Programs

Although there is a rise in high-quality programs for early childhood settings, many practices still lack the inclusion of dual language learners. The California Quality Counts (QC) initiative has improved early programs but has failed to included content specifically to DLLs, by placing them under a supplemental group, especially the fundamental role of language and culture that comes with the child (Zepeda et al., 2020, p 8). When looking at elementary settings such as kinder and TK, the EdGE Inititaive (Education and Global Economy) provided more access to bilingual programs yet, fails to support DLLs, since it "stresses English language acquisition over bilingualism (Anderson, 2012)."Additionally educators receive Multiple-subject teaching credentials which offers bilingual authorizations that cover "language abilities for the target language, knowledge of appropriate pedagogical and assessmenthistorical context of the target language group." But, because of the young age group, educators must provide age-appropriates materials and curriculum to DLLs. (Zepeda, 2017)." Next, educators who desire to be teachers in early childhood programs such as preschools or center-based settings, a Child Development Permit is required. Yet, the permit requires no units of coursework that covers language development for DLLs (Zepeda, 2017). The DRDP supports young children through two domains, language and literacy, and English Language development. Children are supported in areas of listening, speaking, reading, and writing to further promote native language and second language development (English) (California Department of Education, 2012). Due to the range of support and limitations presented in each early childhood setting when teaching DLLs, educators may struggle to acquire proper qualifications and to find appropriate methods to approach DLLs.

Teacher Disposition Framework

According to The National Council for Accreditation of Teacher Education (NCATE, 2006), dispositions are defined as "professional attitudes, values and beliefs" of educators in which they reflect these through teacher-parent-child interactions and collaboration with colleagues and community. According to Katz and Rath (1985), dispositions are described as an educator's characteristics when engaging in day-to-day interactions with the children. By looking at dispositions, it enhances that "a teacher's awareness and attitudes towards cultural diversity play a role. (Zepeda et al., 2020)". Due to the rise of multilingual children in the classroom, dispositions are now more important than ever, because educators must be anti-bias towards each child, to consider their strengths and view weaknesses as improvements. Educators should use a broad frame of reference, to create a larger purpose (Hallam, 2009)." By including a DLL's funds of knowledge, children will more likely participate and be engaged in learning.Teachers of dual language learners need to have specific teacher dispositions in order to have, "authentic cultural and linguistic responsiveness to young learners from diverse linguistic and cultural backgrounds (Zepeda et al., 2020). Dispositions such as (1) being continuously educated to build his or her knowledge on teaching DLL's, (2) building relationships with the child and family to increase cultural knowledge and family engagement into the classroom, and (3) advocating for DLLs and their families by reflecting on their beliefs in bilingualism, and language and literacy development as a key instrument to help DLLs overcome barriers (Zepeda et al., 2020)."

ECE Workforce

A study done on California's Early Childhood Education workforce demonstrated that "approximately 130,000 people care for children under the age of five in California; in Los Angeles County alone, this number is 36,310." This number included teachers, assistant teachers, aides, center directors, and family daycare providers (Whitebook et al., 2006). Surprisingly because there is no state requirement for early childhood educators working with Dual Language Learnings, many educators lack the professional training and relevant coursework. The study states the statistics of ECE educators to be significantly low.

> Statewide, only 45.9% of child care centers have at least one teacher who has participated in non-credit training and 36.4% with relevant college coursework… Statewide, licensed providers have either participated in noncredit training (12%) or college coursework (7%) related to dual language learning (Whitebook et al., 2006).

These numbers are primarily influenced by policy changes. Teachers are not prepared to work with multilingual children due to Prop 227. In 1988, Prop 227 required schools to teach only in English. Yet it was overturned in 2016, by Prop 58, which allowed non-English languages to be used in "public educational instruction" (Jacobs, 2019). There has been an up and down battle with policies supporting multilingual children in school settings. An educator's educational and professional experiences are crucial in order to reflect on their "cultural and linguistic differences practices" to effectively teach dual language learners (Lopez et al., 2012).

Methods

The 5 Early childhood Educators were recruited throughout Southern California for a mixed-methods study, that investigated their beliefs and attitudes towards teaching DLLs. It specifically focused on past education and professional experience working with DLLs, and strategies used to provide DLLs with rich learning experiences. Educators were either directly contacted through e-mail or were first contacted by their principal/ director. Participants were given a consent form, acknowledging voluntary participation to the study, and were given $50 gift cards after the research completion.

Participants

One lead teacher from each early childhood setting, including; (1) head start, (2) center-based care, (3) family daycare, (4) mainstream kindergarten, and (5) dual immersion kindergarten; were recruited to study their self-efficacy and beliefs in teaching dual language learners (see Table 1 for participant information). Table 2 demonstrates the demographic of the educators, including gender. ethnicity, language, and educational attainment. Participants were given a consent form and given $50 gift cards after the research completion.

Table 1

Description of Educators in each ECE Setting		
ECE Setting	**Participant**	**Summary of Teacher Dispositions to teach DLLs**
Family Daycare	*Yolanda*	*Education has helped gain knowledge when working with children, but has not received professional training in DLLs. By building trust and relationship with families and children, the DLL child will feel more comfortable.*
Center-based	*Kathy*	*Education and professional experience has promoted cultural awareness to work with DLLs, but has not had in depth training with DLLs. Communication with parent and bilingual staff collaboration is key when working with DLLs.*
Head start	*Rosario*	*Both education experience and professional training has impacted knowledge through continuous knowledge to work with DLLs. Families are the main tool when working with DLLs, and home visits.*
Mainstream Kindergarten	*Melissa*	*Education experience has made an impact when working with DLLs and using families as a tools to understand culture and language to further support DLL.*
DLL Kindergarten	*Socorro*	*Education experience such as teacher preparation in dual language classrooms and finding connections with families through questionnaires and discussions.*

Table 2

Teacher Demographics

Variable	N (Total of 5 participants)
Gender	
Female	5
Ethnicity	
Hispanic or Latino	4
White	1
Language Spoken (other than English)	
Spanish	4
Both Spanish and Chinese	1
Educational Degree	
A.A	1
B.A. or BS	2
Masters	2
Overall ECE units	
0-12	1
13-24	1
25-49	1
50+	2

Table 3 describes the educator's knowledge in working with dual language learners and education experience. Educators either stated whether or not they worked with DLLs, which 3 (60%) out of 5 educators stated they worked with DLLs. The percentage of DLLs in the classrooms varied, where 2 educators stated they had 0-9% DLLs, 1 educator had 21-40%, 1 educator had 61-80% DLLs, and 1 educator had over 81% DLLs in the classroom. Looking at education and professional experience regarding DLLs, 3 educators stated that they took course focusing on DLLs, while the other 2 educators did not. Finally, only 1 out 5 educators stated that they have not had any professional training with DLLs.

Table 3

Teacher Experiences with Working with Dual Language Learners

Work with DLL children?	
No	40%
Yes	60%
Percentage of DLL's in classroom	

0-9%	40%
10-20%	0
21-40%	20%
61-80%	20%
Over 81%	20%
Completion of a course focusing on DLL's	
Yes	60%
No	40%
Professional Training in DLL's	
Yes	80%
No	20%

Measures

A mixed-method was used to conduct the study in 5 different early childhood settings, which included, an interview and a survey created by the researcher, and a 1-hr observation. The interview focused on teacher background and hands on experience working with DLLs. Additionally, the interview was transcribed and examined for codes and themes. The survey was analyzed through SPSS for a descriptive analysis of 12 questions rating on a 5 pt. Likert scale (1= strongly disagree and 5=strongly agree). The observation required observing how teacher interactions and classroom environment supported the DLL student's learning using anecdotal notes. The notes were then reviewed for codes and themes.

Results

Responses to the interview questions were audio recorded, then transcribed and observed closely for codes and themes. The survey questionnaire was analyzed through descriptive statistics using SSPS, and online data tool. Since, this is a comparative study, some educators did not rate the "working with dual language learners" section of the survey because they felt that it did not apply to their teaching strategies or curriculum planning (4 out of 12 questions). Additionally, observations of teacher interactions and types of strategies used to promote learning with DLLs, were written in anecdotal format, transcribed, and reviewed for codes and themes.

Educator's beliefs in Multilingualism

Educator's beliefs in multilingualism is important when creating a culturally and linguistic pedagogy because it helps shift them away from traditional "monolingual guidelines," to build strong home-school connections, through language and culture (Lundberg, 2018) .Educators demonstrated strong support in building a foundation in child's native language when asked about their beliefs in multilingualism. "Comfort and confidence" are key attributes in helping children develop his or her native language in the classroom. Socorro stated that "Well my belief is that every child is capable of learning more than 1, 2, and 3 languages. You know…as long as they're both at an early age they are able to pick it up …because they absorb everything." Melissa continued with, "when I get kids that speak

Spanish I get parent's go "They are losing their Spanish because we aren't speaking to them in Spanish." And I say, "Please don't stop speaking to them." Because its part of their culture, if they lose it then they can't speak to their grandparents. It's really sad…..I think just to respect other people's cultures. And the kids really love it. They like to learn about, you know, other people's cultures, and it's important too to value it." Furthermore, Yolanda stated, "what you have to do is…you don't have to get rid of that language…you keep that language with the children." Finally, Kathy stated, "You have to meet the children where they are, whether its in Spanish or in another language."

Although not only promoting home language, some educators stressed the influence of bilingualism as a career advancement. Socorro stated, "I think it's very powerful. It's very…It's a great asset for these kids at being an adult that's multilingual." Melissa also said, "It's important in the world we live in now, that you know another language…you know just in your job and just the way we are developing as a world."

It's important to also reflect on one's own beliefs on how culture has influenced their teaching approaches to dual language learners. Rosario states the importance of being sensitive to the diverse cultures. She said, "I want to say yes because I know there are some things that maybe another culture might not be okay, like some words." Another teacher expressed herself similarly was Socorro, by saying, "It does and it doesn't. We'll have different terms and will always talk about how there's different terms for the same thing and how we value all those different terms.". Additionally, as a monolingual teacher and taking into consideration the change of demographics of the population, Kathy said, "one has to be open and accommodating to the children. Everything we do is connected to culture, I have to be sensitive and accommodate the family' s ways of doing things as much as possible."

Melissa described how losing one's language can create a barrier within families, "Yes. I think that language and culture is intertwined. I don't think it can be separated. If you lose your native language, how will you talk to your grandparents?"

Professional Training in Dual Language Learners

Furthermore, when discussing professional training and educational experiences each educator's background varied. Besides working in Dual Immersions settings, there were no specific requirements needed to work with DLL. For example, Socorro shared that, "We are sent to workshops and like I said, I'm taking a Dual Language class. It's at the University level." While Yolanda who isn't in a dual-immersion setting stated, "I haven't had any." Additionally, Kathy shared that she did not have any "in-depth training working with DLLs," but attends workshops on building relationships with families.

Also, teachers either gained experience through a teacher credentialing program or if they demonstrated a personal interest in the topic and sought support. Others like Socorro stated that her experience was, "I went through a BCLAD credential program." Melissa also referred to all her BCLAD courses but also stated that her district offered training, such as, "GLAD training which is Guided Language Acquisition Design, which is a lot of charts, a lot of pictures, telling them stories while you are drawing."

When asked about what types of support they would require furthering their understanding when working with multilingual children and families, the educators expressed the need of "continuing with research" and "taking specific courses that dealt with that topic on a continuous basis." Melissa added the need for finding ways to stress the importance to families by stating, "I think really educating parents on what's it about and showing them you know that the job market is out there." While Socorro took a different approach by saying a specific concept she struggled in teaching. She would need further "training on writing with dual language and being able to transfer language from their native to the target language." Kathy expressed that research based on monolingual educators working with DLLs would be beneficial and "learning techniques that are not just about repetition and pointing in English but making it meaningful."

Looking at the data in Table 4, it shows that the self-efficacy of the educators varied as they answered the survey on a 5 pt. Likert scale (1= strongly disagree to 5=strongly agree)(see figure 1 as reference). All educators strongly agreed that they helped their DLL student build their vocabulary with (SD)=.0 . The other area the educators felt most competent was that, they found it easy to assess and screen a DLL student so that they are not under or over diagnosed (SD=0.447). The majority of the educators felt effective enough to teach their children, by answering that the use of bilingual aides was not really necessary (SD = 1.34). Yet they did not feel experienced in scaffolding language, so that their DLL students can have easier comprehensions of the material demonstrating an (SD)=1.67. Another area most did not feel competent in was being able to provide effective feedback and corrections to their DLL student (SD=1.41). When answering the questions about dual language learners, some educators were influenced by the idea that "I am not a dual language classroom, so I do not have any dual language learners. I only teach in English." Or that, "most of them who come are English speakers, so even though they have exposure to Spanish it's not their true native language…they are not necessarily engaged in it."

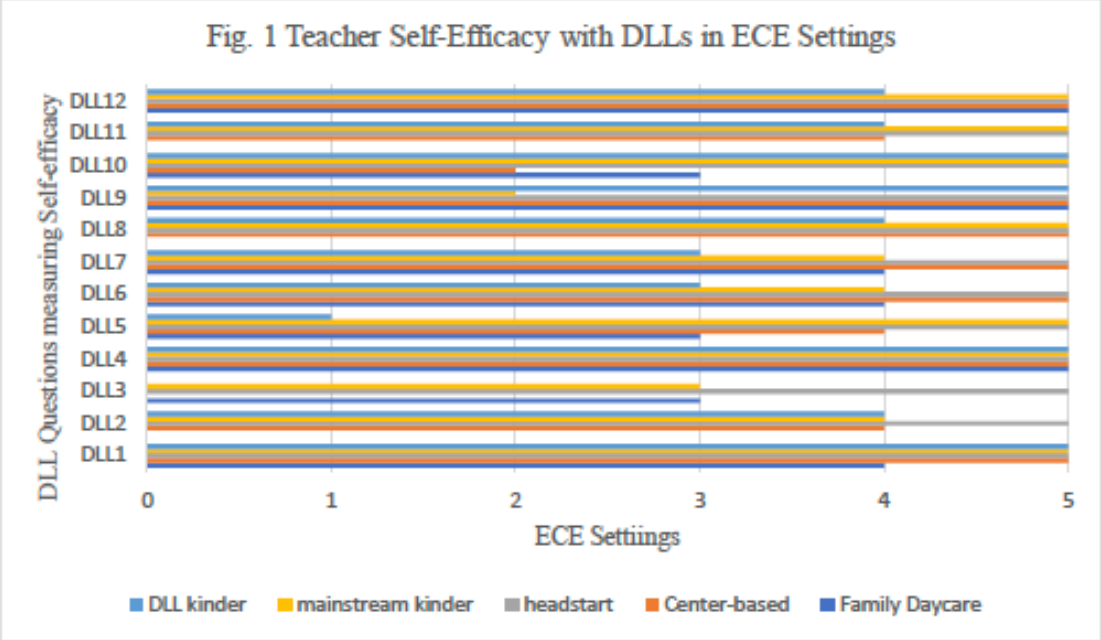
Table 3

Teacher Self-Efficacy with DLLs in ECE settings

Label	DLL questions	M	S(D)
DLL1	I feel prepared to work with DLL children and their families.	4.80	.44721
DLL2*	I find it easy to teach DLL children.	4.25	.50000
DLL3 *	I help DLLs improve their literacy development in their native language while to improve their English	3.6667	1.15470
DLL4	I help my students build their vocabulary	5.00	0.0000
DLL5	It is not hard for me to scaffold language, so that the DLL student can have an easier comprehension of the material	3.60	1.67332

DLL6	I find it easy to improve a DLL child's academic language	4.2	.83666
DLL7	It is not hard for me to teach my class when there are many DLLs in my classroom.	4.2	.83666
DLL8*	I feel capable at adjusting and modifying my lesson plan and teaching style for DLLs.	4.75	.5000
DLL9	I would feel more comfortable having assistance from a bilingual aide in my classroom, to make my teaching more effective.	4.40	1.34164
DLL10	I am capable of providing feedback and corrections to my DLL students.	4.0	1.41421
DLL11*	I feel that my classroom management strategies are effective when working with DLL children.	4.50	.57735
DLL12	I find it easy to work with other staff when assessing and screening a DLL student so that data is not misinterpreted, and he or she is not under or over diagnosed with disabilities.	4.80	.44721

**DLL questions with an asterisk (*) include educators who did not fill out a rating because they felt it did not apply to them.*



Looking at Figure 1, the head start educator, felt the most competent and effective when working with DLLs, especially as a dual immersion setting. In contrast, the educator in family daycare, did not feel as competent and effective compared to the other settings.

Strategies used in the Classroom

When working with dual language learners, educators stressed the importance of valuing each child and family's funds of knowledge in in order to promote his or her learning. Rosario stated, "bring in their music from where they are from and just make them feel comfortable as possible with things from home, and eventually they start picking up phrases and words." Yolanda also commented on family input, "interview the parents to see what their culture is, how do they live at home, what sort of things do they do there that might be able to bring to the classroom setting as well.

The educators also supported the use of visuals as a tool when promoting language development with children. Melissa said, "Engaging them is very important. Using pictures, like letting them draw out stuff. And a lot of oral expression." Her classroom included a variety of circle maps of the alphabet letters along with pictures to create picture-word connections. In the color words' circle maps, children were able to attach small items from home onto the paper to represent the color (ex. tiny blue lego= color blue). Socorro also states, "I try to make it very visual. Very colorful. Where they can use color to disseminate information." Along with similar circle maps like in Melissa's classroom, to promote writing skills, she color codes the story structure. As she tells a story, she asks who the character is, then before she writes on the board, she draws the image with the color orange. Then proceeds to write the name of the image in orange as well.

Another strategy, included collaboration with bilingual aides in the classroom. Most educator did not feel they needed an aide to make their teaching more effective, since they were already bilingual. Yet, Kathy stated, "having staff that were able to speak the languages of the children, was extremely helpful" because she feels its important to not give children the false perception that even though she knows basic words in other language, she does not want to seem that she will fully understand them. Also, Rosario, stated even though her program was dual immersion, she is grateful to have "2 bilingual aides" that further support her knowledge.

In order to create anti-bias curriculum, the types of assessments used with dual language learners are crucial, so that children are not being under or over diagnosed. Language should be closely looked at with each individual child. Socorro stresses the need to figure out the difference between a disability and a language delay by answering, "we always take into account, language takes 7 years, so especially when it's the production of language. Do they have the same mistakes or do they make the same errors in their native language?"

Adding to the production of language, Melissa goes on to say, "well for the little ones, of course looking at sounds. Their beginning sounds of letters and the name of the letters… and for Spanish I guess it would be syllables." By using tools to target phonemic awareness helps children promote language and literacy development. Socorro adds, "we use Estrellita for Phonics and that has really shown how they are really growing and understanding the breakdown from sounds to syllables to words."

Also, the DRDP involves both language and literacy development and English Language Development, which can further help understanding where a dual language learner lies. Socorro responds, “by looking at the receptive language…is he able to understand it, is he able to speak it, is he able to understand books being read.” Yolanda also states how she promotes language skills by, “reading books, having a lot of conversations. We talk to the children all day long, we talk adult-language, we don’t baby talk them or anything.”

Discussion

Professional training and development are mostly seen through dual-immersion settings, whereas in other ECE settings, workshops about working with dual language learners, aren’t the primary focus.

Additionally, there continues to be a misconception between English Language Learners and Dual Language Learners. Due to a variety of terms describing multilingual children, some educators still demonstrate confusion when labeling children appropriately. For example, some educators felt that because the ECE setting was not a dual immersion program the children in their classroom were not considered DLL. Also, some educators expressed the belief that because a child has a weak foundation in his or her native language, it labels them as English-speaking only.

Most importantly ECE educators expressed the importance of the impact of a child’s funds of knowledge when developing the curriculum, by integrating the use of visual aids. By focusing on enhancing language development, it served as a guide to finding appropriate tools and assessments for dual language learners. Also, family involvement is crucial to a DLL’s development, therefore, finding cultural and language connections can further support a DLL’s learning.

Limitations. The study primarily focused on a certain geographic area, therefore, other regions may pose different findings. Also, the primary language/culture of the children in the ECE settings were Spanish/Latinos, as well as the dual immersion settings. Looking at other demographics, and dual immersions programs reflecting other languages, besides Spanish, is important to get a better overall understanding of teaching dual language learners. The study also conducted only a small sample of educators working with dual language learners.

Further Research. There is a lack of research looking at teacher self-efficacy when teaching dual language learners, even though there is an abundant of research about tools that help teachers gain techniques.

By continuing to follow educators on how competent they feel in applying those strategies and tools into the classroom with dual language learners, it would be resourceful to understand ways to further support their knowledge. Most importantly it is crucial that educators are given the support in both their educational journeys and through professional development, in order to provide more resources for them to become more competent in teaching dual language learners.

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Neighborhood Council 'Talk Story': A Comparative Analysis of Planning and Land-use Influence by Neighborhood Councils in Los Feliz and Hollywood Hills West

Abstract

Beginning the late 20th century neighborhood associations emerged as key players in the governance of American cities. Today, Los Angeles boasts the largest and most formalized system of neighborhood governance, with 99 elected and publicly funded neighborhood councils. Scholars have investigated the role such councils play in affecting policy, improving social service delivery, and furthering democratic participation, And while the literature on Los Angeles neighborhood council system has both explored the historical context of its emergence and critically assessed its representativeness, there is a lack of in-depth research on the ability of neighborhood councils to influence land-use and planning decision making, and specifically how such influence is exercised. Using two of the city's most high-functioning neighborhood councils—Los Feliz and Hollywood Hills West—as a comparative case study, this paper investigates how neighborhood councils leverage social and political capital to influence planning and land-use decision making at the city level. The authors' findings offer key insights as to the challenges and opportunities of achieving equity and democracy in neighborhood governance.

Research Question

How do high-functioning Neighborhood Councils influence planning and land use decision making?

Literature Review

Bherer, Laurence. 2010. "Successful And Unsuccessful Participatory Arrangements: Why Is There A Participatory Movement At The Local Level?." Journal of Urban Affairs 32(3):287-303. Retrieved (http://file:///home/chronos/u-6ab56b5fae2b0f0b335873af120aff30f1469ea7/MyFiles/Dow nloads/Research%20assistant%20/Successful%20 and%20 Unsuccessful%20participatory% 20arrangements%20(1).pdf).

Bherer examines the reasons behind the participatory movements implemented by public authorities at the municipal level to gain residents participation by analyzing unsuccessful experiences in local governance. This study defines participatory movements as an all encompassing term for actions (successful or not) taken to form municipal governments that foster community involvement in local politics. Bherer questions the motivation for the city government to be inclusive of community members input during the policy making process. The 'governance approach' was used to analyze Bordeaux's input-oriented municipal government in 1995, and the participatory measures in legislation by qualitatively analyzing interviews conducted with participatory tools. The micro-level approach analyzed three main aspects: the neighborhood councils goals that were addressed, the target populations for the councils, and the goals of individuals implementing change in municipalities. Overall Bherer concluded that democratizing projects such as the one done in Bordeaux show higher level governments are encouraging local participatory movements. He urges that public policy making be analyzed byexploring the interweaving web of connections between multilevel governments.

Chemerinsky, Erwin, and Sam Kleiner. 2019. "Federalism From The Neighborhood Up: Los Angeles's Neighborhood Councils, Minority Representation, And Democratic Legitimacy." Yale Law & Policy Review 32(2):569-581. Retrieved (https://digitalcommons.law.yale.edu/ylpr/vol32/iss2/7).

Chemerinsky and Kleiner analyze the neighbourhood councils in the city of Los Angeles in order to provide constructive feedback by assessing the quality of their performance and inclusive engagement of historically disadvantaged minority groups. The authors stress the importance of measuring the quality of engagement in the councils rather than the quantity. The questions investigated include; what role neighborhood councils should play in city governance, how should the success and effectiveness of neighborhood councils be measured, and how are neighborhood councils fostering political involvement in minority communities? The researchers used a qualitative method through their analysis of the Douglas Houston and Paul Ong Study (2004) and assessing the councils success in influencing city governments to act on their proposals and concerns. This was expanded on through the exploration of a case in 2004 where neighborhood councils mobilized to defeat the cities proposal to dramatically increase the water prices. In closing, Chemerinsky and Kleiner suggest an early-warning system where the city councils inform neighborhood councils with ample time to mobilize and plan for actions being taken by the city. Lastly, the article emphasizes the importance of providing an arena for underrepresented minority communities access to representation that they historically have been excluded from.

Cooper, T. L., & Musso, J. A. (1999). The potential for neighborhood council involvement in american metropolitan governance. International Journal of Organization Theory & Behavior, 2(1/2), 199–232. https://doi.org/10.1108/IJOTB-02-01-02-1999-B008

This paper examines the role that neighborhood associations might play in helping to govern American cities. In contrast to recent arguments that there has been a decline in grass-roots level “social capital,” the empirical evidence suggests that local neighborhood associations are growing in number, and are increasingly active. We discuss the theoretical foundations for involving neighborhoods in governance, and argue that informal associations can mediate between citizens on the one hand, and large-scale bureaucracies and businesses, on the other. In addition, a formal system of associations may encourage discussion among fragmented neighborhoods, which in turn could improve conflict negotiation and develop mutual understanding. We argue that a major impediment to the development of a neighborhood council system in Los Angeles has been a lack of information about existing neighborhood-based associations, and discuss an ongoing initiative to develop a comprehensive base of information regarding neighborhood associations in Los Angeles.

Historical framing of LA’s City Charter reform (and establishment of the NC system) as a response to lack of communication between city government and spatially disparate neighborhoods. There are useful quotes from those who advocated for the creation of the current system. Conclusion offers insight as to problems posed by having no clear definition of “neighborhood” or “neighborhood organization” in the

Jun, K.-N. (2007). Event History Analysis of the Formation of Los Angeles Neighborhood Councils. Urban Affairs Review, 43(1), 107–122. https://doi.org/10.1177/1078087407302123

This article investigates the impacts of community contexts such as divergence with the city, differences within the community, and community capacity on the successful formation of Neighborhood Councils (NCs) in the City of Los Angeles. To date, 86 certified NCs out of 97 communities submitted applications for certification. Event history analysis is conducted as an effective method to understand NC formation and the timing of the event. The results indicate that community heterogeneity characteristics such as race/ethnicity and income heterogeneity have dissimilar influence on the formation of NCs. Community capacity is also found to be positively related to earlier formation of NCs.

The author's theoretical model of group formation emphasizes three sets of community characteristics: 1) divergence with the surrounding city; 2) diversity within the community and 3) community capacity. The first is perhaps most relevant to my work, as it asks whether neighborhood council formation (and perhaps for my paper, NC influence) is a result of a high level of divergence between the median voter of the area and those of the larger administrative jurisdiction. To measure this, the authors use proximity to the median household income as a proxy, which assumes that the average (median income) voter agrees with the resource allocation decisions of the city. My study can add more nuance to this through qualitative methods.

Kathi, Pradeep Chandra, and Terry L. Cooper. 2005. "Democratizing The Administrative State: Connecting Neighborhood Councils And City Agencies." Public Administration Review 65(5):559-567. Retrieved (http://file:///home/chronos/u-6ab56b5fae2b0f0b335873af120aff30f1469ea7/MyFiles/Dow nloads/Research%20assistant%20/Democratizing%20the%20Administrative%20State_ma rked.pdf).

Kathi and Cooper allocate processes that will break the barriers between citizens and the public administrators that inhibit democratic governance relationships which will allow for greater public participation in forming policies. The authors sought to answer the questions of; what are the challenges to citizen participation in governance, and how can neighborhood councils and city agencies work together to perform collaborative relationships? Kathi and Cooper developed the learning and design forum, a research approach with 3 critical stages that provided socratic seminars for neighborhood council leaders and city representatives to collaborate. This method exemplifies a way to deliberate and deliver collaborative solutions between municipal governments. In conclusion, the authors provide resources to break the barriers of control, hierarchy, and excessive regulation of administrative governments. These resources include organizations such as; the National issue Forum, Study Circles Resource Center, America Speaks, and the framework of Fung and Wright (2001). These organizations largely work to empower participatory governments and enhance public involvement and civic education.

Musso, J., Weare, C., Elliot, M., Kitsuse, A., & Shiau, E. (2007). "Toward Community Engagement In City Governance: Evaluating Neighborhood Council Reform in Los Angeles", Civic Engagement Public Policy Briefing. USC Civic Engagement Initiative & USC Neighborhood Participation Project: Los Angeles, CA.

This report presents findings from the Neighborhood Participation Project's multi-year study of neighborhood council implementation in the City of Los Angeles. We discuss the extent to which the system has developed the institutional requisites for success, including democratically legitimate councils, political innovations to support participation, and the capacity for neighborhood councils to act on issues of interest to their constituent communities. We also consider the long-term effects of the reform on political networks and civic culture in Los Angeles. We find a mixed record of success. While a citywide system of certified councils is in place, and some neighborhood councils have developed the capacity to act on behalf of their constituent communities, other neighborhood councils struggle, and the City has done a poor job of developing participatory arenas within which councils can interact constructively with city government.

The authors note that homeowners with long tenure in the community are most heavily represented, which is not surprising considering that the councils are geographically defined advisory boards. The ramification of this stakeholder orientation is that Latinos are underrepresented, and boards are disproportionately wealthy, white, and highly educated.

Most notable is that the authors argue many neighborhood councils simply lack capacityand leadership resources to adequately engage their stakeholders and develop a voice. They also claim that many councils suffer from weak relationships with the city. Instead, councils more often form alliances with one another to oppose/shape central decision making by city agencies.

The authors point out that it is difficult to define success of the NC system because the Charter laid out very vague goals to begin with. This will be helpful in framing my own work, where I will be asking NCs to define success themselves. Given this ambiguity, the authors define the system's long term goals as: 1) increased participation of diverse stakeholders; 2) improved community capacity; and 3) strengthening the civic culture of Los Angeles.

A flaw in this study is that they conclude that the neighborhood council system has achieved its goal of civic participation simply by the fact that councils have been created, with the certification process essentially acting as a proxy for civic engagement.

Discussion of representation on p15 (and graphs on p16) is useful in breaking down description representation vs substantive representation, and raising the questions as to whether a descriptively non-representative board can be substantively representative--the author's claim that they can, but it depends on the fairness and openness of the Board's process of deliberation and decision making.

However, they conclude that “elite-dominated” boards best characterizes NC makeup (but this isn’t necessarily as much of a problem as others might believe).

P23 has a useful table showing what progress the City has made in achieving “empowerment provisions” included in its revised charter, such as the extent to which NCs can influence the budget and service delivery.

P30 notes that land-use and planning are the most important issue to councils. 49% of activities coded on council agendas were in this issue area. P31-33 has graph breakdown of issues covered by councils.

Findings on p36 indicate the internal conflict on the Board is the most significant challenge for NCs. P37 includes a graph that shows strengths and weaknesses.

Musso, Juliet A., Christopher Weare, Nail Oztas, and William E. Loges. 2006. "Neighborhood Governance Reform And Networks Of Community Power In Los Angeles." The American Review of Public Administration 36(1):79-97. Retrieved (http://file:///home/chronos/u-6ab56b5fae2b0f0b335873af120aff30f1469ea7/MyFiles/Dow nloads/Research%20assistant%20/Neighborhood%20 Governance%20 Reform%20and%20 Networks%20of%20Community%20Power%20in%20Los%20 Angeles.pdf).

This research aims to show how neighborhood councils can change the structure of elite dominated governance through broad-based participation developed by reforms within the councils. The authors explore the questions of how neighbourhood government reforms promote citizen participation that decentralizes the power of; the decision making, deliberation process, and participation for community members. Using the network analysis theory the researchers tracked the developments of the Los Angeles council overtime to bridge multiple networks at the micro, meso, and macro level. While the progress of the Los Angeles council was tracked overtime it is important to point out that the data was taken at a single point which makes it more difficult to analyze the individualized relationships within. In conclusion their research indicated that these councils lack diversity amongst ethnic origin, socioeconomic class, and status. The authors suggest that successful reforms depend on the dynamic of emerging networks and the development of the weak ties. The authors also leave the readers to investigate if changesby emergent networks can lead to institutional change.

Park, Sunggeun (Ethan), Jennifer E. Mosley, and Colleen M. Grogan. 2016. "Do Residents Of Low-Income Communities Trust Organizations To Speak On Their Behalf? Differences By Organizational Type." Urban Affairs Review 54(1):137-164. Retrieved (http://file:///home/chronos/u-6ab56b5fae2b0f0b335873af120aff30f1469ea7/MyFiles/Dow nloads/Research%20assistant%20/Do%20residents%20of%20low-income%20 communitie s%20trust%20organizations%20(2).pdf).

The authors (Sunnggeun, Mosley, and Gorgan) seek to examine resident beliefs and values to explore if Neighborhood councils are truly a platform that can reduce political inequalities in poor urban communities. The study focuses on divulging the questions of whether Neighborhood councils are seen as appropriate representation for its residents, and what individual and community level factors are associated with trust in different organizational types. The case study examines eight Chicago South Side communities to understand resident views; drawing from telephone surveys to assess individual values, and the census as well as community surveys for an understanding of the community organizations, religious congregations, and school presences. This study indicated that the two most prevalent individual factors: age and health status, influenced levels of trust in alderman and politics. Overall these communities reflected a declining trust in formal electoral politics, with the majority of individuals trusting community organizations rather than alderman to speak on their behalf in the political framework.

Parlow, M. J. (2010). Revolutions in Local Democracy? Neighborhood Councils and Broadening Inclusion in the Local Political Process. Michigan Journal of Law and Race, 16, 1-18.

Political marginalization of minorities and government corruption are two key factors that have led to the overwhelming decline and decay of America's major cities. Local governments must combat the historical entrenchment of these two evils in order to reverse the trend toward demise. Neighborhood councils may be the best structural changes to local government because they provide more meaningful opportunities for political engagement of minority groups, while also serving as an antidote to systemic corruption in local government. This Essay analyzes the problems plaguing local government in urban cities and explores how neighborhood councils may be able to help address them.

The authors examine the two issues they claim are most detrimental to urban politics and governance: marginalization of minorities and political corruption. The authors focus on Detroit in their discussion, but often cite Los Angeles' NC system as a success story. In particular, they praise boundary drawing as allowing for a more "organic" creation of NCs. The authors cite a lot of research that argues that bribery and corruption remained rampant in local government, particularly in police departments and land-use decision making.

The authors offer little evidence to support their claims, and thus the article consists mainly of normative statements about the potential benefits of NCs, with an eye towards LA's system.

Rosen, Gillad, and Nufar Avni. 2019. "Negotiating Urban Redevelopment: Exploring The Neighborhood Council Planning Model." Journal of Planning Education and Research 0739456X1988410. Retrieved (http://file:///home/chronos/u-6ab56b5f ae2b0f0b335873af120aff30f1469ea7/MyFiles/Dow nloads/Research%20assistant% 20/Negotiating%20Urban%20Redevelopment_Exploring% 20Neighborhood%20 Council%20Model_marked%20(2).pdf).

In this case study, Rosen and Nufar seek to examine the role of neighborhood councils in conjunction with developers, residents, and government (also referred to as the hybrid four) in the redevelopment of communities, more specifically the redevelopment of a neighborhood compound in Jerusalem. The authors question the role of the neighborhood council and the representation of residents' views in the planning process of redevelopment. The case of redevelopment in a neighborhood compound in Jerusalem was analyzed using a social justice lens which includes the framework of democracy, diversity and equality to qualitatively divulge interviews and observations of residents in the redeveloping neighborhood. The Jerusalem case indicated that the neighborhood councils' intermediary role between government and residents played a significant role in 'just' planning until their views collided with the municipality, in which case the neighborhood council was often marginalized. In conclusion, the authors propose that neighborhood councils need more tools to collect and analyze data for future developments, to better mobilize citizen participation, and a more elevated position to influence the municipal government.

In summary, previous scholars have delved into the emergence of participatory movements outlining the historical presence of neighborhood councils and their capability to bridge the gap between people and government. The scholarly literature around neighborhood councils has questioned their inclusivity and success at forming representative councils that embody the voices of historically marginalized communities. Authors such as Bherer, Chemerinsky, and Kleiner attempt to define what is viewed as success in a system that was built without concrete guidelines or a pathway to achieving such. The purpose of this comparative case-study is to add to the conversation around defining success rather than methods for success. To combat the lack of depth in research regarding how neighborhood councils can influence planning and land-use policies, this study serves to examine how high functioning neighborhood councils utilize various tools to "successfully" shape and maintain community character and effect decisions in planning and land use within the municipal government.

Methods

In preparation for this research quantitative data was gathered from the Department of Neighborhood Empowerment (DONE) to help inform the selection of Hollywood Hills West and Los Feliz neighborhood council. In order to evaluate which neighborhood councils were considered "high functioning" we measured how many community impact statements and agendas the councils in Los Angeles County had posted. Lastly, interviews were conducted with managers from DONE to narrow down who they considered to be most active and operative within the neighborhood council system.

Using both quantitative and qualitative data gathered from DONE, Hollywood Hills West and Los Feliz were selected for a comparative case study as both councils are located within the Hollywood Hills which made for a more standardized comparison based on the demographics of both councils. After the informed case selection was made, interviews were conducted using a pre-established questionnaire with active board members, committee members, district representatives, and city council members. Using the Dedoose software to analyze this qualitative data, the interviews were transcribed and sorted into categories by way of emergent themes that defined the various codes such as: political capital, social

capital, cultural capital, individual vs. council goals and demographics, and attitudes toward land use. Excerpts from these one-to-one interviews were used to analyze the experiences and value of individual narratives and what these individuals collectively communicate about neighborhood governance as a tool/means to influence planning and land use policy making.

Methods

The findings reported in this paper are exclusive to two interviews with members from the Los Feliz neighborhood council. These interviews will contribute to the larger and ongoing case study. With that in mind, the interviews that are interpreted here as well as the others that will be conducted are preliminary and will inform the selection of a specific planning project from each council that will be evaluated throughout its progression. To investigate how high-functioning neighborhood councils influence planning and land use decision making, excerpts from the interviews were used to explain the factors of influence. During an interview with Los Feliz neighborhood council member Mike Hain (public health and safety chair) was asked to characterize the relationship between his neighborhood council and the municipal government at large. He responded saying,

> You know we've actually written a lot of impact statements and we are the number one neighborhood council that has actually has worked with our CD4 for council district four. We are actually working with our state assembly so [there are] many different arms of the government we are actually right in there with. We've had dinner with several of our government people: we had David Ryu speak, we were supposed to get Alex Padilla the state D.A. but he didn't make it, and also we had Laura Freedman, our state assembly person come to our meetings and speak at the neighborhood council. So I think we have a good relationship as well.

This statement was coded as a form of political capital as it explains the connections the Los Feliz council has with city, and state officials who work with them regularly. As you can see from the statement above Mr. Hain mentions several city and state officials who have either spoken or attended events with the council more than once. This data indicates different branchesof government that are involved in the neighborhood council, and their varying levels of significance based on the actors involved. When Andy May the chairman of public works and beautification was asked the same question as Mr. Hain he responded:

> At large, well right now it's very good…For a variety of reasons; one is the political socioeconomic capital of the neighborhood because we do have North of the Los Feliz Boulevard, North of the Boulevard is where all the rich people live. And so a lot of them are politically connected and what not and the neighborhood is close to downtown. It does have a very good relationship with the city and the neighborhood council is as you have probably been told and it's true, as the neighborhood Council we are the first stop on any projects in terms of a neighbor engaging with the city.

This statement was coded under social capital as it defines the network of resources Los Feliz council has access to because of the economic composition in the neighborhood. Within the same question Mr. May concluded his answer stating,

> My point in all of this is to say that when the Neighborhood Council takes action on something the city does pay attention to it. And more so for us I think than even other Neighborhood Councils is because we are kind of at this point he considered one of the 'better ones...' There's plenty of them that're dysfunctional, either they fight amongst themselves or they don't follow rules or they don't even meet regularly. Ours is very buttoned up and whatnot.

As you can see from the statement above Mr. May says that Los Feliz is considered one of the 'better' neighborhood councils and continues to explain that by explaining that other councils are dysfunctional while Los Feliz is not. This statement characterizes the relationship between the municipal government and their inclination to work with neighborhood councils who are seen as higher functioning. These three factors can be attributed to the tools the neighborhood councils utilize to influence planning and land-use decision making and policies.

Discussion

High functioning neighborhood councils influence planning and land use decision making by utilizing networks of capital that have contributed to their recognized status as cohesive and collaborative decision making groups. The character and resources afforded to these councils assists in their relationships with local officials and thus policy reform. This qualitative approach to research deconstructs individual narratives which convey the attitudes and networks that create the relationships between Los Feliz council members and local elected officials that we question today. Los Feliz neighborhood council utilizes political, and social capital to reach city council leaders and create long standing relationships connecting neighborhoods, city, and state governments. It's in this intertwined web of social and political networks of power that land-use decision making is influenced in collaborative governance.

The political capital characterized in the Los Feliz neighborhood council exemplifies the strong ties developed through interpersonal relationships with city officials. The excerpt from Mr. Hain reflects the layers of government that this neighborhood is a part of. Los Feliz not only has the attention of their district representative at the city level but the attention of elected officials such as the district attorney: Alex Padilla. While it may not seem very remarkable that a community such as Los Feliz which tends to be: Whiter, wealthy, and more affluent has politicalconnections it is through those personal and longstanding relationships that can influence planning and land use decision making. Previous literature often questions what exchange neighborhood councils can offer to influence city-level decision making and the political relationships necessary to do so (Musso, Oztas & Loges 2006). Utilizing the social capital in Los Feliz, this high functioning council can potentially provide many advantages to local officials. City council members especially have much to gain by building relationships with people in their district by way of the neighborhood council as it is a platform that engages people in the community with local government. As the excerpt from Mr. May suggests the position of Los Feliz in the Hollywood Hills alongside the socioeconomic capital of the community serves the council by connecting city officials with the neighborhood council. The analysis from both interviews indicates how city council members are more inclined to work with neighborhood councils that are seen as united in their policy views. Lauman and Papi have recorded that "a number of city council offices have begun to facilitate direct contacts between neighborhood council members and the city

councilor and legislative deputies who are decisive in policy formulation." (Lauman & Papi 2006) This describes the attitude that city officials have towards working with councils who are seen as successful and united in their decision making process. Emerging neighborhood councils are typically those who lack the political and social capital while deciphering how to form a united platform. Newer councils typically experience a greater divide and therefore are less likely to attract the attention needed to form close relationships with city officials.

In closing, neighborhood councils are able to influence land use policy and decision making through their sources of political and social capital. In conjunction with councils that possess high levels of capital, local officials are more inclined to work with those that are seen as united in their policy views and thus can be defined as "successful". While this comparative analysis remains underway, the findings thus far serve to disrupt previous policy notions that advocate for educational training about government to enhance the success and quality of emerging councils. This research serves to push the boundaries set by previous studies, to show how it is not simply the knowledge of government that leads to successful councils that influence policy making. It is the personal relationships and networks between neighborhood councils and actors within the municipal government that create lasting success and policy level change.

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Native Mycorrhizal Response to Invasive Species, Hirschfeldia incana, withina Post-Fire Chaparral Ecosystem in the Angeles National Forest

Abstract

California Chaparral plant communities that experience unnaturally frequent and large wildfire events are highly vulnerable to nonnative species invasion and require restoration. Nonnative grasses thrive substantially well in these dry, and poorly enriched areas and account for more than 26.8% of the flora in California chaparral (Rundel, 2000). Consequently, these species rapidly outgrow and outcompete native species for nutrients and space in post-fire recovery sites (Keeley, 2019). Mycorrhizae are a crucial symbiont for the chaparral plant community as they provide root access to water during drought and provide a defense against nonnative competition. Native vesicular-arbuscular mycorrhizae (VAM) provide chaparral plants the ability to absorb nutrients and protect from pathogenic infections making them highly important elements for habitat health and survival (Sikes, 2010). Nonnative annuals, such as Hirschfeldia incana, have been found to contribute to the deterioration of natural soil mycorrhizae by producing antifungal properties that suppress microbial abundance near the plant; a characteristic of the Brassicaceae family (Pakpour, 2015; Young-Mathews, 2012). Nonnative species are exceptionally resilient and exhaust the soil of its already sparse nutrient availability. Often left unmitigated after wildfire events, annual grasses invade native regrowth leading to an increase in habitat destruction and fragmentation long term. Inoculation of VAM into the soil used alongside restoration methods may provide a key supplement for long term health and resilience of native regrowth after wildfire catastrophes (Raklami, 2019, Norris, 1992). Restoration sites from the Copper Fire Restoration project will provide roots sample collections that will be analyzed for VAM inoculum levels dependent on the proximity to nonnative annuals. The indication of a significant decrease in mycorrhizal presence may indicate the adverse effects of invasive antifungal properties that contribute to increased habitat loss after wildfire.

Project Objective

The intent of this experiment is to explore how mycorrhizal abundance varies between the closeness to nonnative plant species in the chaparral. Result may provide further reasoning in explaining why some native species in restoration sites have recovered more successfully than others.

Literature Review

The chaparral biome is the most extensive native Californian plant ecosystem, with species ranging from the west coast of southern Oregon to Baja California, Mexico (Wilson, 2012). Chaparral biomes ca be found globally in locations that share a similar climate to the Mediterranean and are found to contain 20% of plant biodiversity in the world. This makes them a crucial focus for conservation and restoration efforts (Chepkemoi, 2017). Chaparral is characterized by its dense monolayer of stress-tolerant woody shrubs, composed of plants adapted to periods of drought and a wide range of seasonal temperatures. Species found in this community are naturally fire adapted and rejuvenated by periodic wildfire seasons that allow for biomaterial waste to burn off and seed casings to open allowing for germination. Natural intervals between wildfire events should be seen at 50 to 200 years. However, due to human influences and global climate change, the chaparral experiences larger and more frequent wildfire seasons ranging closer to every 5 to 15 years

(Lovich, 1999). Record breaking wildfires of California in the past three decades have caused a massive increase in the amount of disruption to native regrowth ground coverage by exposing it to invasive annual grasses (Bendix, 2002). After large wildfire events, the chaparral ecosystem becomes highly susceptible to invasion by introduced species that quickly take over vast amounts of newly opened ground coverage and outcompete the native species for space and resources. These introduced grasses have short life spans and leave behind layers of dry, easily ignitable underbrush which accumulate to fuel the next super wildfire events. Scientists that study native communities, such as the chaparral, define a healthy ecosystem by its relative abundance of biodiversity and native species coverage (Allen, 2005). Research and plant surveying data is now suggesting that an estimated 26.8% of native ground coverage in California has been replaced by such invasive species of plant growth (Rundel, 2000).

In 2002, The Copper Fire burned through roughly 20,000 acres of native chaparral shrubland and surrounding plant communities in the Angeles National Forest near Santa Clarita, California (CalFire, 2003). Now, 17 years later, the ecosystem has suffered large areas of regrowth disruption by nonnative annual grass invasion. The stability of a living ecosystem is dependent on its nutrient access and availability. The soil found in chaparral communities is very nutrient poor and highly vulnerable to erosion during rainy seasons, especially after wildfire events (Parker, 2016). The microbiota of the soil living around the roots of the plants are also important for the sustainability of water absorption, nutrient uptake, and provide a source of water uptake during periods without fire and extended drought. (Bendix, 2002).

The microbial interactions that take place between the roots and soil of plant ecosystems, known as the rhizosphere, are extremely crucial to the growth and nutrient supply for individual species. So much so, that fungi species dominate 70% of microbial biomass in healthy undisturbed soils (St. John, 2000). The rhizosphere of chaparral soil includes a variety of fungal species that provide nitrogen and phosphorus to the plants that otherwise is not abiotically available (Sikes, 2010). The symbiotic fungi that grow in association with the roots are known as mycorrhiza. There are two dominant types of mycorrhiza, ectomycorrhiza and endomycorrhiza (Stolp, 1988). Endomycorrhiza will be the primary focus of this study as they are the most abundant and favored type of mycorrhiza found in chaparral soil (Wilson, 2012). These fungi penetrate the roots and live both inter- and intracellularly within the tissue (Evert, 2013). One specific form of endomycorrhiza is known as the vesicular-arbuscular mycorrhizae (VAM) which form vesicles, likely for storage, and arbuscules which serve absorptive purposes (Atlas, 1998). VAM are highly diverse and are found growing in a large range of California chaparral species. Mycorrhizae serve a paramount function of nitrogen and phosphorus fixation and are largely responsible for the successful growth and sustainability of the chaparral.

Significant prior research has been done on efforts to re-inoculate the mycorrhizal presence into degraded soils to revitalize and assist with plant growth and nutrient supplementation. Overwhelmingly, results have shown that adding mycorrhizae back into the soil of growing plants positively affects instances of growth rate and nutrient uptake (Raklami, 2019). This is an important method of positive restoration, largely in part for plant communities such as chaparral that are deficient in soil nitrogen and phosphorus.

VAM inoculation may be a solution in combatting and revitalizing degraded soils from invasive species that have hindered mycorrhizal numbers. Hirschfeldia incana (common mustard), and similar mustards within the Brassicaceae family, are highly prevalent invasive annuals that have been proven in prior research to have antifungal properties (Pakpour, 2015; Young-Mathews, 2012). This discovery is of interest to restoration practitioners, as the need for mitigation and remediation of invasive species damage becomes more relevant in restoration prescriptions (Phillips, 2019). It may also benefit to implement inoculation practices into restoration methods in order to increase nutrient uptake and defense for recovering plants from pathogenic infection and competition by invasive species (Asmelash, 2016; Sikes, 2010). This research will estimate the severity of impact on native mycorrhizae root inoculum percentages regarding variable proximity of neighboring invasive species. *1

*1Due to unforeseen circumstances surrounding the COVID-19 pandemic, research was temporarily paused before completed data sets were collected. Interim results of this study will be projected based on the average species degradation found by Dr. Sepideh Pakpour and Dr. John Klironomos using their results from th 2015, University of British Columbia, Brassica nigra report. Actual data and results will be recorded once research is permitted to continue.

Methodology

Research Site

The root samples collected for this project were taken from multiple plots within the Copper Fire restoration project area of the Angeles National Forest in Santa Clarita, California. Experimental sites were selected based on high presence of invasive species H. incana. Control sites were selected by scouting out large native coverage thickets near experimental sites, preference was given to areas with very low to zero presence of invasive species. Control plots were used to model mycorrhizal colonization percentages in an undisturbed native chaparral rhizosphere.

Sample Collection

Root samples were collected with a narrow 15cm Hori Hori knife to remove shallow cores of soil containing small diameter surface roots at the crown of native shrubs. Two native species were sampled for this study: Eriogonum fasciculatum (California Buckwheat) and Adenostoma fasciculatum (Chamise). For qualitative comparison purposes, Hirschfeldia incana roots were also collected to check for any mycorrhizal presence.

Root Staining & Data Collection

A standard Trypan-Blue fungal staining procedure was performed on all samples. Roots were cut into 1cm length segments after staining and mounted on light microscope slides. Percent colonization was counted by positive identification of blue colored root fungal presence. Mycorrhizal and fungal cells found within root tissue were included in the percentages.

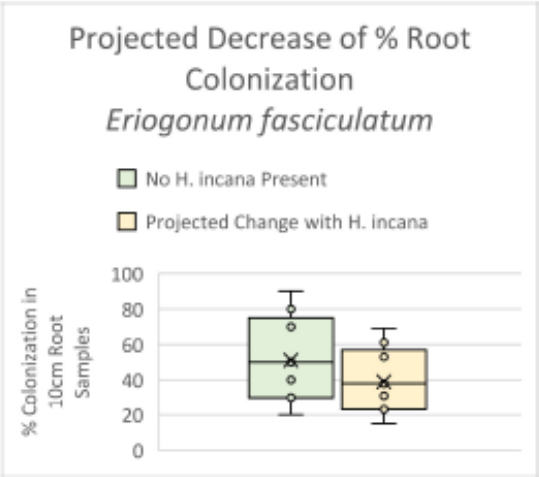
Data Analysis

Data analysis will be viewed using a one-way analysis of variance between control and experimental plots to determine a difference in root mycorrhizal concentration.

Results

The results for the control experiment indicate a clear and relatively abundant presence of mycorrhizal and fungal cells within root tissues of undisturbed native thickets shown in Figure 1. Due to restraints on the continuance of sampling and processing of field sample regarding the COVID-19 pandemic restrictions placed on the university, the results for the full experiment are halted until further notice. Results indicated in Figure 2 and Figure 3 show an estimation of mycorrhizal percent colonization loss using the models taken from the 2015 University of British Columbia study on a similar species from the Brassicaceae family. The results predicted indicate that an estimated 30% decrease in the colonization of plots with high presence of Hirschfeldia incana.

Fig 1. Control slides stained roots of Eriogonum fasciculatum (left), stained root of Adenostoma fasciculatum (right).



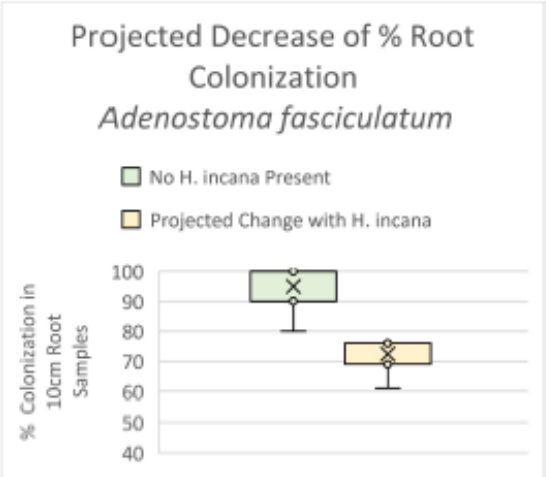


Fig. 2 Result projections for *Adenostoma fasciculatum*. **Fig. 3** Results projections for *Eriogonum fasciculatum*.

Discussion

Discussion of the results will be paused based on a lack of definitive results of the study. Predictions indicated by prior and similar studies in chaparral ecosystems that contain invasive species from the Brassicaceae family should suggest that mycorrhizal percent colonization will significantly decrease because of their presence. As indicated by the control portion that was completed, it was beneficial to indicate that mycorrhizal presence was detected, thus providing a basis of variance between the control and experimental field sites. Should the study continue, it would be expected that mycorrhizal presence is hindered by the invasive species, though it is not known if the hindrance is caused by other factors.

In further experiments it would be important to test for soil differences such as moisture levels and nutrient levels in areas with and without presence of invasive species of Brassicaceae. If the projections of this experiment are matched by the true results, it would be of significance to establish what factors contribute to native species reaction and to create a model for reintroducing and rehabilitating the microbial community within the chaparral soil.

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Do Mentorship Programs and Supportive Environment Encourage Women to Enter Leadership Positions?

Background

Imagine a woman walking into an executive or a board meeting of a Fortune 500 company. Once she enters the room, she sees a long, shiny wooden table surrounded by men. Although she is familiar with these coworkers, the thought processes of these men are different from hers. This increases her confidence to make herself stronger to voice her thoughts and ideas. As she listens to the discussions on various topics, she realizes that presence of more women would bring diversity of thoughts and ideas. She starts to envision ways for companies to empower more women into the path of leadership. Gender diversity sparks creativity, and it has a positive impact on financial performance.

As she walks around the familiar workplaces, she sees many women in non-managerial, support roles. Many of them are hard-working, motivated, and dedicated to their work. It is a sight she has seen several times before. She starts to wonder if there are so many women in the workplace, why are there so few in the executive ranks. What is holding them back?

Based on the research, women make up a small portion of the executive ranks in the corporate world. Of the 1,000 companies "that make up the 2019 Fortune 500 list, 33 have women CEOs" (Connley, 2019). Over the last 30 years, there has been some improvement. However, the increase of women in executive ranks has been minimal. As mentioned in the Wall Street Journal, "if companies in the U.S. continue to make the same, tiny gains in the numbers of women they promote and hire into management every year, it will be another 30 years before the gap between first-level male and female managers closes" (Fuhrmans, 2019).

Figure 1

Despite near-parity in entry-level numbers, women are outnumbered almost 2 to 1 by men in first-level manager jobs that are the bridges to senior roles LUCI GUTIERREZ

Retrieved from https://www.wsj.com/articles/where-women-fall-behind-at-work-the-first-step-into-management-11571112361

As shown in Figure 1, women are struggling to even move and settle into a first-level management position as men shoot up to the executive ranks. As mentioned in the Wall Street Journal article, "long before bumping into any glass ceiling, many women run into obstacles trying to grasp the very first rung of the management ladder" (Fuhrmans, 2019).

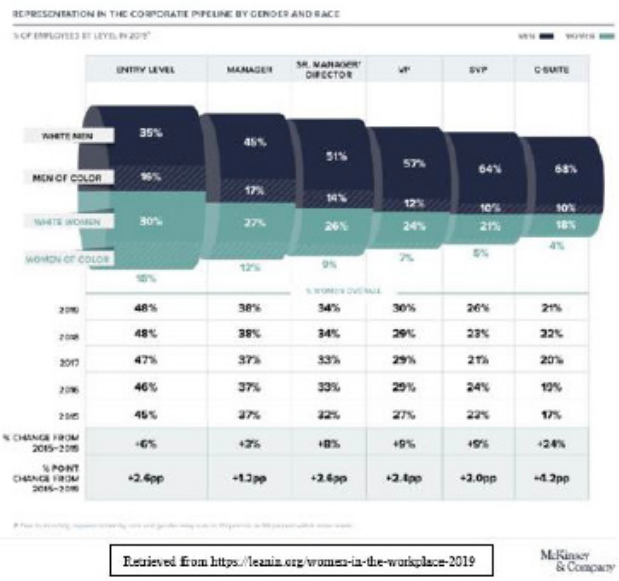
There are "sizable numbers of women occupying jobs at the bottom of the pyramid—but at the junior and midlevel management levels, men suddenly pull sharply ahead. From there to the top, men increasingly outnumber women" (Fuhrmans, 2019).

Glass ceiling is described as "discriminatory practices that have prevented women and minorities from advancing to executive-level jobs" (Mathis, Jackson, & Valentine, 2014).

Women are not given the opportunity to land positions that will pave the way to the C-suite dream careers. "A C-level executive holds a senior role within a company. In general, the 'C' designation applies to those who are the absolute head (strategic level) of their team — the chief" (Scudder, 2018). Some of the C-suite designations are CEO (Chief Executive Officer), CIO (Chief Information Officer), CHRO (Chief Human Resources Officer), and COO (Chief Operations Officer). "In more professional-level roles, women also are less likely to be in jobs that can accelerate careers, such as dealing with high-profile clients or helping build a line of business. More often, they take on or are steered into support roles, such as project management" (Fuhrmans, 2019).

"Few efforts are likely to remedy the problem as much as tackling the gender imbalance in initial promotions into management, says Lareina Yee, a senior partner at McKinsey & Co., which co-led the research with LeanIn.Org" (Fuhrmans, 2019). Thirty years is a long time. It does not have to take three decades to fix the process to help more women to get on the first rung of the management ladder. Women and men could reach equality in terms of gaining management positions at the same rate within the thirty years if that access to the first rung of the ladder is provided equally.

Figure 2



Retrieved from https://leanin.org/women-in-the-workplace-2019

If companies do not make stronger efforts to include high-potential women into their management team, they start to lose confidence and faith in their workplaces. As shown in Figure 2, entry-level jobs are made up of 48% women. As the management levels increase, the percentage of women decreases. “Over time, many women come to see a workplace stacked against them. Among the more than 68,500 employees whom McKinsey and Lean In also surveyed from the participating companies, a quarter of women said their gender had played a role in a missed promotion or raise. Even more expected it to make it harder for them to get ahead in the future” (Fuhrmans, 2019).

Hence, based on the remarkable study from McKinsey, I hypothesize:
Hypothesis 1

When given mentorship opportunities; women will be more likely than men to aspire to enter managerial ranks.

According to Catalyst, women struggle to get high-visibility projects.

> “Women are less likely to get the ‘hot jobs’ that are springboards to bigger roles. In a 2012 study of more than 1,600 M.B.A. graduates by the research and advocacy group Catalyst, men reported leading projects with larger teams and budgets twice the size of women's. Their work was also more likely to be on the radar of the C-suite. It's about how do you position women and minorities to succeed in the roles that are likely to lead to higher-level positions"(Fuhrmans, 2019).

Why are not women positioned in ways for them to succeed in these roles? Women suffer from the negative consequences of gender bias and gender stereotype. Some of the biggest forces are “traditions of, and expectations for, male leadership in workplace cultures contribute at least somewhat to women’s lack of representation in top positions. Other preconceptions also play a role, including women being seen as prioritizing family over career, and the perception that women are less effective leaders than men” (Rockefeller Foundation, 2016).

Figure 3

Capability	Women's percentile	Men's percentile
Takes initiative	55.6	48.2
Resilience	54.7	49.3
Practices self-development	54.8	49.6
Drives for results	53.9	49.8
Displays high integrity and honesty	54.0	49.1
Develops others	54.1	49.8
Inspires and motivates others	53.9	49.7
Bold leadership	53.2	49.8
Builds relationships	53.2	49.9
Champions change	53.1	49.8
Establishes stretch goals	52.6	49.7
Collaboration and teamwork	52.6	50.2
Connects to the outside world	51.6	50.3
Communicates powerfully and prolifically	51.8	50.7
Solves problems and analyzes issues	51.5	50.4
Leadership speed	51.5	50.6
Innovates	51.4	51
Technical or professional expertise	50.1	51.1
Develops strategic perspective	50.1	51.4

Note: The t-values of all data are statistically significant.
Source: Zenger Folkman 2019

© HBR

Retrieved from https://hbr.org/2019/06/research-women-score-higher-than-men-in-most-leadership-skills

As shown in Figure 3 by Harvard Business Review, women have the leadership skills required to make a company successful. Based on this information, it is important to address the gender bias and empower women to feel confident in their abilities. "In fact, women are usually collaborative while men are competitive by nature. They empathize with others and are sensible to others' feelings. They are experts in interpersonal skills and soft skills. They can handle stress better than men. By nature, men are aggressive. However, women are soft and well-behaved. Women are also expert in hidden data of communication. That is why they know the knack of understanding male egos, emotions, and feelings better and act accordingly" (Rao, 2018).

It is important for a good leader to understand other people in ways beyond physical and verbal communication. According to the author of Organizational Communication: Approaches and Processes, Katherine Miller, mentions the concept of emotional intelligence. "Emotional intelligence involves both a clear understanding of the emotional needs of the situation and the self-awareness and self-control necessary for using the right emotional display to cope with the situation. In essence, those who have a high 'emotional intelligence quotient' (EQ) have a clear understanding of the rules of emotional display and an ability to follow and adapt those rules as necessary" (Miller, 2012). Based on the research, women seem to excel in the language of emotional intelligence. This ability to connect with employees' emotions to inspire them to achieve an overarching vision positively impacts the community and encourages them to bring this vision into fruition regardless of the challenges.

This connection allows women to have a positive impact on improving the finances and strengthening the diversity of the organization. “A growing body of research links greater gender diversity on teams and in corporate management to more innovation and better financial performance” (Fuhrmans, 2019).

Research by Martin indicates that women approach work in a more self-reflective way than men. "In contrast to men, who tend to be career-centric and want to maximize their financial return from work, women view work more holistically, as a component of their overall life plan." Therefore, they're more likely to approach their careers in a self-reflective way and value factors such as meaning, purpose, connection with co-workers and work-life integration. When women bring this strength to bear for their teams and employees, it has long-lasting implications. It improves employee retention, creates stronger team players, and develops the next generation of female role models” (Martin, 2019).

This improves the overall work environment for all employees, and it positively contributes to the company’s financial performance. Hence, based on Figure 3 from Harvard Business Review which shows women’s leadership characteristics, I hypothesize:

Hypothesis 2

When women are given (a) proper guidance and (b) supportive environments, they will aspire to enter managerial ranks at a higher level.

Career Advancement

Morse made a very interesting observation. As she noted in her article, men seem to have more opportunities to experience networking.

> “While men have long enjoyed support from networks and clubs that cater to them, women historically have had fewer options -- particularly when they're younger. Lindsay Kaplan and Carolyn Childers want to change this for good. In January 2019, they founded the New York City-based private women's network Chief, which offers C-suite execs and rising vice presidents mentorship opportunities across industries, focused career coaching sessions, and networking events. There's also access to a clubhouse, a speaker series and workshops. ‘These core groups allow people to have sessions where they can really use each other for support and advice and have that private space to unwind, but also really tackle their biggest challenges,’ says Childers” (Morse, 2019).

Hence, based on the research that women benefit from networking and career coaching, I hypothesize:

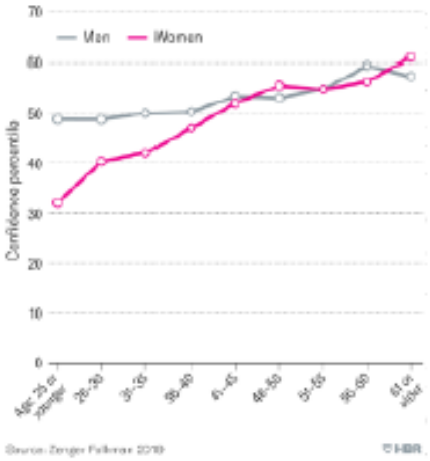
Hypothesis 3

When given access to career advancement training, women will be more likely than men to take advantage of those opportunities.

Figure 4

Women Rate Themselves as Less Confident Than Men Until Their Mid-40s

Data on 3,876 men and 4,779 women since 2016 shows that women's gains in confidence are more than three times that of men — but only because of a massive gap at the beginning of their careers.



Retrieved from https://hbr.org/visual-library/2019/06/women-rate-themselves-as-less-confident-than-men-until-their-mid-40s

If women are given similar guidance and support as men especially during the early stages of their careers, the number of women in executive ranks will be much higher. As shown in Figure 4 from Harvard Business Review (HBR), women seem to lack confidence during the early stages of their career. As Gerdemen noted, this is due to unconscious gender bias. "They lack confidence in their ability to compete in fields that men are stereotypically believed to perform more strongly in" (Gerdemen, 2019). Hence, I hypothesize:

Hypothesis 4

Women in mentorship programs will have higher confidence levels compared to those who are not.

According to Matt Moore, chief talent officer at Alpine Investors, a private-equity firm based in San Francisco, women have not the opportunities to gain the required leadership experience that is a prerequisite for many companies. He believes that this does imply that women do not have the skills or acumen to perform effectively (Sardon & Dieter, 2019). The reason for the lack of opportunities are due to lack of confidence among young women and gender stereotypes.

As Mathis et al. (2014) mentioned, there are various ways to shatter the glass ceiling such as mentoring programs, career rotation, increasing the number of women in top management and board of directors, establishing clear goals for women to progress in management, and holding managers responsible to achieve these goals (Mathis, Jackson, & Valentine, 2014).

To aggressively close the gap between male and female managers, companies need to make concerted efforts. “To make a dent in the numbers and offer more opportunities, companies are experimenting with education benefits that pay upfront tuition costs, formal mentoring and sponsorship programs, and networking opportunities designed for women” (Weber, 2019). There are some examples of companies taking the initiative to create focus groups, mentorship programs, and supportive environments to cultivate the diversity of the organizations. Eli Lilly is a good example of such efforts.

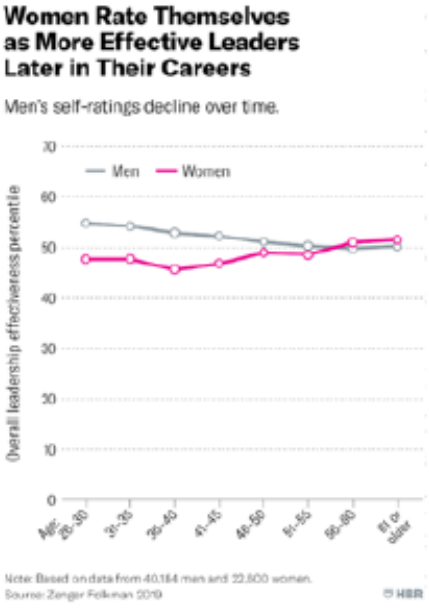
The Indianapolis-based pharmaceutical firm, Eli Lilly, realized that its current diversity efforts are unsatisfactory in closing the gender gaps in managerial positions. Based on its current diversity efforts, it estimated that it will take 70 years to achieve the gender equality. It took a well-established process called the “Patient Journey” which it uses to gather data from customer satisfaction surveys, focus groups, and online journaling and used it for the new process called “Employee Journey.” Approximately 400 high potential women in managerial ranks took this journey (Weber, 2019).

> “It worked because it took a business process that already had credibility within the firm and applied it to the often ambiguous work of diversity, says Joy Fitzgerald, who became vice president of diversity and inclusion shortly after the effort began. ‘That's like the nirvana of D&I,’ she says” (Weber, 2019).

As Weber noted, this process had a positive impact on the pharmaceutical company.

> “The feedback that resulted sparked changes in the company's culture and processes that have significantly boosted the representation of women and people of color in Lilly's leadership ranks. From December 2016 to August 2019, the share of women in management grew to 44% from 38%, and the share of women who report directly to the CEO rose to 38% from 29%, Lilly says. The changes Lilly made included altering its recruitment, development and succession processes, and reviewing talent metrics with all top leaders at least once a year” (Weber, 2019).

Figure 5



Retrieved from https://hbr.org/visual-library/2019/06/women-rate-themselves-as-more-effective-leaders-later-in-their-careers

As shown in Figure 5 from Harvard Business Review (HBR), women's confidence seems to rise later in their careers. The recruitment, development and succession efforts along with reviewing talent metrics such as those that Eli Lilly has implemented should reduce the confidence gap between men and women in the early stages of their careers.

According to several Edison executives and senior managers, having a diverse experience in various aspects of business operations can lead a person to becoming a knowledgeable and effective leader. It is critical to "place young leaders in intense assignments with precisely described development challenges. Identify the riskiest, most challenging positions across the company, and assign them directly to rising stars" (Martin & Schmidt, 2010).

As Barsh et al. (2012) explained, it is important for young women to experience challenging assignments early on their career so that they will be prepared for more senior management positions.

> "Focus on helping women gain broad line experience early on. This should include international stints as appropriate. Top teams and sponsors in leadership positions can accelerate women's growth so that once women begin to form families, they will already have some of the prerequisites for advancement. International experience is one good example: moving women earlier in their careers may be easier to do. Individuals with the robust work ethic of the successful women we met will embrace the challenge. And over time, seeing more women in these positions will help shift everyone's mind-set" (Barsh & Yee, 2012).

Hence, based on the research that job rotation will increase women's chance of getting into management, I hypothesize:

Hypothesis 5:

When given the opportunity to participate in job rotation programs, women will be more likely than men to aspire into management roles.

It is important for leaders of a company to surround themselves with diverse group of people. A CEO is a role model to other employees in a company. "Companies with diverse leadership do not happen by accident. Change happens when CEOs and boards say they value diversity and follow through" (Leung, 2020). As Leung explained, when a leader embraces diversity, that person becomes a catalyst.

Figure 6

Retrieved from https://www.catalyst.org/research/infographic-the-double-bind-dilemma-for-women-in-leadership/

> "We don't have a supply problem, in terms of women and women of color for these positions," Silbert said. "We have a demand problem." In other words, what's holding women back is not themselves, but implicit bias" (Sardon & Dieter, 2019). This implicit bias makes it harder for women to get high visibility projects. The concept of Double Bind Dilemma makes the burden of implicit bias more difficult. "This concept makes adopting a firm leadership style challenging particularly for young women" (White, 2007). Many young women try to maintain their good girl image while trying not to seem like a pushover.

Figure 6 from Catalyst describes this paradox. When a woman is strong, she is seen as arrogant and domineering. However, if she is too sensitive, the woman is automatically seen as incompetent for the position.

Edison has mentorship programs such as Leadership Edge, High-Po, and Women's Roundtable to encourage women into leadership positions. Candidates for Leadership Edge are chosen company-wide to be trained for senior leadership roles. Candidates for High-Po Program include training high potential people from groups company-wide to be trained to be future leaders. The Women's Roundtable group provides women with personal and professional development. Edison's biggest program for Diversity and Inclusion is Paradigm 4 Parity. The purpose is to make it 50/50 in managerial ranks by 2030.

Figure 7

Figure 8

Retrieved from https://www.edison.com/content/dam/eix/documents/sustainability/eix-2018-sustainability-report.pdf

As of December 31, 2018, Edison International, the parent company of Edison, had 12,574 full-time employees (Edison International, 2018). As shown in Figures 7 and 8, 68% percent of those employees were female and/or diverse race/ethnicity. The company has provided additional breakdown in its 2018 Sustainability Report. 33% of the executives are female. Based on this report and interviews with other senior executives and managers, Edison has taken steps to pave a future of equality for women.

The lack of diversity is also reflected in corporate boards. “Research also suggests there is still a lot of room for improvement. Only 2% of S&P 500 companies have boards in which at least half of the members are women, and at only seven companies in the index are at least half of senior managers women. In fact, at 80% of S&P 500 firms, fewer than one-third of senior managers are women” (Sardon & Dieter, 2019).

As cited in the Wall Street Journal article, the biggest challenge to improve diversity in corporate leadership is lack of accurate data. “Only 3% of companies in the S&P 500 share a full breakdown of their boards' ethnic diversity, and only 4% publicly disclose how ethnically diverse their senior management team is, according to the data compiled by the Journal analysts. Without precise data, executives may struggle to put the right D&I initiatives into place, they say” (Sardon & Dieter, 2019).

Methodology

The purpose of this research project was to gather information on the challenges inspiring women face to overcome the glass ceiling and institutional bias to enter managerial ranks through mentorship programs and supportive environment. The scope was to complete multiple interviews and surveys. The surveys were given to men and women in junior and senior levels. This survey covered various items such as mentorship, professional development, career advancement training, confidence levels, and exposure to other areas for job rotation.

The survey was created using SurveyPlanet website. The survey included twenty-six questions. The survey was distributed to fifteen men and fifteen women from the ages of 18-64. The ages were broken down to 18-24 years old, 25-34 years old, 35-44 years old, 45-54 years old, and 55-64 years old. The following table shows the number of participants in each age group:

Age Range (years)	18-24	25-34	35-44	45-54	55-64
Number of Participants	1	8	13	7	1

The survey participants were employees from various companies. The years at the company were broken down to 0-2 years, 3-5 years, 6-10 years, and 10 and above. The following table shows the number of participants in each group:

Years at the Company	0-2	3-5	6-10	10 and above
Number of Participants	2	10	10	8

To test the first hypothesis, "If women are given mentorship opportunities or programs, then more women than men will aspire to enter managerial ranks", the following statements from the survey were used:

1. I am satisfied with the efforts that the organization has taken to train me to reach specific work goals
2. I am satisfied with the opportunities that I am offered to express my knowledge
3. I believe that my company cares about my professional development
4. I am satisfied with training that improves my skill set for my current job
5. I believe that my company cultivates an atmosphere of supportive environment
6. I am interested in entering the management route.
7. I am interested in staying in the technical route.
8. I am satisfied with the professional growth opportunities offered

To test the second hypothesis, "If high-achieving women are given proper guidance and supportive environment, then there is a higher chance that they will aspire to enter managerial ranks", the following statements or questions were used:

9. How do you feel about the quality of mentoring you received from the company?
10. How do you feel about the mentoring you are currently receiving from senior management?
11. My organization has given me the opportunities to receive formal mentorship
12. Are you enrolled in a formal training for management and leadership opportunities?
13. Would you like to be enrolled in a formal leadership training program but are not?
14. Do you have any informal training (talking to peers, coworkers, etc) on management training?

To test the fourth hypothesis, "Mentorship programs will increase the confidence level among women", the following statements were used:

15. I am confident in my current job
16. I am confident in my job abilities
17. I am confident that I will be successful in a managerial position
18. Women feel more confident after receiving management mentorship

To test the third hypothesis, "If women are given career advancement training, then more women than men will take advantage of those opportunities to advance their careers", the following statements or questions were used:

19. I believe that there are opportunities that are available for me to advance my career
20. Did you take advantage of those opportunities?
21. How do you feel about the career advancement training you receive from the company?

To test the fifth hypothesis, "If women are given the opportunity to experience job rotation to get exposure to various areas within the company, then more women than men will be more comfortable in taking on management roles", the following statements or questions were used:

22. I believe that there are opportunities that are available for me to do job rotation to get exposure in various areas
23. Did you take advantage of those opportunities?

Lastly, the following demographic questions were asked:

24. Please choose your gender:

25. Please choose your age range:
26. How long have you been with the company?

Quantitative Analysis of Results

The data above was converted into CSV format, which poured the data into an excel sheet. The Likert Scale was used to convert the survey answers into numerical data. "Developed in 1932 by Rensis Likert to measure attitudes, the typical Likert scale is a 5- or 7-point ordinal scale used by respondents to rate the degree to which they agree or disagree with a statement (table)" (Sullivan & Artino Jr., 2013). With the Likert Scale, it is easier to find the mean, median, and standard deviation of the respondents' answers. The table below shows the 5-point method scale I had used to numerically evaluate each survey answer.

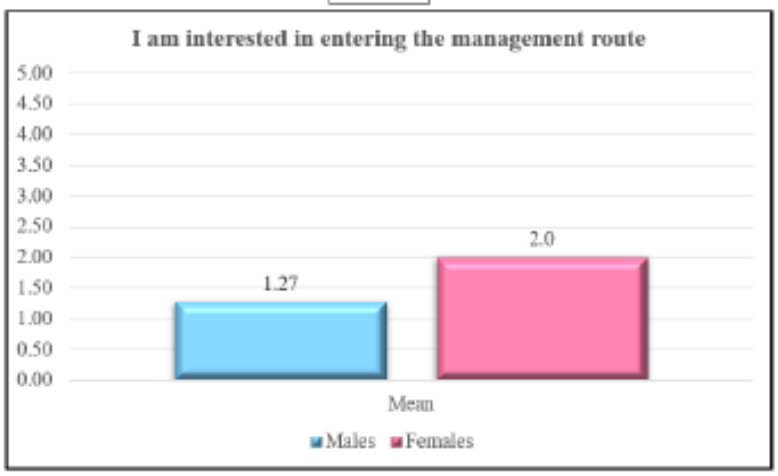
0	1	2	3	4	5
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
No	Yes				
	Male	Female			

To efficiently measure the data, the results were filtered to male and female. This way it would be more appropriate to conduct Descriptive Statistics, T-tests: Paired Two Sample for Means, and Anova: Single Factor. Descriptive Statistics depict the mean, median, and mode of a specific data set (Kenton, 2019). This allows for the comparison of the means between males and females in the questions. The inferential statistic, t-test, was used to determine the significant difference between the means of two groups (Kenton, 2019). In this case, the two groups are males and females. The ANOVA test analyzed the data groups and determined if there was a significant relationship present (Kenton, 2019). This test was used for questions with "yes or no" answers. Out of the 26 questions, I chose a few to do a detailed statistical analysis to give the reader a better understanding.

Chart 1

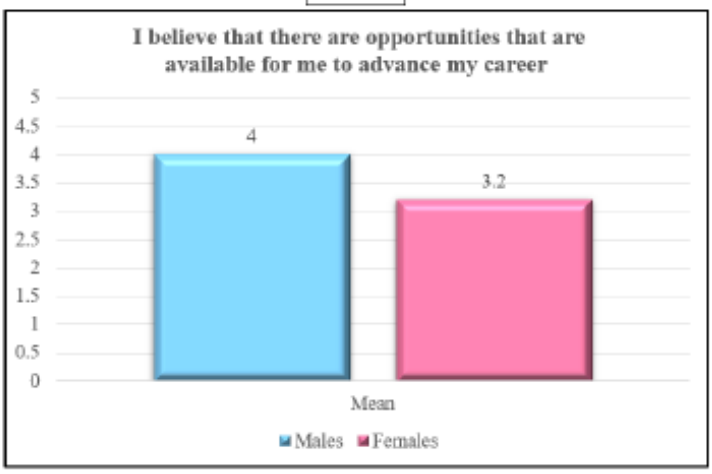
Males to females were compared on if they believe that their organization cares about their professional development through training and opportunities using descriptive statistics. As shown in Chart 1, the mean for males is higher than the mean for females. This describes that males tend to agree more than women that their organization cares about their professional development through training and opportunities. Based on the analysis, this supports hypotheses 1 and 3 which focus on mentorship opportunities, programs, and career advancement training. There was a significant difference in the scores for males (M=4, SD=0) and females (M=3.76, SD=0.61); t(44)=-19.34, p=3.87 E-23. The P-value of 3.87 E-23 is less than the commonly used significance level of 0.05, which means that the data is statistically significant. This analysis confirmed that men are more likely than women to believe that their organization cares about their professional development.

Chart 2



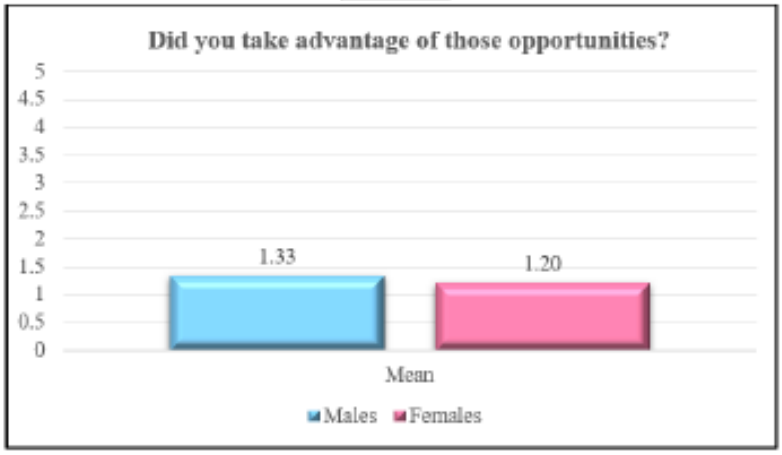
Males to females were compared on who is interested in entering management route. As shown in Chart 2, the female participants demonstrated a higher mean than males. This indicates that women aspire more to enter managerial ranks. The analysis supports the overall concept that women are interested in management positions. There was a significant difference in the scores for male (M=1.27, SD=0.46) and females (M=2, SD=0); t(14)=-23.13, p=1.49E-12. The P-value of 1.49E-12 is less than the significance level of 0.05, which means that the data is statistically significant. This analysis confirmed that women are more interested in entering the management route.

Chart 3



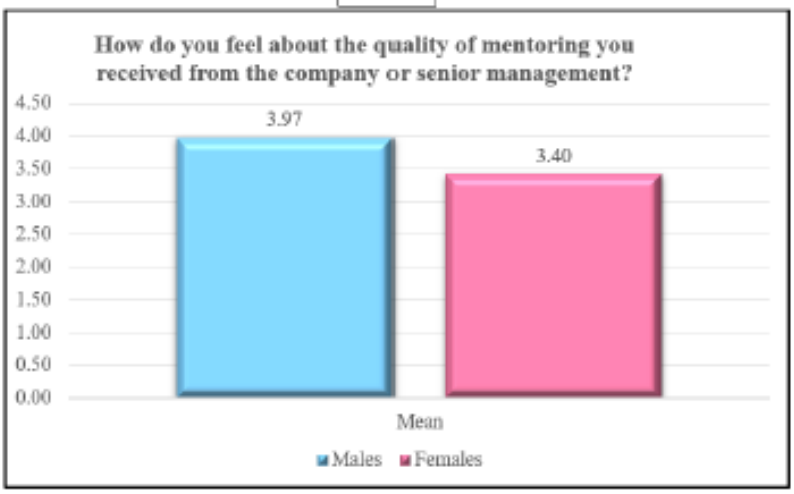
Males to females were compared on if they believe that there are opportunities available for them to advance their careers. As shown in Chart 3, the male participants demonstrated a higher mean than females. Based on the analysis, this data supports hypothesis 3 which focuses on career advancement opportunities. There was a significant difference in the scores for males (M=4, SD=0) and females (M=3.2, SD=1.01); t(14)=-4.58, p=0.004. The P-value of 0.004 is less than the significance level of 0.05, which means that the data is statistically significant. This analysis confirmed that men are more likely to experience career advancement opportunities.

Chart 4



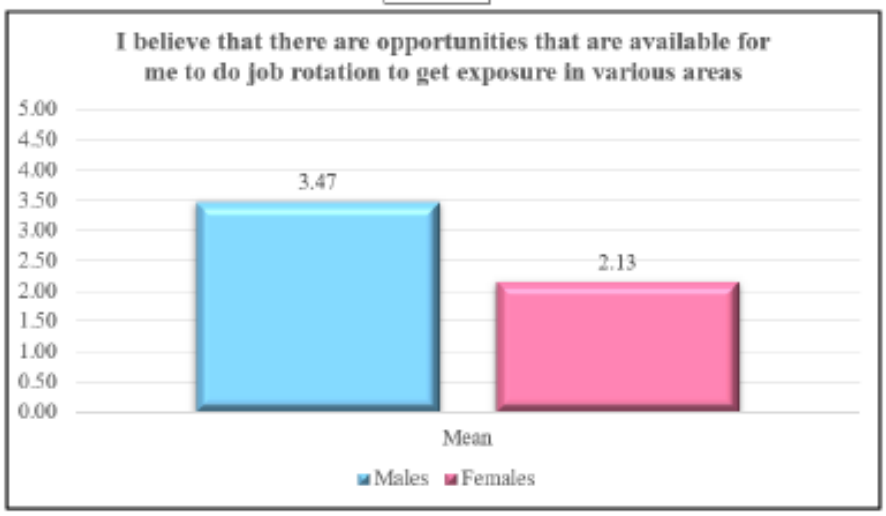
When asked if the respondents took advantage of those career advancement opportunities, it can be seen from the Anova test results in Chart 4 that men (M=1.33) have a slightly higher average than women (M=1.20). This may be due to the lack of career advancement opportunities presented to women. However, this would need to be tested by looking at only those who were offered opportunities. There is not sufficient data to make that analysis. Anova showed that the effect of taking advantage of career advancement opportunities on men and women was not significant, F(1,28) = 0.21, p=0.65. The P-value of 0.65 is greater than the significance level of 0.05, which means that the data is not statistically significant. Although it may be trending in the hypothesized direction, a larger pool of respondents is needed to verify the trend.

Chart 5



Males to females were compared on how they feel about the quality of mentoring they received from the company or senior management. As shown in Chart 5, the male participants demonstrated a higher mean than the females. This describes that males tend to receive a more favorable mentoring from their organization or senior management. Based on the analysis, this data supports hypothesis 1 which focuses on mentorship. There was a significant difference in the scores for male (M=3.97, SD= 0.1826 and females (M= 3.4, SD= 0.8550); t(29)=-9.15, p=4.8E-10. The P-value of 4.8E-10 is less than the significance level of 0.05, which means that the data is statistically significant. This analysis confirmed that men are more likely than women to experience mentorship.

Chart 6



Males to females were compared on if they believe that there are opportunities available for them to do job rotation to get exposure in various areas. As shown in Chart 6, the male participants demonstrated a higher mean than the females. This describes that males tend to receive more job rotation opportunities than females. Based on the analysis, this supports hypothesis 5 which focused on employees receiving opportunities to experience job rotation. There was a significant difference in the scores for males (M=3.47, SD= 0.74) and females (M= 2.13, SD= 1.25); t(14)=-2.47, p=0.027. The P-value of 0.027 is less than the significance level of 0.05, which means that the data is statistically significant. This analysis confirmed that men are more likely than women to experience job rotation opportunities.

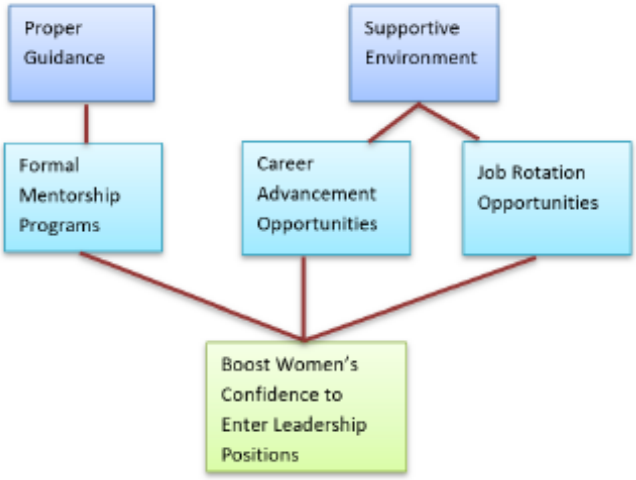
Chart 7

Males to females were compared on confidence levels. As shown in Chart 7, the female participants demonstrated a higher mean than the males. This describes that females are more confident in their capability to be successful in a managerial position. Based on the analysis, the data supports hypothesis 2 which focuses on women's aspirations to enter managerial ranks. There was a significant difference in the scores for male (M=4.53, SD= 0.74) and females (M= 4.80, SD= 0.41); t(14)=-9.93, p=1.01E-07. The P-value of 1.01E-07 is less than the significance level of 0.05, which means that the data is statistically significant. This analysis confirmed that women are more likely than men to be confident that they will be successful in a managerial position.

Lastly, males and females were compared on if they believe that women feel more confident after receiving management mentorship. All 30 respondents chose "Strongly Agree". Based on this analysis, the data supports hypothesis 5 which states that mentorship programs will increase the confidence level among women.

Disscusion

The model below depicts the hypothesized relationship between the hypotheses.



More women than men will aspire to enter managerial ranks. This is supported by the data from the survey statement "I am interested in entering management." Higher number of women answered "yes" than men. This indicates that the problem is not in women's interest in entering management (or supply), but rather the issue could be lack of opportunities due to implicit bias (or demand).

It is important for high-achieving women to be given proper guidance and supportive environment. This will give them a higher chance to aspire to enter managerial ranks. This is supported by the data from the survey statement "Believe that their organization cares about their professional development through training and opportunities." As shown in Figure 1, women are still struggling to grasp the very first rung of the management ladder (Fuhrmans, 2019). They need to be provided with avenues that can help them.

Mentorship programs do increase the confidence level among women. This is supported by the data from the survey statement "Women feel more confident after receiving management mentorship" As shown in Figure 6 from HBR, women feel more confident later in their careers (Zenger & Folkman, 2019). Mentorship programs offered to aspiring young women, can change those statistics. Women would have a stronger foundation to stand on through those given programs.

If women are given career advancement training, then more women will take advantage of those opportunities to advance their careers. This is supported by the data from the survey statement "I believe that there are opportunities that are available for me to advance my career." As shown earlier in the McKinsey and Lean In report, the percentage of women decreases as management levels increase (Lean In & McKinsey&Company, 2019). When asked "Did you take advantage of those opportunities", men had a higher mean than women. Although this trend is opposite of the hypothesis, this finding was not statistically significant. However, this may be an artifact of a relatively small sample size so no more research should be done.

If women are given the opportunity to experience job rotation to get exposure to various areas within the company, then more women will feel comfortable in taking on management roles. Job rotation broadens the skill set, makes the employee valuable, and paves the path to an executive position. Based on survey statement "I believe that there are opportunities that are available for me to do job rotation to get exposure in various areas", men have more opportunities than women. As shown in Figure 4 from HBR, women feel less confident early in their careers (Zenger & Folkman, 2019). This may be due to the fact these women experience job rotation much later. The confidence levels will increase if young women experienced job rotation much earlier in their careers.

Implications for Human Resources (HR) Practice

Human Resource professionals play a significant role in shaping the diversity policies for employees. These policies should focus on eliminating the limitations and restrictions women may face in the professional realm. HR's main goal to reduce the gender gap in management should be to solve the unseen problem which is to repair the broken first rung of the management ladder. The five areas of importance in developing a person's career based on this research are mentorship programs, supportive environments, career advancement training, job rotation opportunities, and self-confidence. HR programs in

these five areas should be customized for women. Following are some examples of such programs:

Mentorship programs would consist of managers observing the work environment to spot high-potential women. These women will be assigned mentors that coach and teach them to become effective leaders. Supportive environment programs would include training all managers and executives on the benefits of a diverse workforce. This would also include unconscious/implicit bias awareness training.

Career advancement programs would include all managers and executives assigning challenging and meaningful assignments to high potential women. Job rotation programs should encourage managers and executives to recommend their high potential women to other groups to help them expand their business knowledge. This will allow women to gain meaningful experience in various areas of the business. These programs should allow especially young women to improve their self-confidence, knowledge, and experience to pursue higher management roles.

Hence, Human Resources professionals can use the findings of this report to create effective diversity and inclusion programs and incorporate them into the company's recruiting strategies. These programs will help managers and executives become aware of the prevalent implicit bias that currently exists within the corporate world.

Impact

The heart of these findings lies in the empowerment of women. How can we raise the voices of talented women yearning to rise and shine as managers and executives?

Women, especially young women, will be positively impacted by these findings. It is critical for young women to be aware of the implicit bias so they can self-promote and be confident. As shown earlier in Figure 3 from HBR table of leadership traits, women need to take every opportunity to showcase their innate qualities such as initiative, resilience, high integrity, honesty, and bold leadership (Zenger & Folkman, 2019). Also, it is very important for women to choose companies that offer supportive environment and mentorship guidance.

In addition to women, men will also be greatly impacted by this study. As shown Figure 2, men make up 78% of the executive ranks (Lean In & McKinsey&Company, 2019).

As Barsh et al. (2012) mentioned, it would be a great opportunity for male leaders to be role models for their colleagues by setting an example by supporting the Paradigm for Parity.

> "Hands-on CEOs reach out to get other senior male leaders involved in the effort, making them catalysts for change. These leaders recognize that gender diversity starts with personal consciousness; once they are committed to the issue, they encourage others to shift mind-sets and behaviors in support of the cultural transformation" (Barsh & Yee, 2012).

Lastly, the companies are also impacted by this study. According to research by Noland et al. (2016), companies that went from none to 30 percent female leaders correlated to a 15

percent increase in companies' net revenue margin. The HR programs mentioned above will help companies go through a major transformational metamorphosis to become better financial competitors compared to those that do not.

Study Limitations

There were a few limitations that should be recognized. Due to the worldwide epidemic of Covid-19 virus, the lives of many were turned upside down. The means to obtain a large sample of respondents was very difficult. The survey results were relatively small to validate the significant patterns between male and female. The questionnaire should have included questions regarding gender bias and glass ceiling. Respondents would have been able to directly express their views if these challenges are prevalent in their workplaces.

Future Research

The differences between mentorship and sponsorship should be further analyzed. "Sponsors create opportunities for high-potential women (and men); while some executives make it to the top without sponsors, most gained new opportunities, active support, and advocacy from such relationships. Great sponsors believe in the talented women they help, open the door to growth opportunities, counsel them through valleys and peaks, and advocate for their advancement" (Barsh & Yee, 2012). Women tend to receive more mentorship than sponsorship. They are totally different concepts. Research must be done to figure out how to effectively combine both techniques to help talented individuals to move up the career ladder.

The research should expand to verify if women leaders really support other female protégées who are interested in entering management. Since the journey to executive management for most women is a long and arduous path, do female leaders really find the urge to help other women or do they see them as rivalry?

"The competition for 'spots' in favored in-groups increases, women are less inclined to bring other women along. Because of obstacles women face in their career and corporate environments, and the achievement of hard-fought success, their attitude toward other women is 'I figured it out, you should too.' Executive women are often overly encumbered with daily duties and responsibilities and don't take the time to mentor and support young women" (Andrews, 2020).

Conclusion

Imagine a woman walking into an executive or a board meeting of a Fortune 500 company. This time when she enters the room, she sees equal number of men and women around the long, shiny wooden table. This paradigm for parity should not take 30 years to accomplish. The main problem for women is getting access to the first rung of the management ladder.

As shown in this report, HR programs based on my five hypotheses: mentorship, supportive environment, confidence, career advancement training, and job rotation will empower more women to gain knowledge and experience to access that first rung. Hence, Human Resources professionals can use the findings of this report to create effective diversity and inclusion policies and incorporate them into the companies' recruiting strategies. These policies will help managers and executives become more aware of the prevalent implicit bias that currently exists within the corporate world.

The discoveries from this report impact women, men, and organizations. It is critical for young women to be aware of the implicit bias so they can take action to develop effective career strategies. It would be a great opportunity for male leaders to be role models by supporting the Paradigm for Parity. As shown in the Wall Street Journal, gender diversity develops creativity and has a positive impact on financial performance of the organizations.

Some companies have already started to fix the broken first rung of the management ladder for women. The pharmaceutical firm Eli Lilly realized that it needed to take the unclear work of diversity and inclusion to heart. Hence, the company's culture and processes were changed based on its employee journey surveys. This effort increased the number of women in Lilly's leadership positions. It is time for other companies to follow in the footsteps of Eli Lilly.

As a final thought, think about coming to work every day and reporting to a leader who genuinely cares about your career and personal life. Employees will feel a sense of belonging, satisfaction, safety, and well-provided for in the workplace. Does that not sound wonderful? To create that kind of a supportive environment, gender diversity in all leadership positions paves the way for a company to cultivate nurturement, enrichment, and engagement of employees.

Citations

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Author's Biography

Sheena Devadoss is completing her undergraduate degree at Cal Poly Pomona. She works as a Network Engineering intern in Information Technology (IT) Department at Southern California Edison Company. She is pursuing Master of Business Administration at University of Massachusetts, Lowell. Her interest in management bloomed as she noticed that women are being under-represented in this area. She had partnered up with the non-profit organization EmpowHer that helps girls from disadvantaged, low income families to become confident in their educational and career goals. She even created a fundraiser within her IT Engineering team to raise funds for these girls to achieve their goals. She also competed in the Miss America local pageant and gave a social impact initiative speech about empowering women into managerial ranks. She wants to be an example by shattering the glass ceiling and moving up in management.

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Use of McMaster Fecal Egg Count to Evaluate Alternative Haemonchus contortus Treatments in Sheep (Ovis aries)

Abstract

Haemonchus contortus (HC) is a parasitic intestinal nematode causing anemia and mortality in small ruminants around the world. Resistance to standard anthelmintic treatment for HC has severe economic implications for livestock industries and the search for natural and innovative alternatives to standard treatments is ongoing. The African Spider Plant, Cleome gynandrya (CG), is one candidate treatment and purported inhibitor of HC in sheep. The efficacy of CG as a management and prevention for HC nematode infections is currently being investigated as part of a long-term study at Cal Poly Pomona. A modified McMaster fecal egg count system quantifies egg burden in control and treatment animals by allowing HC eggs to be separated from fecal matter through a flotation test, which separates the eggs based on their density. Baseline egg counts have been conducted with two groups, one in December (n = 50) and one in January (n = 36), to standardize methodology and establish pre-treatment conditions in the Cal Poly Pomona sheep herd. The results found that there was no significance in variation between egg counts within the December group (p = 0.36), January group (p = 0.59), or cross-comparison of the January group (p = 0.33). This data was used compare counts in experimental animals throughout the study.

Introduction

The intestinal parasite, HC has become a major issue worldwide on farmlands and with wild ruminants. HC, also known as the barber pole worm, is one of the main sources of helminthic infestations in ruminants causing health issues such as anemia and death. Due to its high levels of genetic diversity, it has developed a high resistance to anthelminthic medication normally prescribed to eradicate infestation (Gilleard & Redman, 2016). HC has become so adaptive that alternative methods are now needed to kill the nematodes in order to maintain a healthy ruminant population on farms.

An alternative treatment to kill HC is the plant CG. This plant contains specific compounds that are thought to be productive in eradicating HC infestations in sheep due to high levels of inhibitive properties and low toxicity levels to sheep. Fouche and colleagues examined the effects of an acetone extraction of the plant CG on HC infections in ruminants. The phytocompounds found in the annual plant were able to inhibit the nematodes egg hatchings. The results of the experiment concluded that there was a 68% inhibition when the ruminants were given the plant extract. The concentration was 2.5 mg/mL and were standard across the board with the other plant extracts examined. Not only was CG the most efficient at inhibiting egg hatching, but it also had the lowest toxicity rate of the 15 plants, making it an ideal choice to test. The compounds contributing to the high inhibition rate were phenolics, flavonoids, flavanols, and proanthocyanins. The saponin and alkaloid compounds were found in low concentrations in the plant which is why there was a low toxicity level (Fouche et al., 2016).

An important factor in determining the infection rates of HC is having the proper technique to count the eggs. The McMaster method is used to separate HC eggs from fecal matter and combine them in a flotation solution that can be put into a McMaster slide and examined underneath a microscope to physically count the eggs present. This count is then

multiplied to scale to determine how many eggs can be expected to be found in the manure.

In summary, this project will use McMaster fecal egg count method to establish baseline counts of HC burden in sheep. Ultimately, the counts found in this study will be used in an ongoing project which determines if CG is an effective treatment to eradicate infestation from the nematodes. The literature discussed served the purpose to understand the foundation of experiments that have already been conducted on this plant specifically and to understand the benefits and limitations of the McMaster method that will be used in this project to test for the nematode population. Based on this review, the goal of this study is to contribute to the progression of standardizing the McMaster method to use in future projects to test the efficacy of CG as an alternative treatment for HC in sheep.

Methods

Fecal Collection

The sheep used in the experiment were from the farm at California State Polytechnic University, Pomona. The sheep used in the first sample group, collected in December, (n = 50) were a mix of both male and female as well as hair and wool sheep. The sheep used in the second group, collected in January, (n = 36) were also a mix of male and female but limited to hair sheep. Fecal samples were collected in December of 2019 over the course of 5 days and counted within 7 days as recommended by the University of Rhode Island (Zajac, 2014). Fecal samples processed in January 2020 were collected directly from the rectum of the sheep over the course of one day and analyzed within 36 hours after collection. The sheep were lined up to enter the shoe and with a gloved finger the collector extracted fecal samples digitally and placed them into a zip lock bag in a cooler with the animal ID.

Flotation Solution Preparation

The flotation solution is composed of a mix of Magnesium sulfate (MgSO4) and DI water. The solution was prepared by mixing 125 grams of MgSO4 and 500 mL of water until completely dissolved. 2 grams of the fecal sample was then weighed out on an analytical balance and mixed into the solution until completely incorporated. After resting for 5 minutes, the flotation solution was filtered through a cheesecloth into a new container until all the liquid was extracted. A 1mL pipette was used to transfer the sample into the McMaster slide and allowed to rest for another 5 minutes so the eggs could float to the top of the slide. The McMaster slide was examined under a compound microscope at 10x magnification and observed eggs were counted so long as they were found with more than ½ of their body size inside the grid. All samples were tested within 36 hours of collection to ensure no eggs were lost in between collection and analysis.

Statistical Analysis

In order to determine if the McMaster fecal egg count method is a viable technique to determine HC burden in sheep, a quantitative approach was used. Microsoft Excel was utilized to apply paired t-tests to the data collected with a ($p = 0.05$) to establish significance.

Results

Sexual dimorphism

In the December 2019 sample group (n = 50), male and female data were compared to determine sexual dimorphism within the group. Females had an egg burden ranging from

0-90 eggs/mL (Figure 1) while the males had a range of 0-15 eggs/mL (Figure 2). The average fecal egg count for females was 8.65 eggs/mL of fecal sample solution with a standard deviation of 15.58 eggs/mL (Table 1) compared to males who had an average of 5 eggs/mL with a standard deviation of 4.76 eggs/mL (Table 1).

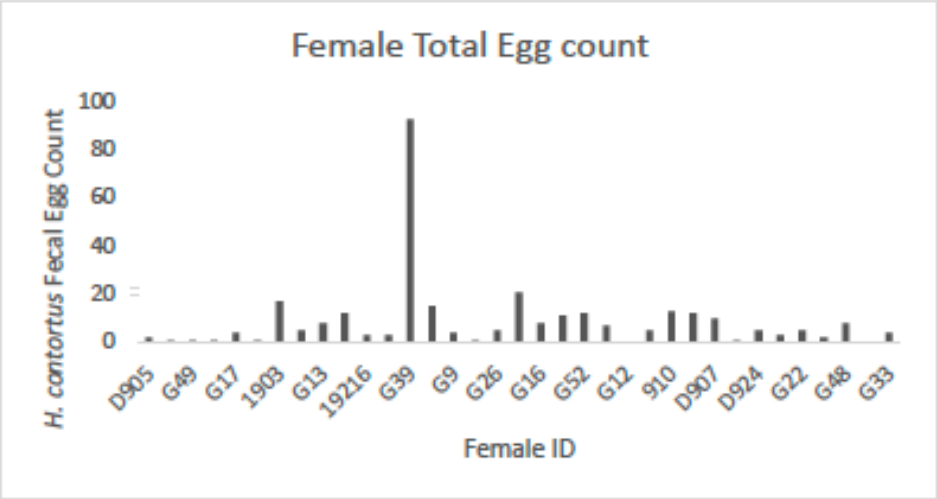

Figure 1: Female fecal egg counts December sample group (n=50)

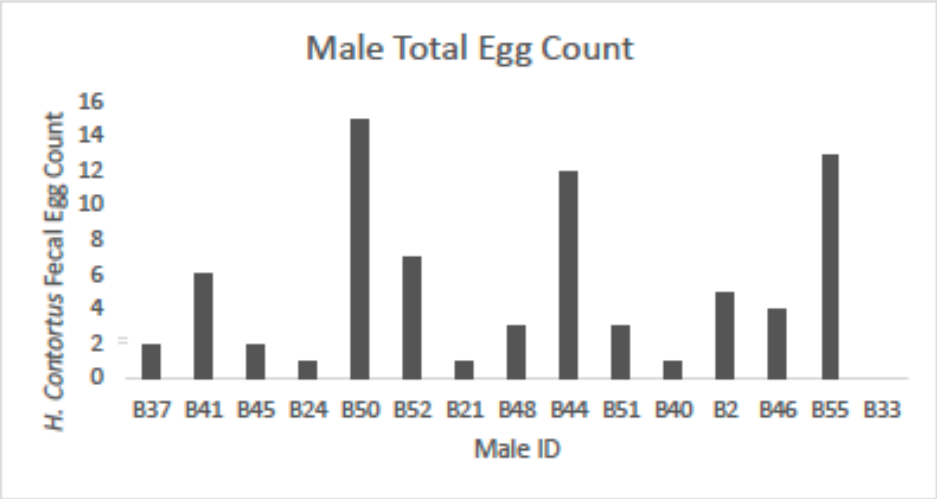

Figure 2: Male fecal egg counts December sample group (n=50)

Table 1December group female and male average egg counts, standard deviation, and p-value

	Average Egg Count (per 1 mL)	Standard Deviation	p-value
Female	8.65	15.58	0.36
Male	5	4.76	

A paired t-test was applied and a calculated result of p=0.36 was determined between the males and females (Table 1). Since there was no significant difference between the sexes, for future analysis, males and females were treated the same in the study.

Repeatability

In the January sample group (n = 36), 23 of the fecal samples were prepared and counted twice, then cross-compared, in order to determine consistency within the group. In the first round of data analysis (n = 23), there was a range of 0-18 eggs/mL (Figure 3) and an average egg count of 3.68 eggs/mL of fecal sample solution with a standard deviation of 4.29 eggs/mL.

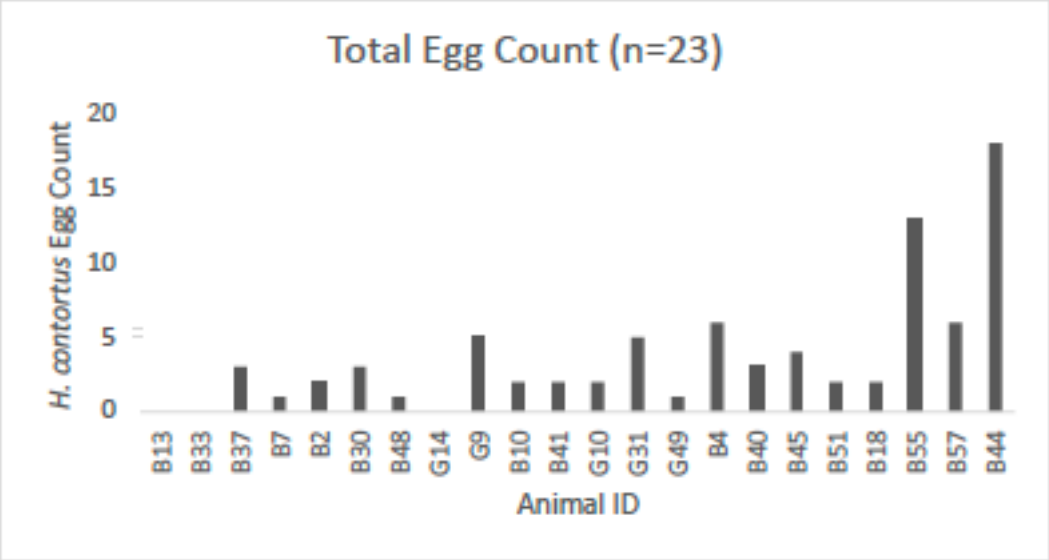

Figure 3: Fecal egg counts of first round of counting for January sample group (n=23).

The second round of data analysis (n = 36), where all January 2020 samples were counted, egg burden ranged from 0-9 eggs/mL (Figure 4) and the average egg load burden was 3.27 eggs/mL with a standard deviation of 3.84 eggs/mL. A paired t-test was applied to (n = 23) and (n = 36) and resulted in (p = 0.59) (Table 2).

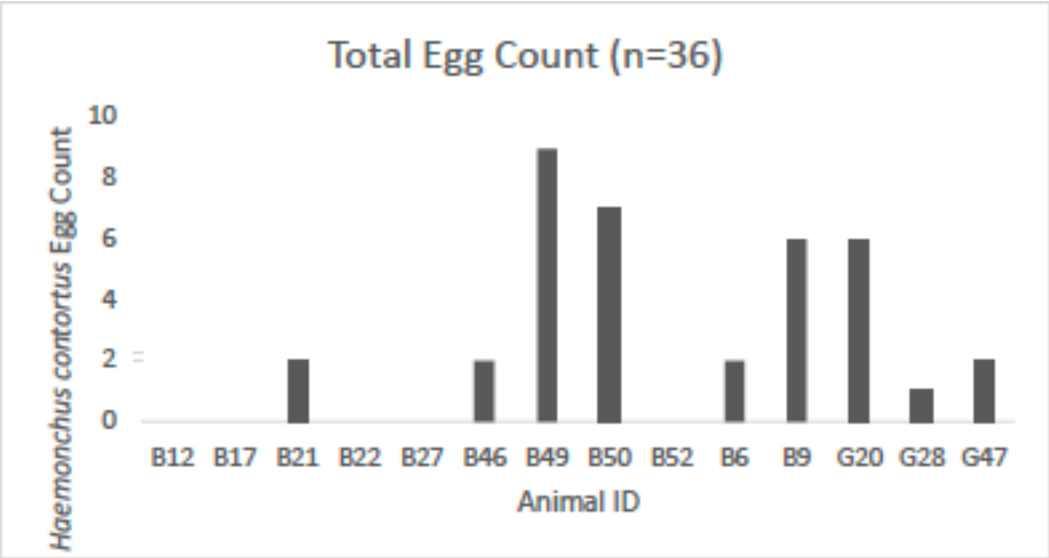

Figure 4: Fecal egg counts of second round of counting for January sample group (n=36)

Table 2: January group (n=23) and (n=36) average egg count, standard deviation, and p-value

	Average Egg Count (per 1 mL)	Standard Deviation	p-value
First count (n = 23)	3.68	4.29	0.59
Entire group (n = 36)	3.27	3.84	

Cross Comparing Sample Groups

To thoroughly assess the differences between the December and January sample groups, the 15 sheep that were found in both groups were separated and had their values compared to one another. The egg burden average of the sheep found in the December group was 5.2 eggs/mL with a standard deviation of 4.64 eggs/mL compared to the January group where the average was 4.2 eggs/mL and a standard deviation of 4.99 eggs/mL. The paired t-test comparing these two groups resulted in (p = 0.33).

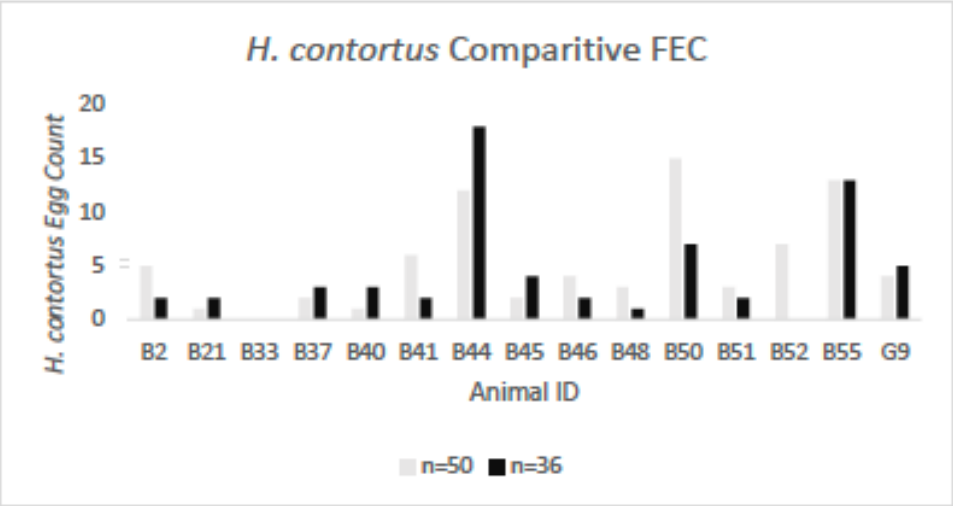

Figure 5: Fecal egg counts of sheep found in both (n=50) and (n=36)

Table 3: sheep found in both (n=50) and (n=36) average egg count, standard deviation, and p-value

	Average Egg Count (per 1 mL)	Standard Deviation	p-value
December	5.2	4.64	0.33
January	4.2	4.99	

Discussion

The results of this study support the hypothesis that the McMaster method is an efficient method to determine the egg load burden of HC in sheep. The parameters for statistical significance for this study was set at (p = 0.05). In the December group, it was determined there was no statistical significance between males and females (p = 0.36). Within the January group, the statistical analysis comparing the first 23 counts and the second counts (n = 36), determined (p = 0.59). Again, there was no significance between the two data sets. In order to test the accuracy of the McMaster method, the sheep that were found in both sample groups were compared to determine if there was a discrepancy in egg counts between the months of December and January.

The average egg count of each group varied by 1 egg/mL and had a resulting ($p = 0.33$), meaning that there was no significant difference between the egg counts when samples were prepared at different times and no inconsistency over the course of 2 months. However, this study did not examine whether seasonal changes affected egg load burden, therefore, further studies should look into the role hotter climates play with HC.

These results are consistent with previous studies that have been done to determine the efficacy of the McMaster method. For example, in a study which compared the accuracy of three different fecal egg count tests, the McMaster method had the "most accurate technique for detecting strongylid eggs" (Napravnikova et al. 2019). It is important to note that the McMaster methods was not the most precise of the three tests conducted in the study, therefore, a different test might be needed especially if there are different parasitic eggs beside strongylid.

Ultimately, this project set out to determine if the McMaster method is an efficient and sufficiently standardized test to determine egg load burden in sheep. The resulting p-values given for the different variations of sample group demonstrate that the flotation solution protocol and egg count procedure are consistent enough to produce reliable results. The data from this study will be used as a part of pre-treatment conditions for sheep for an ongoing project at Cal Poly. These baseline counts will be used to compare post-treatment egg load burdens and inform the value of CG as a potential alternative treatment for sheep infected with HC.

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What's in the Box? The Effect of Negative Corrections on Children's Belief in Misinformation

Abstract

The continued influence effect occurs when belief in misinformation persists even after correction. Although several techniques can reduce belief in misinformation, none are able to eliminate belief entirely. In fact, attempting to correct misinformation may increase belief when negative corrections are presented to individuals not given the misinformation. The current study's purpose is to test whether the same effect occurs in 3-to-6-year-old children. We will test misinformation belief while manipulating exposure to misinformation and negative corrections. Approximately 40 children will watch a presentation in which the contents of eight boxes are discussed by two characters. Depending on the condition, one character will provide misinformation (e.g., there are marbles in the blue box) or no information, the other character will then provide a negative correction (e.g., there are not marbles in the blue box) or no correction. After each box, the child will be asked what they believe is inside. We hypothesize that when children are exposed to misinformation, negative corrections will reduce belief in misinformation relative to no correction; however, when not exposed to misinformation, negative corrections will increase belief in misinformation relative to no correction. Our preliminary results support these hypotheses. We found that when misinformation is provided, misinformation belief is greater when no correction is given compared to a negative correction. In the no misinformation condition, however, we found that belief in misinformation is greater when a negative correction is provided, compared to no correction, demonstrating that negation out of context may increase misinformation belief in children.

Today, more than ever, we have access to information regarding just about everything, whether it be through the internet, television, cell phones, etc. These extremely interconnected media outlets allow for anyone to spread information to millions of people in just a matter of seconds. Because of the increased dissemination of and access to information, however, we are more likely to be exposed to misinformation, which can have a number of effects, ranging from misattributing a quote to falsely convicting an innocent person. Although studies regarding misinformation seem to primarily focus on adults, many have shown that the effects extend to children as well. Researchers who have aimed to study the effects of misinformation on children have found that similar to adults, children's memories are influenced by exposure to misinformation, with 3-to 4-year-olds being especially susceptible (Bruck & Ceci, 1999).

Unfortunately, a simple correction is not always enough to do away with misinformation. The persistence of false beliefs after they have been corrected is a phenomenon known as the continued influence effect. In the classic demonstration of this effect, Johnson and Seifert (1994) had subjects read about a fictional fire investigation scenario based on materials from Wilkes and Leatherbarrow (1988). Subjects were given misinformation, followed by a correction depending on each subject's experimental condition. The researchers found that even after the correction, the false information persisted in the subjects' minds and they relied on the false information when answering questions about the scenario. This study demonstrates that once information is believed,

whether it is accurate or not, it becomes difficult to correct. Because of the continued influence effect, many researchers wondered if there was a way to minimize belief in misinformation. In the same study, Johnson and Seifert found that giving an alternate causal explanation as a correction, rather than a simple negation, reduced the influence of false information.

Along with explanation, retraction has been shown to minimize the influence of misinformation. Using the same fictional fire investigation scenario, Ecker, Lewandowsky, Swire, and Chang (2011) presented subjects with misinformation and a retraction, which contradicts the misinformation. It was found that when answering questions about the scenario, subjects who read the misinformation followed by a retraction believed the misinformation less than those who did not read the retraction. This result demonstrates that retraction can be used as a technique to correct misinformation. However, its effects are not strong enough to completely do away with misinformation, as the results also demonstrated that even when subjects read the misinformation and retraction, they still believed the misinformation more than those who did not read either of the two.

Although studies have shown that corrective techniques, such as explanation and retraction, can effectively reduce belief of false, inaccurate information, none have been able to eliminate belief. Some researchers have found that attempting to correct misinformation may have an adverse effect that causes the misinformation to be remembered as true (Skurnik, Yoon, Park, & Schwarz, 2005). In their experiment, Skurnik et al. had subjects read statements that were identified as either true or false. Of all the statements and truth values, half were presented once, while the other half was presented three times. After a delay of 30 minutes or 3 days, the subjects were presented with another list of statements and were asked to determine whether each statement was true, false, or new. The researchers found that for older subjects with the 30-minute delay, repeatedly identifying a statement as false helped subjects remember the statement as false, but for those with the 3-day delay, the repetition resulted in them misremembering the statements as true.

As mentioned previously, young, preschool-aged children are easily susceptible to misinformation (Bruck & Ceci, 1999). The memory report of children has been the interest of many studies, as interrogative situations are an issue of major importance, both from a developmental and legal standpoint. In recent years, children testifying in criminal matters has been a common occurrence. Evidence from real cases, however, has shown that children are at times exposed to suggestive questioning techniques (Holliday, 2003). In Holliday's study, children witnessed an event, followed by misinformation that was read or self-generated either before or after a cognitive interview took place. Following the interview, the children were given a recognition test regarding the event. It was found that a cognitive interview, in which subjects are simply asked to recall everything they can from the event, resulted in more correct details than a structured interview, in which specific questions are asked in a particular order. This demonstrates that the structured interview questions had some sort of suggestibility effect on the children.

The focus of previous studies, such as the one described above, has been on the effects of post-event misinformation on children's memory. The current study, however, will aim to examine how corrections to misinformation may reduce or increase false beliefs in 3-

to 5-year-old children, specifically negative corrections. To my knowledge, this type of research has not been done on preschool-aged children.

The focus on negative corrections is due to the negative correction effect, which occurs when the negation of ideas has a paradoxical effect, leading one to believe that the negated idea is true. Many examples describing the counterproductive effects of negation can be found in the literature of this area of research, specifically when the negation is given out of context. Results from experiments measuring reading time, lexical decisions, brain waves, etc. have demonstrated that in the absence of context, negated statements develop salient meanings (Giora, 2006). What this demonstrates is that when a statement is given outside of appropriate context, the person who receives the statement may be more inclined to believe the statement is true. For example, saying “the ball is not red” requires the person on the receiving end of that statement to understand why the speaker chose to say this (Grice, 1975). However, if the statement is relevant, such as in the case of reading a book or watching a movie in which a ball is red, it makes sense that the color red would be negated. The context in which negation occurs may play a significant role in how children comprehend negation. In a recent study (Nordmeyer & Frank, 2014), researchers collected eye-tracking data to explore how children between the ages of 2 and 5 years old understood negation depending on the context. In the first experiment, subjects were presented with a video in which they heard out-of-context negative statements that referred to absence (e.g., look at the boy who has no apples). In the second experiment, the subjects were presented with another video in which they heard positive statements (e.g., look at the boy who has apples). The data revealed that negative statements resulted in greater comprehension difficulties.

The previously mentioned studies demonstrate that under certain conditions, negation can have an unintentional effect. While the purpose may be to correct someone, negation may do the opposite and cause one to believe that the misinformation is true. This effect is apparent in adults; however, because of their suggestibility, we believe the effect will be just as apparent in young children. The purpose of the experiment reported here is to test whether the presence of misinformation influences the effects of negative corrections on preschool-aged children’s belief in misinformation. To do so, we will manipulate the presence of misinformation and negative corrections, which will then create four experimental conditions, and we will measure the children’s belief in the information provided. Depending on the condition, the presence of misinformation will be manipulated by making a false statement (e.g., there are marbles in the blue box) or no statement. The presence of negative corrections will be manipulated by providing a negative correction (e.g., actually, there are not marbles in the blue box) or no correction. We expect a main effect of misinformation, with greater belief for subjects who received the misinformation compared to those who did not, a main effect of correction, with greater belief for subjects who did not receive the misinformation compared to those who did, and an interaction between misinformation and correction, in which negative corrections decrease belief -- relative to no correction -- in the misinformation condition, but increase belief in the no misinformation condition.

Methods

Subjects

A total of 18 children (age range: 3-6, Mage = 3.83, 7 females) were recruited to participate in the study using convenience sampling. The children were recruited from the Cal Poly Pomona Children's Center. Participation only occurred if parental consent and child assent were granted.

Materials

One of two 4-minute slideshows was presented to each subject. Each slideshow was counterbalanced and consisted of 24 slides, in which an animated teacher character and various child characters discuss eight colorful boxes. The presentation consisted of eight trials, two per experimental condition: misinformation-control, misinformation-correction, control-control, and control-correction. A response sheet was used to record the subjects' answers to the questions asked within the slideshow.

Procedure

Parental consent form packets were distributed to the Cal Poly Pomona Children's Center, who then distributed them to the parents of the children at the center. Child assent was then obtained verbally from those whose parents returned a parental consent form on their behalf by asking if they were interested in watching a video and answering questions about colorful boxes. Individual subjects watched a slideshow, in which eight boxes, two representing each experimental condition, were presented. Depending on the experimental condition, a statement was made in the presentation regarding the content of each box (e.g., there are marbles in the blue box), followed by a negative correction (e.g., actually, there are not marbles in the blue box) or no correction, or the video made no statement regarding the contents of each box, followed by a negative correction or no correction. Following the presentation of each box, the child was asked what they thought was inside, and their answers were recorded on a response sheet. After all eight trials were completed, the child was compensated with a reward, such as stickers, and a debriefing statement was sent home with them for their parents to review.

Table 1
Experimental trials

Experimental Condition:	Trial:	Expected chance of responding "marble":
Misinformation-Control	"There are marbles in the blue box" No correction	High
Misinformation-Correction	"There are marbles in the blue box." "Actually, there are not marbles in the blue box."	Low
Control-Control	No misinformation No correction	Very Low/Zero
Control-Correction	No misinformation "Actually, there are not marbles in the blue box."	Medium

Preliminary Results

A 2 (exposure: misinformation vs. no misinformation) x 2 (correction: negative correction vs. no correction) within-subjects ANOVA was conducted to measure subjects' belief in misinformation when answering questions regarding the content of various boxes described in the study. All tests were evaluated with an alpha level of .05. A total of 18 subjects completed the study; however, the preliminary results presented here are based on the data of 14 subjects, due to the other subjects not responding in any of the trials. The ANOVA revealed a main effect of exposure, $F(1, 13) = 3.96$, $p = .068$, $\eta P2 = .23$, with exposure to misinformation ($M = .45$, $SD = .22$) resulting in greater misinformation belief than no misinformation ($M =.32$, $SD = .21$). The ANOVA also revealed a main effect of correction, $F(1, 13) = 2.94$, $p = .110$, $\eta P2 = .18$, with negative corrections ($M = .45$, $SD = .26$) resulting in greater misinformation belief than no correction ($M = .32$, $SD = .18$); however, the main effects of exposure and correction were not significant. We believe that this may be due to the inadequate sample size. Despite the inadequate sample size, a significant interaction between exposure and correction was found, $F(1, 13) = 20.06$, $p = .001$, $\eta P2 = .61$. In the misinformation conditions, the proportion of references to the misinformation target word, which is how we are measuring belief in misinformation, was greater when subjects did not receive a correction ($M =.64$, $SD =.36$) compared to when they received a negative correction ($M = .25$, $SD =.38$); however, in the no misinformation conditions, we found that the proportion of references to the misinformation target word were greater when a negative correction was given ($M = .64$, $SD = .41$) compared to no correction ($M = .00$, $SD = .00$).

Discussion

Consistent with those of past studies (Wilkes & Leatherbarrow, 1988; Skurnik et al., 2005; Ecker et al., 2011), our preliminary results suggest that correcting misinformation may not always result in a decreased belief of that misinformation. In our study, we manipulated the presence of misinformation and the presence of negative correction to test the effects of negative corrections on preschool-aged children's belief in misinformation. Based on what has been found in prior studies, we predicted a main effect of misinformation, with greater misinformation belief for subjects who received the misinformation compared to those who did not, as well as a main effect of correction, with greater belief for subjects who did not receive the misinformation compared to those who did. We also predicted an interaction between misinformation and correction, in which negative corrections increase misinformation belief, compared to no correction, when subjects are not exposed to misinformation, but decrease misinformation belief, when subjects are exposed to misinformation.

Our preliminary findings seem to be headed in the direction we expected. We have found that in the misinformation conditions, misinformation belief is higher when subjects do not receive a negative correction, demonstrating that negative corrections may minimize belief in misinformation when given within context. In contrast, we have found that in the no misinformation conditions, misinformation belief is higher when negative corrections are given, demonstrating that negative corrections out of context may increase belief in misinformation. These results, however, are based on a sample size too small to determine statistical validity. More data is needed to test whether these findings are truly significant.

If this study continues to produce the results we expect it to, after more data has been collected, it would not only address a gap in literature regarding misinformation correction in children, but it will also allow for the development of more effective corrective techniques that can be used by parents, schools, courtrooms, news media, and anyone else interested in disseminating accurate information to mass audiences.

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Making a Community-Based Urban Farmers Market: The Role of Critical Food Systems Activism and Education

Abstract

Through our research project, we evaluate how the Pomona Valley Certified Farmers Market addresses food insecurity in the city of Pomona and examine how it works within and against traditional food systems. While working closely with community partners at the farmers market, the research goal and objective is to increase food access among the residents of Pomona and explore how the space contributes to the development of socio-ecological community in the city. Through extensive hands-on participation as activist-ethnographers, we as members of Team Food Justice have quickly developed deeply-rooted relationships and companionship with the residents of Pomona. In working closely with these individuals, the three undergraduate researchers involved have come to realize that the safe and lively atmosphere at the farmers market is the direct result of the altruism and tenacity of community members. As a result, this work highlights a multitude of unique perspectives. Our wide-ranging world views have helped us connect on a fundamental level with the community members and leaders at our observation site.

Introduction

The aim of our project is to examine the ways in which food access and food insecurity are being addressed in the city of Pomona. Prior to starting this project, we set out to analyze community members' disproportionate access to fresh and healthy food along with the meanings of those complex terms ("fresh" and "healthy"), specific to each individual. We also wanted to delve into the role that community empowerment and engagement plays in the level of success of these endeavors to address food insecurity and food access issues in Pomona.

In constructing our literature review for this project, we learned that we were not the first to explore issues relating to food security and food access in a low income community or in a food desert. However, as is evident in the literature review below, these attempts were not always successful. In fact, in our research of pre-existing scholarly work, several patterns began to emerge regarding the success of these food access spaces (or lack thereof).

Typically, the desire to increase low income groups' access to healthy foods manifests itself in the creation of farmers markets. These spaces face a plethora of common obstacles. One such issue involves the forced prioritization of economic gaining potential over community need. There are countless costs for vendors who participate in farmers markets. These costs not only include the time vendors must devote to selling produce at the market space but also the monetary funds they must commit to transportation in order to reach the market space. Often, these vendors must set expensive prices if they are to make a profit or simply break even. Despite the fact that community members cannot often afford to pay these steep prices, vendors are often unable to lower them. Therefore, they are often forced to leave the spaces rather than cater to community needs. The Pomona Valley Certified Farmers Market addresses this obstacle in an innovative way through a volunteer-based model.

Through this model, vendors are able to avoid incurring the costs of transportation and time selling at the market. Managers and volunteers provide service by driving to outside locations in order to pick up market produce from these vendors. We then volunteer our time and sell the produce on behalf of the vendor.

Another common obstacle involves unidirectional knowledge distribution. Generally, market managers wanting to create spaces that address food access inadvertently assume that their levels of expertise qualify them to know what is "best" for the community, what that group "needs," and even what qualifies as "healthy" foods. As a result, they often dispense their ideas onto an unsuspecting public without asking community members themselves for input. As a result, the spaces created are not necessarily of, by, or for the communities they serve. Our project addresses this concern, as well, through a process known as knowledge sharing. Through this model, community members' input is an equal part of each aspect of the market. This knowledge sharing manifests itself in planning meetings in which volunteers (who are community members) are encouraged to provide their input and in the recipe sharing tent at the market at which food demos are conducted by managers and volunteers and recipes are also provided and documented by community members.

Literature Review

Food justice is both an activist/advocacy movement and conceptual framework for framing research, since it is deeply rooted in community activism and practice (e.g., Alkon & Agyeman, 2011; Alkon & Norgaard, 2009). In contrast to the sustainable agriculture movement, which has largely aligned itself with notions of "alternative food" through emphasizing agribusiness (Alkon & Agyeman, 2011), environmental sustainability, a White, upper middle-class ethos (Alkon & McMullen, 2010; Bradley & Herrera , 2015), and the consumption of elite, gourmet food (Alkon & Norgaard, 2009), critical food justice explicitly "links food access to broader questions of power and equity" (Alkon & Norgaard, 2010, p. 300), especially class, gender, and race, which mediate access to fresh, high quality food. Indeed, as Bradley and Herrera emphasize, "The food justice movement is fundamentally a social justice movement. It takes issue with inequalities in access to food, exploitative labor practices in the food system, and environmental degradation associated with conventional agriculture and environmental racism" (2015, p. 100). Thus, critical food justice is explicitly concerned with the empowerment of underserved communities, particularly concerning questions of food access and security, as well as environmental degradation and racism (Tornaghi, 2017). For food justice to maintain its decidedly critical lens, Alkon and Guthman emphasize that activists and scholars alike must remain attuned to "how food organizations may produce and reproduce neoliberal forms and spaces of governance" while being committed to imagining and enacting alternatives (2017, p. 11).

Julian Agyeman and Jesse McEntee (2014) recently suggested that food justice (both as an academic theoretical concept and as a social movement) would benefit from integration with urban political ecology (UPE) because food justice's "position is in a theoretically awkward space…not only guided by reactions to unequal access to food but also interested in addressing the causes of unequal access to food, which are tied up in broader structures and political-economic forces," a position which could benefit from integration with UPE's "historical-geographical materialist approach to urban-nature metabolic processes" (Ageyman & McEntee, 2014, pp. 215-216).

Although a thorough review of UPE is outside the scope of this proposal, we glean several insights relevant to the theoretical framing of this project. In their book, In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism, Nik Heynen, Maria Kaika, and Erik Swyngedouw develop a "manifesto" for urban political ecology,

> … Urban political ecology more explicitly recognizes that the material conditions that comprise urban environments are controlled, manipulated and serve the interests of theelite at the expense of marginalized populations. These conditions, in turn, are not independent from social, political, and economic processes and from cultural constructions of what constitutes the "urban" or the "natural." (2006, p. 6)

The recognition that economic, political, and social processes (both historical and present day) producing urban landscapes are spatially differentiated and uneven is critical to the current project insofar as food, vis-à-vis this lens, becomes a socially and materially produced resource to which access is spatially differentiated, typically along the lines of class, gender, and race. It also recognizes that urban spaces are not strictly social (i.e., human), but rather socioecological to the extent that social processes do not operate in isolation from the ecological or the natural (Heynen et al., 2006; Swyngedouw, 1999). Thus, human beings are viewed as entangled in relations with other living entities and the material world and these relations can and should be less exploitive. As Agyeman and McEntee (2014) note, merging UPE with food justice provides an analytic for "highlighting societal structures and the intertwined nature of the urban and the natural" and for understanding how material conditions and relationships (like those with food, land, water, plant and animals), "serve the elite at the expense of everybody else" (2014, pp. 211-212).

While UPE provides the tools to unpack and understand these uneven socioecological relations that produce unequal access to food, it is also critically important to explore less exploitative ways of developing these relations, especially those that explicitly challenge neoliberal capitalism's grip on global and local food systems (e.g., Agyeman & McEntee, 2014; Alkon & Guthman, 2017; Tornaghi, 2016). Thus, in this project we embrace food activism scholarship and practice, especially feminist food activism (CITE SOURCES). We are especially moved by Tornaghi's (2016) strategies for a politics of engagement, empowering, and commoning because she explicitly explores urban agriculture's capacity to challenge neoliberal urbanism and enable underserved people to regain control over food reproduction through food commoning. Tornaghi (2016) maintains, for example, that urban agriculture can build new alliances between social struggles (and thereby contribute to a politics of engagement and empowerment) through a critique of neoliberalism that: (1) calls for an alternative urbanism centered around food education and production, as well as the acknowledgement that people have a right to the city; (2) challenges mainstream market economies that largely fail to serve the poor; (3) challenges spatialized divisions of labor whereby cities have become places where food is consumed, but not produced; (4) calls for a new educational system that recognizes the importance of knowing the basic skills for survival, such as healthy food behaviors and sustainable food practices; and (5) challenges the neoliberal management of collective services (like water, land and sewage) and instead envisions urbanites as in control of important resources and nutrients needed for food production and social reproduction (2016, p. 794). Finally, through food commoning, Tornaghi suggests a restructuring of local food economies (like urban agriculture) such that

they include open and enclosed land, produce, they include open and enclosed land, produce, and locally processed food and also trade using alternative currencies like time, skills, and services, alongside money. She also points to resource sharing (such as "land, labour, produce, cooked food, organic waste, storage space, transport, time and skills") and the use of a wide variety of urban spaces, "including front and back gardens, and/or planners, vertical walls, schools, courtyards, public spaces, etc." (Tornaghi, 2016, pp. 796-797).

Methods

The goals we set prior to the start of this project were as follows:

- To examine how the Pomona Valley Certified Farmers Market contributes to the development of socio-ecological community in the city of Pomona.
  - Who is included and in what ways?
  - Who is empowered and in what ways?
- To explore how the Pomona Valley Certified Farmers Market currently addresses food access and insecurity needs.
  - What needs are not being met?
- To understand how the activist collective, Pomona Community Farmer Alliance, brings low-cost organic/chemical-free food to the Pomona Valley Certified Farmers Market.
  - What are the barriers and tensions associated with doing this work?

We addressed these goals through participant-observation and ethnographic interviewing. By immersing ourselves in the everyday activities and occurrences of the participants at the Pomona Valley Certified Farmers Market and conducting interviews with them, we were able to gain insights into the lived experiences of those participants in order to understand their senses of belonging and empowerment in the community, how their food access and insecurity needs were being met (or not), and the barriers and costs these individuals face with regard to their ability to participate in this space.

Participant-observation, one of the primary tools of ethnographic research, involves immersion in the site being studied while writing jottings and later expanded field notes that serve as a primary data source (e.g., Emerson, Fretz, & Shaw, 2011; Hammersley & Atkinson, 2007). By becoming volunteers at the Pomona Farmers Market, as well as patronizing the market, we have gained first-hand access to key informants who will provide us with insider knowledge (e.g, farmers market volunteers, community members who patronize the farmers market, vendors, community activists). We have also already conducted participant-observation (and will continue to do so) at City Council meetings, stakeholder meetings with city government officials, community organizing meetings, and other gatherings where important decisions about the market are made. The kinds of things an ethnographer pays attention to at the research site are shaped by the theoretical framework of the study (in our case, food justice/urban political ecology) as well as by conversations with study participants and interactions with the nonhuman environment (e.g., plants, animals, soil, insects, water).

Ethnographic interviewing. Ethnographic interviewing, our other primary method of data collection, is a specific interviewing technique designed to elicit what is important to the informant in relation to the study objectives.

Like the writing of expanded field notes, interview questions are carefully crafted with the theoretical framework (food justice/urban political ecology) serving as a guide (Heynen et al., 2006; Heynen, Kurtz, & Trauger, 2012). Interviews will follow a semi-structured format, allowing for new questions to emerge during the interview process (Hammersley & Atkinson, 2007). Interview questions will draw on previously published interview protocols used to ethnographically study urban agriculture sites (e.g., McCullen, 2008) and on our early fieldwork experiences at the sites, which began October 2018. These early fieldwork experiences have provided key data specific to our research sites that will be critical in the framing of interview questions.

Results

Community Empowerment and Engagement: Knowledge Sharing

Our team gained several remarkable insights with regard to the role that community engagement plays in the ability of a market space to thrive. As we previously mentioned, the success of community spaces is often short-lived without the support and investment of the community the space serves. This led us to postulate that a major part of the reason why the Pomona Valley Certified Farmers Market is currently experiencing steady growth is because every aspect of the space is dependent upon the commitment and enthusiasm of the community members themselves. The aforementioned processes of knowledge sharing and the volunteer-based models ensure that community engagement remains constant. This continual drive for community input is shown in many interviewees' testimonials including the following account from Emma, a volunteer at the food demo booth:

> "I mean I'm about ready to knock on doors of everyone that lives around there saying 'Do you know what you're missing?' You know, 'Come see us!' Um.. we put out...I put a--started a little book out for just that reason. 'What can we do better? What would you like to see?' So, I put a little journal next to our spiritual nourishment table with a pen. So, now it's just reminding folks that they could...they have something to say. 'What do you think we could do to do better? What would you like to see here? What do you like about it?' And maybe we can get them to participate and come to you guys can do something with it."

This volunteer emphatically states her desire to involve community members in market participation not only so that they will have the opportunity to receive the gifts that the market has to offer but also so that they can enrich the market with the knowledge that they themselves possess. In this way, she places equal value on the ideas of the market managers and the community members themselves.

Self-Care and Care for Others

While we assumed that we would discover findings regarding the importance of community member involvement, we were not expecting to problematize this involvement. However, a closer examination of Pomona Valley Certified Farmers Market's volunteer base (ourselves included) forced us to do just this and to confront the issue of self-care and care for others. The farmer's market's volunteer base is predominantly female. While the demographic makeup of this volunteer base is beneficial in many ways, it is also somewhat problematic because it lends itself to the creation of a space where, yet again, females are

being paid little to nothing to do hours of intense labor. Upon making this discovery, we postulated that this aspect might lead these individuals to burnout. However, in participating as female volunteers ourselves, we found that this concern was tackled in a unique way. The female volunteers of the market create a network wherein each individual can lean on the others and divide workloads amongst ourselves in the form of volunteer scheduling cycles, pickup rotations, and open communication. These concepts are highlighted in the testimonial of Mia, a volunteer coordinator:

> "I feel like [our market manager] has been incredibly open and very much like you know, 'help me.' Like just very open to hearing me out and like what I'm interested in like she makes a point to be very grateful for my presence and to communicate to me about her needs, her wants for the market and you know I asked her, 'how can I get more involved?' and [...] I feel like other volunteers are also that way, because we are all there I think for common cause so we are all just helping each other trying to balance everything that's going on."

This coordinator comments on the importance of investment in each other and how this collective investment can simultaneously help each individual invest in themselves and their own well-being. We hope to pass these unique aspects of "care" to other communities hoping to achieve the same goals as our own project.

"Fresh" and "Healthy": Different for Everyone

One emergent pattern in our findings was the frequency of the use of the terms "fresh" and "healthy." Many interviewees referred to a desire for fresh and healthy food. In our analysis, we discovered that not every participant had the same definition for these complex expressions. For instance, for some attendees, fresh and healthy involved the absence of chemicals:

> "[...] I just hate the word healthy, I'm very like 'diet talk' minded, but um just nutritious food that is not, doesn't have chemicals in it, things like that just to and to just educate people about what is nutritious to them while considering um how accessible it is."

Other participants defined fresh and healthy produce according to the feelings the consumption of such food evoked for them or patrons with whom they came into contact:

> "[...] a couple of folks for sure have even come back and told us weight loss, uh feeling better, more energy, things like that. Where i'm like, once you take those baby steps you start feeling better, you just see that spiral effect. So I go every week hoping for one more of those people."

From this data, our research team can glean that obtaining chemical-free produce that provides people with a sense of improved feelings of health is a priority for patrons of the farmers market. However, it has also become apparent that these patrons may not necessarily expect those feelings to appear overnight. They may be willing to invest in their own health for long periods of time in order to achieve long-term results.

Importance of Marketing, Promotion, and Geographically and Culturally Relevant Forms of Engagement

Geographic Barriers

While our research team discovered many points of contentment with regard to participants' overall feelings about the farmers market, several participants did mention a few barriers that prevented the growth of the space. Farmer Ryan, a former vendor and current volunteer, comments on the role that a geographic barrier plays in preventing South Pomona residents from attending the market:

> "This current market we're talking about is located on the corner of Holt and Garey, which is north--north of Holt. So you have Holt, you have the railroad tracks in downtown, you have Mission Boulevard, you have this whole corridor. And nobody in South Pomona crosses that corridor to go shop north of it. And so, even though it's so close, there's a literal barrier. And so, South Pomona probably needs its own farmers market for the people who live in South Pomona. And I b--just had a phone conversation this morning with a young lady from IPS. We're donating uh produce to um middle school farmers market pop-ups. And so they go on campus, set up the thing, the kids get out of school, they take all the produce and leave. So, what we were talking about is we have to bring--literally bring the p--produce to right where the people are."

Farmer Ryan not only mentions the existence of the geographical barrier but also provides insight into his lived experience that reveals a potential solution. By devoting energy toward incorporating a delivery system into the volunteer pickup and dropoff model, the Pomona Valley Certified Farmers Market might be able to engage residents of Pomona that live on the southern side of the corridor Farmer Ryan mentions.

Cultural Barriers

Joanna, a potential future vendor and current volunteer and a female of color, also highlights a cultural barrier that occurs in the form of a lack of culturally relevant food:

> "Mmm I'm not--I'm not too sure um I think the one thing I saw as kind of like a road block was um so there's like a taco stand that's interested in um vending at the farmer's market and then, so I asked about them at the last meeting and then so it was like the guideline that well they have to be open to source from a more sustainably growing um meat vendor um which I agree. Like, I know all the issues with um CAFO's, but I think that can also be a road block for access initially and just having those people there because they are what's gonna draw more um of the Hispanic population."

Like Farmer Ryan, Joanna includes a possible solution in her testimonial. By making a conscious effort to seek out vendors who make culturally relevant food, farmers market managers might mitigate this cultural barrier. However, attempts to do so can be problematic when the visions and values of these vendors do not necessarily align with those of the farmers market managers.

Language Barriers

Another barrier that emerged in our findings was the language barrier present within the market. Due to the fact that many of the vendors not affiliated with the Pomona Community Farmers Alliance are non-English speakers, English-speaking volunteers and attendees may struggle to communicate, as Connor, a volunteer at the farmers market describes:

> "Well, all of the yellow tents I spend most of time in. Um, part of the reason for that is, like the vegetable vendor, there's a bit of a language barrier. They speak very little of English, and I speak very little of Spanish. So we have little jokes like we're both trying but we don't know what we're doing, it's fine. Um, but it gets a little awkward when you can't understand as well as you would like."

While Connor acknowledges his feelings of unease with regard to the language barrier, he makes it known that there is a mutual understanding between attendees and vendors wherein both parties are making an attempt to communicate. This level of effort may contribute to participants' ability to form a relationship.

Conclusion

As we have seen in the projects of our predecessors, the success of a community space is entirely dependent upon the involvement of that community; failing to connect with a community because of racial, cultural, or even geographical differences can prevent this type of collaboration entirely. In our research, we have found these notions to be true. However, due to the unique demographic makeup of the population and community space we studied, we were able to expand upon the ideas detailed in this pre-existing literature.

We agree that community involvement is crucial to the success of a food access space. However, we further argue that this involvement must be active and constant. Community ideas must be incorporated into each facet of that space at every turn if the space is to successfully represent and be integrated into the community itself.

Further, we agree that groups that intend to create spaces that provide large-scale community benefits face inevitable barriers and that the racial, cultural, and geographical differences associated with such barriers can lead to breaks in understanding that can potentially disrupt the success of these spaces. However, while these barriers can hinder participants of the market from understanding or even reaching one another, the active inclusion and participation of diverse representatives of the community can lead to diverse ideas--those that give way to innovative and creative solutions that can potentially increase the success of a community space in an exponential way.

Additionally, while the reliance on the free labor and generosity of minorities (i.e. women and people of color) for the success and continued operation of the space can lead to disproportionate monetary recognition for that labor and may contribute to the continued global struggle of such traditionally marginalized groups of people, our active participation at the Pomona Valley Certified Farmers Market has shown us that the formation of a tight-knit group among these individuals--wherein each and every member is equally supported, listened to, and welcome to participate to the capacity of their choosing can mitigate the tensions and pressures associated with such work.

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A SIFT-based Partial Processing Algorithm for Real Time Image Search

Abstract

Today's digital age can be defined by the massive amount of data and information readily accessible in various forms of media [39]. While images have become a popular medium of information, current methods for relevant information search and retrieval face significant challenges.

Due to rapidly growing data ingestion rates, current image retrieval methods have led to increased lag time as well as the demand for massive and expensive computational resources. Therefore, the need for an efficient process of searching data for immediate use has become critical [5] [31]. This research project emphasizes the partial processing paradigm for the design and implementation of algorithms for real time image search. Specifically, we will be focusing on content-based image retrieval methods, where the images are analyzed by their features such as color, texture, and shape. Scale Invariant Feature Transform (SIFT) [7], is one of the more robust feature detection algorithms that we have chosen to work with due to its ability to extract features amidst scaling, orientation, and illumination changes. We provide initial exploration of the aspects of SIFT based image search algorithms that can successfully leverage partial processing and can be successfully deployed on one or more parallel/distributed platforms.

Background: Image Retreieval

Image retrieval can be defined as a process of searchingand retrieving images from a large database. The image retrieval research can be broadly classified into two subareas: Text Based Image Retrieval (TBIR) [38] and Content Based Image Retrieval (CBIR) [30]. The earlier algorithms, known as text based image retrieval (TBIR), utilizes keywords, captions, or descriptions associated with an image. Therefore, the algorithms use text annotation to search for relevant images. According to Tsymbalenko et al, HTML texts around the images provided additional description and context, making it widely used in commercial image search engines [16]. To deal with more specialized images, methods have used various ontologies [17][18] to extract semantic information [2] [19] [20] from the metadata. However, there has been a gradual shift in focus from TBIR to content based image retrieval (CBIR) [1] [28] where the image's visual information is interpreted. CBIR methods try to retrieve images similar to a user-defined specification or pattern such as a sketch or query image. The objective is to extract visual content such as shape, color, and texture. One of the main advantages of CBIR is its possibility of being an automatic retrieval process, instead of the traditional keyword-based approach (TBIR), which usually requires time-consuming previous annotation of database images. While this could explain the transition from TBIR to CBIR, current image retrieval methods in general are not highly effective in light of rapidly growing databases and increased complexity of images [10]. Current methods [14] rely on pre-processing the data using a technique called indexing, where each document is processed entirely before similarities are calculated. Additionally, indexing does not allow for intelligent computational resource allocation, leading to substantial lag time and need for massive computational resources. Fully processing and searching through a growing database is the critical issue.

The Anytime Algorithm

In consideration of the problems dealing with currentimage retrieval methods, this prompts us to question if we can rather partially process data. From this, we may be able to achieve efficiency by reallocating computational resources to the relevant images according to the analysis of partial results. If we can partially process data, we may be able to prevent the wastage of computational resources on non-relevant images and speed up the process by identifying relevant images through partial similarity. To achieve this, we plan to consider algorithms with anytime property. They provide solution quality corresponding with the amount of computational resources applied. Anytime algorithms have the four main properties [32]:

Interruptibility: The algorithm can be stopped at any time and provide a result.

Monotonicity: The quality of the result is a monotonically non-decreasing function of processing time and input quality.

Measurability: The quality of an approximate result can be determined precisely. For example, when the quality reflects the distance between the approximate result and the correct result, it is measurable as long as the correct result can be determined.

Preempt-ability: The algorithm can be suspended and resumed with minimal overhead.

As more execution time correlates with better solution quality, more processing will typically lead to better results. Considering that CBIR methods have the potential of becoming automatic retrieval processes, we will examine prominent CBIR methods and identify our chosen algorithm for our study.

Content Based Image Retrieval

Content-based image retrieval (CBIR) can be defined asanalyzing the visual features of an image rather than the keyword tags or descriptions associated with the image. The variety of CBIR methods, such as [3] [4] [8] [15] [21] [22] [23][24], that currently exist can be broadly classified by useraims: search by association, target, or category [30]. However,CBIR methods can specifically be classified based on whatthey do. One of the most experimented and popularapproaches have been region-based methods [26] [27], wherethese methods form a signature (mathematical form) for theimages by dividing them into various regions based on similar pixel characteristics. Methods such as WALRUS [9], NETra [25], and Blobworld are region based and the calculated signature can be interpreted into extraction for certain concepts and relations of images. To deal with more complex images, methods like WALRUS [9] generate regions by sliding a window over the image and calculating the feature signature for the part of the image under the window. A major drawback is that signature-based algorithms cannot retrieve an image when there are different transformations for it, such as resizing and cropping. This prompts us to discuss another kind of CBIR method: keypoint extraction. This can be defined as the process of automatically computing a compact numerical representation of some qualitative attribute (feature) of digital images. Methods such as SIFT [7], ORB [35] [33], SURF [34] are feature-extraction based and involve a procedure of locating an area of interest and identifying key points that can be compared through images.

Scale Invariant Feature Transform (SIFT): The SIFT algorithm extracts features invariant to scale and rotation from images that can be used to perform reliable matching across a range of distortion, change in 3D viewpoint, addition of noise, and change in illumination[7].

Oriented FAST and Rotated BRIEF (ORB): The ORB algorithm builds on the well-known FAST key-point detector [36]and BRIEF descriptor [37] to extract a feature vectorfrom an image.

Speeded-up Robust Features (SURF): Using a combination of novel detection, description, and matching steps, the SURF algorithm utilizes a Hessian matrix-based measure for the detector, and a distribution-based descriptor for extracting features of an image[34].

Although ORB and SURF have shorter procedures, SIFT has potential capability to generate more precise features. Although it may appear to have more steps, each step of SIFT accounts for ensuring that the key points detected are scale and rotation invariant, as well as susceptible to changes in illumination and distortion. Thus, this algorithm comes to our interest and we will begin our investigation by exploring the steps of SIFT as well as potential ideas for formulating an anytime version of it.

Sift

We are interested in image retrieval techniques thatgenerate distinct features from an image to compare. Therefore, an algorithm we plan to start working with is SIFT, or known as Scale Invariant Feature Transform. This algorithm comes to our interest due to its ability to match features across different images that can be scaled, rotated, illuminated, or distorted. According to Donglei et al, while this feature-detection algorithm has been proven to be one of the most robust among others, accelerating the algorithm is urgently needed due to it being computationally intensive [6]. One strategy under consideration is taking a cascade filtering approach, in which the more expensive operations are applied only at locations that pass an initial test. While we will further explain our experimental study in the following paragraphs, we plan to run tests for different scales and blurs to prove whether increasing them would lead to better results. However, we begin our investigation by exploring the steps of SIFT and how they provide a method for extracting distinctive and invariant features from images that can be accurately matched across a substantial range of distortions, 3D viewpoint, noise, and illumination [7]:

1)*Approximate Key-point Location*: The Gaussian scale-space represents a sequence of increasingly blurred images. This blurring process simulates the loss of detail within an image taken at various different distances. As the digital scale-space is computed, every blur level will be measured in the sampling grid of the input image. Then, the difference-of-Gaussian function is used to identify potential interest points that are invariant to scale and orientation. A gauss pyramid is then constructed (Fig. 1), where several octaves (blur levels) containing several intervals are computed through a Gaussian transformation [6].

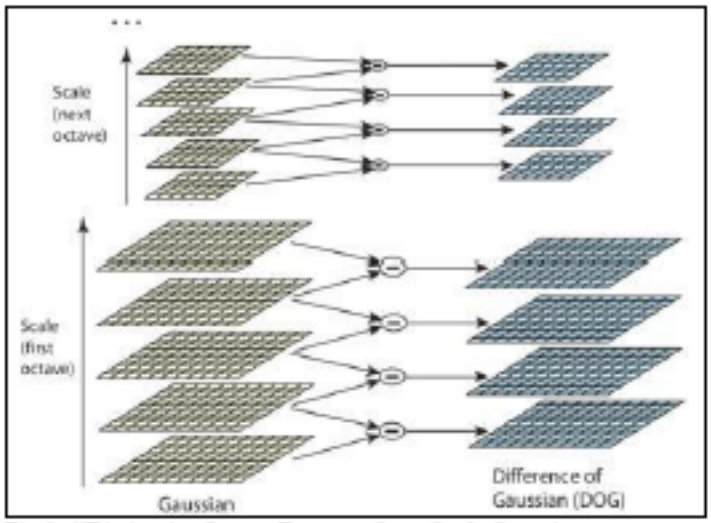

Fig 1. "Distinctive Image Features from Scale-Invariant Keypoints" [7].

2) *Refining Key-point Location*: At each potential location of interest, a detailed model is fit to determine location and scale (Fig. 2). "Key-points are selected based on measures of their stability" [7]. The key-points are detected as maxima/minima of the Difference-of-Gaussians in an octave interval pyramid [6].

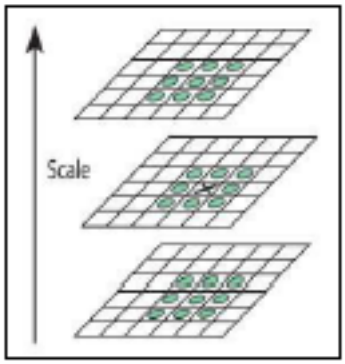

Fig. 2 "Distinctive Image Features from Scale-Invariant Keypoints" [7].

3) *Orientation Assignment:* Each key-point is assignedto one orientation based on local image gradient directions in order to achieve invariance to rotation [6].

4) *Building Key-point descriptor*: A descriptor vectorwill be computed for each key-point (Fig. 3) such that the descriptor is highly distinctive and invariant to variations such as illumination, distortion, and 3D viewpoint [6].

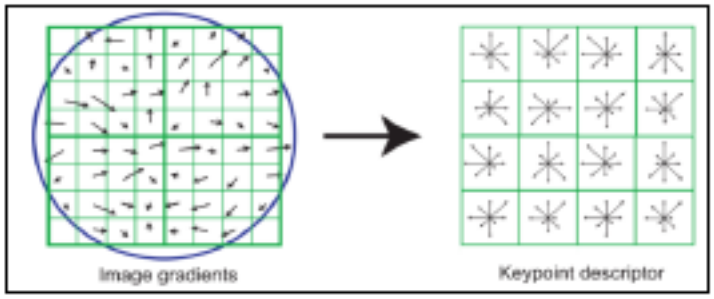

Fig. 3 "Distinctive Image Features from Scale-Invariant Keypoints" [7].

Specifically, this process transforms image data into scale-invariant coordinates relative to local features. For reliable identification, it was determined [7] that at least 3 features be correctly matched from each object. Thus, the key-point descriptors are highly distinctive, so there is a greater probability for a single feature to find its correct match within large databases of features. Although this method provides a potential to be effective, there have been implementations [11][12] towards reducing run-time and increasing accuracy among results. For example, the SIFTpack [11] compacts the storage of SIFT descriptors, which enables faster calculations for both finding nearest neighbors and for computing all distances between all descriptors. Also, from analysis of the parallelism of SIFT at the scale level, feature detection, and key-point descriptor stages [13][6], we can begin to parallelize SIFT to effectively improve its performance. One implementation [6] identifies that dependency on the gauss pyramid and computational complexity in various scales cause work imbalance. To overcome these problems, the dependency in gauss pyramid was removed and a high coupling method and balance allocation algorithm was implemented to allocate key-points. Another implementation [29]adopted the layer parallel restructured box kernel toreplace Gaussian blur operations. As a result, thecomputational amount decreased by a significant amount [29].However, the real time implementation of the SIFT algorithmstill faces the challenges computation complexity, largememory storage, and lag time. Specifically, we aim toformulate an anytime version of the SIFT algorithm that canbe interrupted during execution and generate a usable result atthe point of interruption.

Our Objective and Proposal for Further Research

So far, we have introduced the background of ImageRetrieval, the sub-areas within it, and SIFT. Challenges such as interpretation of partial information, computational complexity, and resource allocation will be considered when formulating and designing our algorithm. Therefore, we have begun to explore, design, and implement SIFT with anytime properties and study its performance advantages through experimental validation. To begin our implementation of SIFT, we chose to work with the Python programming language for simplicity as well as its available functions within the OpenCV libraries. OpenCV is a collection of programming functions aimed at real-time computer vision, and it includes functions that follow the steps of SIFT. As we formulate this algorithm, we have hypothesized that increasing the number of scales and blurs would generate better results for key-points. In the future, continued experimentation for implementing this as well as partially processing the data through parallelization would help us get closer to our goal of an anytime version of SIFT. But broadly speaking, our results are intended to reduce run time, computational resources, and hopefully be a step towards crafting a more efficient method for image retrieval.

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The Effect of Environmental Enrichment on the Number of NADPH-d Positive Interneurons in the Dentate Gyrus of the Rat Dorsal Hippocampus

Abstract

Exposure to an enriched environment has been shown to be beneficial to brain structure and cognition by preserving neuronal integrity and strengthening the functioning and plasticity of neural circuits [1]. These benefits derive from the added spatial, social, and sensory complexities in an enriched environment [2]. It has recently been established that physical exercise and enriched environments stimulate adult neurogenesis [3] and differentiation in dentate granule cells (DGCs) [4] in the dentate gyrus of the hippocampus. However, possible changes in other cell types, particularly interneurons, has remained elusive. Interneurons are an integral regulator in neurotransmission in the hippocampus. Damage to hippocampal interneurons have serious implications and lead to a decline in cognitive abilities [5]. Our study sought to elucidate possible changes in a subclass of interneurons affected by exposure to an enriched environment (EE) and enriched changing (EC) environment. The topographic arrangement of nicotinamide adenine dinucleotide phosphate-diaphorase (NADPH-d) positive interneurons was studied in the dentate gyrus of the rat dorsal hippocampus. We observed an increase in the number of NADPH-d positive neurons found in both enrichment groups. The elevated level of NADPH-d activity was represented uniformly across all six layers of the dentate gyrus and was most significant in the expected granular cell layer (GRCL) and infragranular zone (infraGRZ). The overall results suggest that the brain has the ability to adapt to increased amounts of sensory stimulation. These changes highlight a new mechanism of physiological homeostasis; with an increased demand for energy from new-born DGCs and increased input, the brain will regulate its energy expenditure via an increase in either the activity of existing interneurons, or the actual number of interneurons. Further research will involve observing the differences to the ventral hippocampus, CA1, and CA3 regions, and the effects on other specific subpopulations of interneurons.

Introduction

The hippocampus is the primary region of the brain that is often associated with memory consolidation and decision making. The hippocampus is divided into two distinct regions: dorsal and ventral. The dorsal hippocampus performs primarily cognitive functions and is involved with spatial memory [6]; and the other is the ventral hippocampus, which relates to stress, emotion, and affect [7]. The hippocampus is one of the few regions of the brain that has continual addition of new neurons, particularly newborn dentate granule cells (DGCs) through the phenomenon of adult neurogenesis [8]. Substantial amounts of literature have indicated that these neurons integrate themselves into the circuitry of the hippocampus and are involved in learning and memory [9]. Novel environmental exploration experiences have been shown to increase the addition of adult generated neurons by having DGCs increase their Ca2+ event frequency preferentially [10]. A large portion of these new-born DGCs do not survive an initial developmental phase, termed the “critical survival period” [11]. In addition to their generation, an enriched environment also contributes to the survival of newborn DGCs. As the number of cells increase in the hippocampus, so does the risk of hyperexcitation [12]. Previous literature reports that vulnerability of GABAergic interneurons to excitotoxic damage was recorded in the hippocampal CA1 region of

pilocarpine models of chronic limbic seizures [13]. GABAergic interneurons have highly specialized functions and different types of hippocampal inhibitory interneurons control spike initiation (e.g., axo-axonic and basket cells) and synaptic integration (e.g. bistratified and oriens-lacunosum moleculare interneurons) within pyramidal neurons and synchronize local network activity, providing a means for functional segregation of neuronal ensembles and proper routing of hippocampal information [14]. Indeed, if inhibitory interneurons are key regulators of hippocampal activity, then it is imperative to determine what mechanisms control the activity of interneurons themselves, as the preservation of these interneurons is vital for hippocampal function. Here, we will highlight a new mechanism of interneuron activity regulation via a change in NADPH-d activity of interneurons in the dentate gyrus.

NADPH-d Positive Interneurons

Neuronal nitric oxide synthase (nNOS) activity is determined by NADPH-diaphorase staining. nNOS is primarily expressed by subpopulations of GABAergic interneurons in the mature hippocampus and neocortex, and is responsible for the generation of nitric oxide (NO). As a gaseous very weakly polar molecule without net electric charge and due to its small size, NO can diffuse readily across cell membranes in anterograde and retrograde directions to act presynaptically, postsynaptically, or within the cell that has produced it, functioning as a paracrine neurotransmitter, and also a local vasodilator to increase localized blood flow to active brain areas. Two types of GABAergic nNOS+ neurons have been distinguished histochemically, strongly stained nNOS-Type 1 and weakly stained nNOS-Type 2. Our study focuses only on nNOS-Type 1 interneurons. Type 1 neurons express high levels of nNOS and NADPH-d activity. These interneurons exhibit a fast spiking firing profile, meaning that they are able to generate a train of action potentials at high frequency [15]. Their axons preferentially target the perisomatic region of granule cells, making them ideally suited to rapidly regulate dentate gyrus output [16].

Materials and Methods

Animals and housing conditions

In order to stimulate the rat dorsal hippocampus, we used varying forms of an enriched environment. Twelve male Sprague-Dawley rats were divided into three groups. The first group was a control (N), and was housed in a 1000g/rat sized caged (Figure 1) and received basic necessities. The cages were changed once a week. The second group was classified as the enriched environment (EE) group. The EE group was housed in a 2000g/rat sized cage (Figure 2) and received basic necessities. The EE group also received toys and square pipes to interact with. At the time of weekly cage changing, the interactive objects were replaced with replicas and were placed in the same location, as found in the former cage, in the new cage. The third group was classified as the enriched changing (EC) group. The EC group received the same housing conditions as the EE group. However, the location of interactive objects were rearranged twice a week. Furthermore, when undergoing their weekly cage change, the new cage was filled with a set of toys that the rats had not been introduced to before in a random arrangement. Prior to the cage rearrangement and cage changing, the rats were moved into a 40-gallon tank play arena (Figure 3) that was filled with more forms of enrichment for four hours.

Tissue collection, processing, and statistical analyses

After 30 days of housing, rats were anesthetized and perfusion fixed. The brains were removed and frozen sectioned at 50µm with a sliding microtome. Tissue sections were stained using NADPH-d histochemistry. The topographical arrangement of NADPH-d positive neurons in the dentate gyrus of the hippocampus, as seen in Figure 4 & 5, from sections was recorded by counting individual neurons (Figure 6) in each of the seven layers: hilum, CA4, infragranular zone (infraGRZ), granule cell layer (GRCL), inner molecular layer (IML), middle molecular layer (MML), and outer molecular layer (OML). The counts were standardized and expressed as number of stained neurons per millimeter (Figure 7). A standard deviation of counts was determined for each layer examined (Figure 6).

Results & Discussion

Our results in Figure 6 show an increase in the number of NADPH-d neurons across all seven layers-- associated with both enrichment groups compared to controls. With the developed standard measurement in Figure 7, we saw that the control group (n=7) had 2.32, the EE group (n=7) with 3.45, and the EC group (n=10) with 3.52 stained neurons per millimeter. The overall results suggest that the brain has the ability to adapt to increased sensory input from an enriched environment. These changes suggest a new mechanism of physiological homeostasis; with an increased demand for energy from new-born DGCs and increased input, the brain will regulate its energy expenditure via an increase in either the activity of existing interneurons, or the actual number of interneurons. Which one it is, is still yet to be determined. This is very exciting because an increase in interneuron activity has very rarely been shown before in works of literature. Many papers focus on restoration numbers of interneurons after lesions or induced injury, however, very few have shown that there is an increase in the activity of original numbers of interneurons. Although this alternation in neuron number is potentially compelling, we recognize that our samples are relatively small, and should be recognized as preliminary.

Future Work

A new protocol was submitted to run a restudy on NADPH-d activity of interneurons. The CA1 and CA3 regions will be studied in conjunction with the dentate gyrus. Additionally, we will study the effects of social isolation on the ventral hippocampus with the hypothesis that NADPH-d activity will be reduced due to a decrease in stimuli from social isolation. Subsequently, in both dorsal and ventral hippocampus, we will be looking at the effects of enriched environment and social isolation on specific subpopulations of calcium-binding interneurons. These include parvalbumin (PV), calbindin (CB), calretnin (CR), somatostatin (SOM) and a few others as these interneurons have been associated with high energy expenditure and their critical roles in transmission regulation [17]. Double-labeling with a neurogenesis marker, doublecortin (DCX), is also planned to determine if any of the increase in NADPH-d activity was due to the adult neurogenesis of interneurons, a phenomenon observed only in the olfactory system.

Appendix

Figure 1

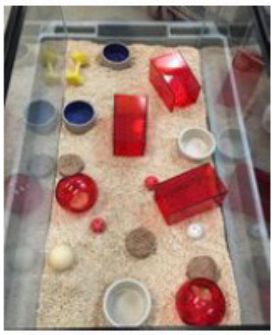

Figure 2

Figure 3

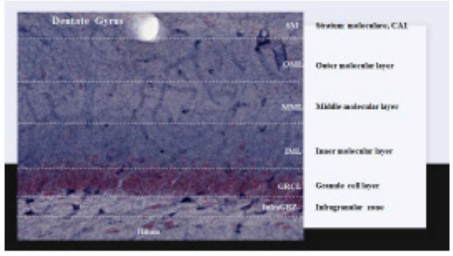

Figure 4

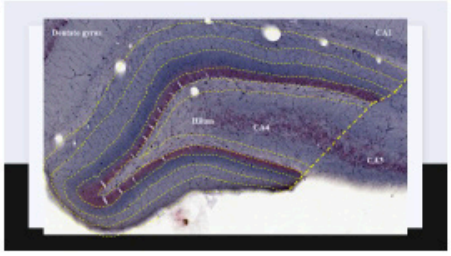

Figure 5

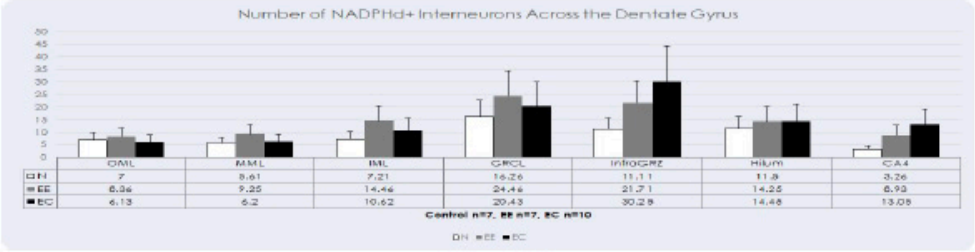

Figure 6

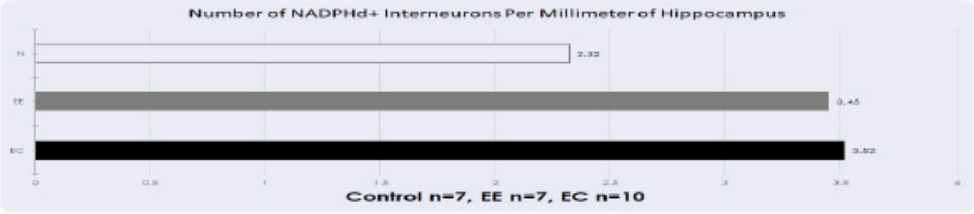

Figure 7

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Should Business Faculty Encourage Their Undergraduate Students to participate in Research ?

Abstract

Psychology literature shows that undergraduate students who participate in research (e.g. as survey takers) find the experience valuable and report the participation as having a positive impact on their education. Although the value of undergraduate students' research participation (RP) has been well documented in psychology literature, little is known about the benefits of RP in marketing, as business education tends to place more emphasis on real-world experience. This study identifies various factors that might influence the effectiveness of RP in marketing, which is measured as perceived value of RP, helpfulness of RP in learning marketing concepts, student's attitudes towards participation, and student's intentions to participate in future studies. Data collected from students enrolled in marketing courses provides general support for the hypotheses. This research sheds light on business pedagogy literature by providing evidence of the effectiveness of experiential learning in business education, as student RP is an example of experiential learning (learn-by-doing), as opposed to a didactic method of learning where students are simply passive listeners.

Keywords: Value of Research Participation, Experiential Learning, Business Pedagogy, Undergraduate Education, Marketing Pedagogy

Introduction and Literature Review

Psychology research shows that students learning psychology prefer RP (i.e. taking surveys) as opposed to other types of learning methods such as attending class lectures or reading textbooks (Elliot, Rice, Trafimow, Madson, & Hipshur, 2010). Participation in psychology research was even shown to help students learn psychology concepts better (Landrum & Chastin, 1995). However, past research also shows there are qualifying factors that moderate such effectiveness (Moyer & Franklin, 2011). This research intends to extend psychology literature to marketing education and apply the "learn by doing" philosophy of experiential learning to marketing curriculum through RP. To this end, we investigate the overall effectiveness of students' participation in marketing research on their learning of marketing and business concepts and assess various factors that could influence RP effectiveness.

Motivation Type. According to the cognitive evaluation theory (Deci, Cascio, & Krusell, 1975; Deci & Ryan, 1980), there are intrinsic (need for competence) and extrinsic (external rewards) human motivations. Research has determined that a combination of both extrinsic and intrinsic motivation leads to better student performance in class (e.g. course grade), than only having extrinsic motivations (Lin & McKeachie, 1999). Thus, we hypothesize that students with both intrinsic (i.e., desire to learn marketing) and extrinsic motivation (i.e., desire for course credit), compared with those with only extrinsic motivation, will perceive research participation to be more effective (i.e. (a) more valuable, (b) more helpful in learning marketing concepts, (c) hold positive attitudes, and (d) future intention to participate in research) (H1).

Incentive Type. Students are often offered course credit for RP in the form of either required or extra credit. Research on the effects of extra vs. required credit for RP have been mixed. For example, studies have shown that required RP does help students learn class concepts (e.g. Landrum & Chastin, 1995); however, Nimmer and Handelsman (1992) found that students hold less positive attitudes towards participation when it is required (vs. not required). In fact, research shows that required credit has the potential to be seen as coercive by students (Miles, Cromer, & Narayan, 2015). Thus, we hypothesize that students given extra credits, compared with those given required course credits, will perceive RP to be more effective (H2).

Sincerity. Sincerity in RP is the extent to which an individual expresses themselves in their responses with their true thoughts and beliefs. Drawing from Vroom's expectancy theory (1964), individuals will be motivated if they believe that strong effort will lead to good performance, which then leads to desired rewards. Thus, students who believe that sincere efforts in their RP will end in a desired reward (e.g. course credit or learning outcome), will exert higher sincerity in their survey responses. Therefore, we posit that sincerity in business RP will be positively related to student's perception of greater RP effectiveness (H3).

Interest. Furthermore, Bowman and Waite (2003) found that social science majors had more favorable perceptions of research and psychology than non-social science majors, which is likely due to their interest in social science. We argue that these findings can apply to business students. Thus, we hypothesize that compared with non-business majors, business majors will exhibit greater level of RP effectiveness (H4) and interest in RP (H5), and that interest in RP will be positively related to RP effectiveness (H6).

Methodology

We used a sample of undergraduate students enrolled in introductory marketing courses (n = 862). Average age was 23 with 48% males and 52% females. Students were offered course credit for their RP in the form of required credit (46%) or extra credit (54%) (type decided by instructor). All students must have participated in at least one study in the same quarter prior to this study (M# of studies = 2.52). Participants responded to an online survey divided into multiple sections. All the constructs were measured on either 1-5 or 1-7 point Likert-type or semantic differential scale. All multi-item constructs were found reliable (Cronbach's alpha's > .81) as seen in Table 1. Thus, we created composite scales by averaging the question items measuring the same constructs for each of the four dependent variables [value of RP (α = .89), helpfulness in learning marketing (α = .93), attitudes towards RP (α = .81), and intention to participate in the future (α = .88)], which collectively represent RP effectiveness in testing hypotheses. See Table 2 for correlations and descriptive statistics for variables used in hypothesis tests.

Results

H1, H2, and H4 were tested with independent samples t-tests. Consistent with H1, results showed that participants with both types of motivations (intrinsic and extrinsic), compared with those with only extrinsic motivation, perceived RP to be more effective (p's < .001) in terms of all four dependent variables. Results of four t-tests revealed that consistent with H2, extra credit was more effective (vs. required credit) for inducing higher intention to participate in the future (p < .001); however, unlike hypothesized, it was not more effective than required credits (p's > .10) in inducing (a) value of RP, (b) helpfulness in learning marketing concepts, nor (c) attitudes toward RP.

Thus, H2 was partially supported. To test H3, we regressed each of the four dependent variables on sincerity, interest, and major (business vs. non-business), with the latter two as control variables. Results confirm the positive impact of sincerity on RP effectiveness (p's < .05), consistent with H3. Results of t-tests show that business (vs. non-business) majors perceived RP to be more helpful in learning marketing (p < .001) and indicated stronger intention to participate in the future (p < .001), but majors had no impact on the value of RP nor on attitudes toward RP. Thus, H4 was partially supported. Results of a t-test show that business majors (vs. non-business) majors had stronger interest in RP (p's = .06; H5), which in turn is positively related to RP effectiveness (p's < .001; H6). H4, H5, and H6 together suggests that interest in RP may mediate the impact of majors on RP effectiveness. A procedure by Baron and Kenny (1986) reveals that it does partially mediate the impact of majors on RP effectiveness.

Conclusion

Our research shows that students who are motivated both intrinsically and extrinsically (vs. only extrinsically) perceive business RP to be more effective overall. This indicates that business faculty should not only emphasize the credits students would earn for RP, but also the learning opportunity it provides. Consistent with past studies (e.g., Landrum & Chastin, 1995), the impact of granting required vs. extra credit for RP were mixed, where the only significant difference between the two groups was that those offered extra credit exhibited more interest in RP in future studies. This allows business faculty more flexibility in planning their class structure without the risk of diminishing the value of RP. Results also show that students who are more sincere in their RP report greater perceived effectiveness of RP, consistent with past studies (Darling et al., 2007). When considering the impact of majors on effectiveness of RP, business (vs. non-business) majors perceived RP to be more helpful in learning marketing and indicated stronger intention for RP in the future. Further analysis revealed that interest in RP mediates this relationship. That is, the reason why business students perceived RP to be more helpful in learning marketing and were more intent to participate in the future is that they have greater interest in RP than non-business majors. This study is the first that extends psychology pedagogy literature to marketing pedagogy literature to suggest RP as a viable experiential learning method for often dry marketing research topics. Limitations include testing students' perceived effectiveness, not actual effectiveness (e.g. course grades), which future research can address.

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Table 1.
Scale Items for Multi-Item Constructs and Reliability

Constructs and Measurement Items	Cronbach's Alpha
Perceived Value of Research Participation (5-point semantic differeiential scale) How valuable did you feel participating in the studies was? • Not worth my time (1) – Worth my time (5) • Not worth my effort (1) – Worth my effort (5)	0.89
Helpfulness in Learning Marketing Concepts (7-point likert-type scale: Strongly disagree - Strongly agree) 1. Participation in the research helped me in understanding how good marketing research should be done. 2. I feel that participating in the studies helped me understand marketing research better. 3. Participation in the research helped me understand marketing concepts in general. 4. I feel that I learned a lot about marketing by participating in the studies available on the sona system. 5. I feel participating in the studies enhanced my knowledge about marketing.	0.93
Attitude Toward Research Participation (5-point semantic differeiential scale) Participation in research is: • Bad (1) – Good (5) • Negative (1) – Positive (5) • Boring (1) – Fun (5) • Useless (1) – Useful (5)	0.81
Intention to Participate in Research in the Future (7-point likert-type scale: Not Likley – Very Likley) 1. How likely is it that you participate in similar studies next time when you are given a chance? 2. I would strongly recommend it to other students.	0.88

Table 2.
Correlations and Descriptive Statistics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Motivation Type	1								
(2) Incentive Type	-0.06	1							
(3) Sincerity	0.09**	-0.03	1						
(4) Interest	0.37***	0.08*	0.31***	1					
(5) Major	0.08*	0.04	0.01	0.07	1				
(6) Value of RP	0.29***	0.05	0.29***	0.53***	0.03	1			
(7) Attitude toward RP	0.27***	0.04	0.35***	0.51***	0.04	0.70***	1		
(8) Helpfulness in Learning	0.35***	-0.04	0.23***	0.49***	0.11**	0.54***	0.55***	1	
(9) Intention for future RP	0.30***	0.16***	0.23***	0.53***	0.14***	0.62***	0.57***	0.53***	1
Mean	0.41	0.54	4.48	3.46	0.67	3.78	4.03	4.83	5.36
Standard Deviation	0.49	0.50	0.78	1.05	0.47	0.91	0.73	1.13	1.29

Note: *<0.05, ** <0.01 and ***<0.001 (two-tailed); **(1)** Motivation Type (0 = extrinsic motivation [i.e., credits], 1 = extrinsic and intrinsic motivation [i.e., credits and desire to learn]); **(2)** Incentive type (0 = required credit, 1 = extra credit); **(3)** Sincerity = Sincerity in research participation (1 = "Not at all sincere," 5 = "Very much sincere"); **(4)** Interest = Interest in research participation (1 item: 1 = "Not at all interested," 5 = "Very much interested"); **(5)** Majors = Student's Major (**0** = Non-business majors, 1= Business Majors); **(6)** Value of RP = Percieved value of research participation (2 items on 1-5 point scale); **(7)** Attitude toward RP = Attitude toward research participation (4 items on 1-5 point scale); **(8)** Helpfulness in learning = Helpfulness in learning marketing concepts (5 items on 7-point Likert type scale); **(9)** Intention for future RP = Intention to participate in research in the future (2 items on 7-point Likert type scale).

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Investigating the role of CR3 in trogocytosis of Trichomonas vaginalis cells by Neutrophil-like cells.

Abstract

Trichomonas vaginalis (T. vaginalis) causes the non-viral sexually transmitted infection (STI), trichomoniasis. Trichomoniasis affected almost 276.4 million people globally in 2008 alone, with most incidents occurring in underserved communities. The main curative treatment for T. vaginalis is an antibiotic, Metronidazole, though antibiotic resistance is on the rise. Neutrophils are the first responders against T. vaginalis, killing the parasite through a recently discovered process called trogocytosis, in which the neutrophils "nibble" on the parasite's membrane leading to killing of the parasite. However, current literature lacks the knowledge of which molecular components are involved in trogocytosis of T. vaginalis. Trogocytosis is a contact-dependent process mediated through opsonins, specifically iC3b, which serves as a tag to make the pathogens "tasty" for the neutrophils. Complement receptor (CR) 3, which is composed of dimer CD11b/CD 18, is known to bind iC3b leading to phagocytosis, but has yet to be correlated with trogocytosis. We hypothesize that CR3 plays a role in mediating trogocytosis of T. vaginalis. To test our hypothesis, we will knockout CR3 on neutrophil like cells using, CRISPR-Cas9 and test whether the CR3 knockout cells are able to kill the parasite with the same efficiency as the unmutated cells, when cultured with T. vaginalis through a cytotoxicity assay.

Introduction

Trichomoniasis is a common sexually transmitted infection (STI) caused by the highly motile anaerobic flagellated protozoan Trichomonas vaginalis (T. vaginalis), affecting nearly 276.4 million people globally in 2008 alone (Kissinger et al., 2015). A population study reported that nearly 90% of incidents of T. vaginalis occur in underserved and low-income communities, with 10.5% of African American women affected compared to only 1.1% of white women (Kissinger et al., 2015). Trichomoniasis can be treated and cured, but nearly half of diagnosed patients do not show any symptoms and consequently do not seek treatment (Schwebke et al., 2004), which suggests that infection rates might be much higher than reported. T. vaginalis infections can have much worse consequences in women than men, especially for those of an older age. Women who test positive for T. vaginalis show increased rates of cervical cancers, spontaneous abortions, and low-weight births, probably due to genital inflammation caused by T. vaginalis and concomitant human papillomavirus (HPV) infection (Yang et al., 2018). Even though infection rates are high, trichomoniasis is classified as a "neglected infection," due to a limited public health response, and little research being conducted on the parasite (Taylor et al., 2014, Muzny et al., 2018). The current treatment against trichomoniasis is a non-specific antiparasitic and antibiotic, Metronidazole (Kissinger et al., 2015). Metronidazole does not prevent reinfection, can have many side effects like nausea and headaches, and up to 10% of T. vaginalis strains have become resistant (Kissinger et al., 2015). Studies are gearing towards understanding how our immune system fights T. vaginalis and hopefully help pave the way for the development of preventative treatments in the future.

Neutrophils are part of the innate immune system and play an essential role as the first responders to sites of injury and infection (Bardoel et al., 2014). Studies have shown

that neutrophils are the major inflammatory cells in the vaginal discharges of patients infected with T. vaginalis (Ryu et al., 2004). It has already been demonstrated that neutrophils kill pathogens through 3 different mechanisms: Neutrophil Extracellular Traps (NETosis), in which they eject their DNA and toxic granules, ensnaring the pathogen in a "net" of DNA making it difficult for them to move and much easier to catch (Bardoel et al., 2014). Phagocytosis, in which they engulf the pathogen whole and digest it, and degranulation, in which they release toxic granules that fuse with the pathogen's cytoplasmic membrane but they can also affect surrounding host tissue (Bardoel et al., 2014). Once differentiated in the bone marrow, neutrophils come out terminally differentiated and have a short circulatory lifespan, and after they are isolated apoptosis will occur within 6 to 12 hours (Kubes at al., 2013). Their short lifespan makes them challenging to work with, which is why researchers often use promyelocytic cells, such as PLB-985 cells (Rosales et al., 2018) as model to study neutrophil functions. PLB-985 cells were obtained from a patient suffering from myeloblastic leukemia (Tucker et al., 1987), and can be differentiated into neutrophil-like cells (NLCs) through dimethylsulfoxide (DMSO) (Rincon et al., 2018).
Though the conventional mechanisms for neutrophil-mediated pathogen removal are NETosis, phagocytosis and degranulation, there is a newly discovered, and less studied method through which neutrophils kill pathogens: trogocytosis. Trogocytosis is a contact-dependent killing mechanism in which neutrophils take "nibbles" of the parasite's cell membrane (Mercer et al., 2018).

Current literature has yet to define the molecular components of trogocytosis, but it has already shown that antibodies and iC3b complement factor, both found in human serum opsonize the parasite (Mercer et al., 2018). It has also been established that trogocytosis is partially mediated by antibody–Fc receptor engagement as part of the adaptive immune system (Mercer et al., 2018), though it has yet to be established whether the complement system does take part in the mediation of trogocytosis and through which molecular player. Studies have shown that iC3b binds to opsonin receptors on neutrophils, such as CR3, which is a complement receptor, part of the innate immune response, composed of dimer CD18/CD11b (Diamond et al., 1993). CD11b is also a differentiation marker for NLCs derived from PLB-985 cells (Pedruzzi et al., 2001, Ashkenazi et al., 2009), and it contains a highly conserved protein domain, called the I domain that binds to iC3b (Diamond et al., 1993). The interaction between CD11b and iC3b has already been shown to trigger phagocytosis (Baldwin et al., 1998), though it has not yet been correlated with trogocytosis. CD11b/CD18 has been shown to be important for the conjugate formation between effector and target cell in trogoptosis, as well as the "nibbling" process leading to trogoptosis (Matlung et al., 2018). Trogoptosis is a trogocytosis-related necrotic process, which happens in antibody opsonized tumor cell death, where an accumulation of trogocytic events, "nibbles", leads to cell death due to plasma membrane damage (Matlung et al., 2018). It has been shown that the efficiency of trogoptosis, and therefore cell necrosis of cancer cells, can be inhibited when CD11b is blocked (Matlung et al., 2018), though CD11b has yet to be correlated with trogocytosis of T. vaginalis. We hypothesize that CD11b as part of the CR3 receptor is involved in the triggering of trogocytosis of T. vaginalis. To test the enabling effect of CD11b on trogocytosis of T. vaginalis, we will mutate the CD11b gene, more specifically the I domain, through CRISPR-Cas9 with the help of a uniquely designed guide RNA (gRNA) (Xu et al., 2019).

We plan to induce a complete functional deletion of CD11b I domain to test whether CD11b triggers trogocytosis , using CD11b knock out NLCs in a cytotoxicity assay, where NLCs and T.vaginalis are coincubated in the presence of human serum (Mercer et al., 2018). To test whether the complement system does play a role in killing of T. vaginalis we performed the cytotoxicity assay in the presence of heat inactivated human serum. Heat inactivates serum complement proteins allowing us to examine the role of the complement system in innate immune interactions (Mankovich et al.,2013), such as those between neutrophils and T. vaginalis. We have already confirmed the presence of CD11b and CD18 surface markers on the membrane of NLCs through antibody staining and optimized the cytotoxicity assay, though we are still working on optimizing our transfection assay to generate the CD11b knockout NLCs.

It has been shown that trichomoniasis is one of the most prevalent STIs partially due to the lack of symptoms presenting in the host and lack of treatment, it can also help facilitate transmission of many secondary infections including HIV(Kissinger et al., 2015). The development of preventative treatment is critical and understanding the molecular mechanism through which immune cells fight the parasite will hopefully contribute to literature on T. vaginalis and pave the way to development of even more effective therapy or preventative treatments like vaccines, and hopefully offer some relief to the impacted communities.

Results

PLB-985 cells differentiate into Neutrophil-like cells

The short lifespan of neutrophils makes them challenging to work with since after isolation they will undergo apoptosis within 6 to 12 hours (Kubes at al., 2013). We therefore used the promyelocytic cell line, PLB-985 as a neutrophil model (Rosales et al., 2018). The PLB-985 cells were differentiated into NLCs with RPMI 1640-complete media supplemented with granulocyte colony-stimulating factor (G-CSF), and dimethyl sulfoxide (DMSO). We used PLB-985 cell line because once differentiated, they expresses the same surface markers as neutrophils, amongst which are CD11b and CD18 surface markers (Rincon et al., 2018). An antibody

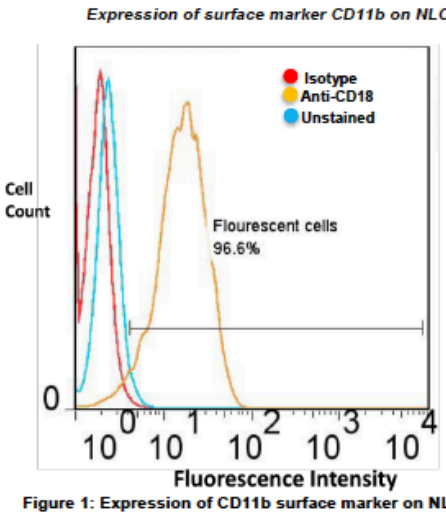

Figure 1: Expression of CD11b surface marker on NLCs, day 7 of differentiation. Flowcytometry results for antibody staining with FITC antihuman CD11b antibody (Biolegend) yellow. FITC isotype control: mouse IgG1 (Biolegend) (fluorescence intensity baseline [blue]). Unstained NLCs (negative control [red]). Data analyzed with Flow-Jo.

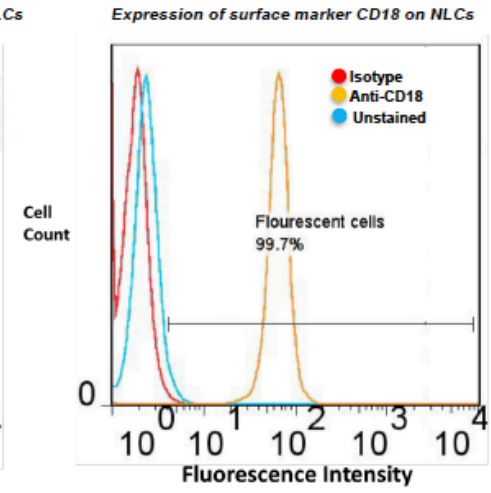

Figure 1: Expression of CD18 surface marker on NLCs, day 7 of differentiation. Flowcytometry results for antibody staining with FITC antihuman CD18 antibody (Biolegend) yellow. FITC isotype control: mouse IgG1 (Biolegend) (fluorescence intensity baseline [blue]). Unstained NLCs (negative control [red]). Data analyzed with Flow-Jo.

staining assay helped determine the efficiency of differentiation of PLB-985 cells (Fig.1), by quantifying the expression of CD11b surface marker through flow cytometry. We used FITC antihuman CD11b antibody (yellow) on differentiated PLB-985 cells on their 7th day of differentiation and compared their fluorescence levels to unstained (negative control [red]) or FITC mouse IgG1 isotype control cells (fluorescence intensity baseline [blue]), and analyzed the data with Flow-Jo. We saw a fluorescence level of 96.6% for the anti-CD11b cells (yellow) (Fig.1), concluding that almost 97% of the cells had been differentiated into NLCs. Since CR3 receptor is composed of CD11b and CD18, we also tested for the presence of CD18 integrin on the surface of the cells on their 7th day of differentiation. We used the same antibody assay with unstained cells (negative control [red]) and FITC mouse IgG1 isotype control cells (fluorescence intensity baseline [blue]), and analyzed the data with Flow-Jo. We found that the fluorescence intensity in the FITC antihuman CD18 antibody labelled cells was 99.7% (Fig.2), which told us that almost all our cells were expressing CD18 on their surface. We also repeated the antibody assay on PLB-985 cells cultured with RPMI 1640-complete media supplemented with G-CSF and DMSO, on day 3, 4, and 5 of differentiation to test whether CD18 and CD11b were expressed constitutively on PLB-985 cells. We found that almost 100% of the cells were expressing CD18 on days 3,4, and 5 of differentiation (Fig.S1), suggesting that CD18 is constitutively expressed in PLB-985 cells. We also found that CD11b was expressed at relatively low number (50%) on day 3, and the expression increased two-fold by day 4 (97.3%) (Fig.S2). Gating strategies and results can be found in Supporting Information Section.

Strategy for functional deletion of CD11b

The CRISPR-Cas9 system makes targeted cuts in genes at specific locations, guided by the gRNA. We designed a gRNA, which would direct Cas9 nuclease to its target, where it should make cuts in the CD11b-I domain, resulting in complete functional deletion of CD11b binding activity. The specificity of the Cas9 protein target is determined by a 20-nucleotide guiding sequence within the gRNA that is complementary to the genomic target sequence (Ran et al., 2013).The CD11b gene consists of roughly 3500bp in its longest transcript, and the I domain is found between the base pairs 450-927. Using the online CRISPR Design Tool: E-CRISP, we found the gRNA sequence: 3'-CACCGCTGCTTGGGCGGACACACA-5' within the CD11b gene, that targets the I domain at location 659bp-679bp, as well as 3'-CACCGCCCCTTGCTGAGCACTGTG-5' which targets CD11b at location 1087bp-1107bp. We created two constructs (px459 plasmid / gRNA), one for each target by pairing the sense and antisense gRNA oligomers to create a oligo duplex and the ligating the duplex into px459 CRISPR/Cas9-Puro vector (Addgene) (Fig.3). We only used the construct directly targeting the I domain for the transfection of PLB-985 cell.

To create the (px459 plasmid / gRNA) construct we first digested the px459 plasmid, and visualized it under UV-light, to confirm size of around 9175bp in reference to the GeneRuler 1kb DNA Ladder (Fig.4) and continued with ligating the oligo duplex into the vector. We confirmed the insertion of the oligo duplex in the vector at position 214-238bp through sequencing by a third party (Source Bioscience) and analyzed the data with A plasmid Editor (ApE). Results can be found in Supporting Information Section (Fig.S.2). We used the (px459 plasmid / gRNA) construct to transform competent E. coli cells, isolated single colonies and used ZymoPURE™ Plasmid Maxiprep kit to isolate the (px459 plasmid / gRNA) construct targeting CD11b- I domain, which we used to transfect the PLB-985 cells.

Upon successful transfection we selected for successful transfection through puromycin selection assay.

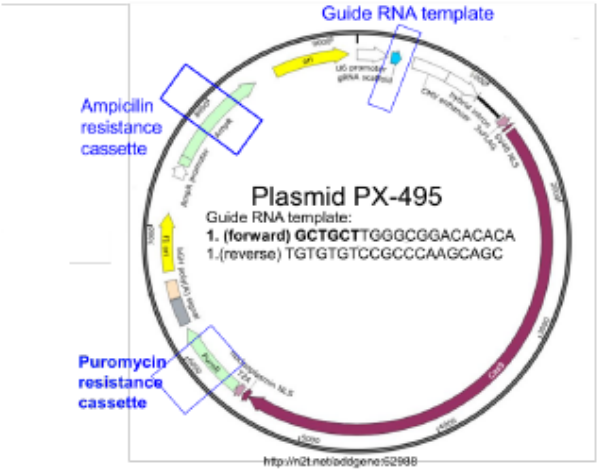

Figure 3: Plasmid pSpCas9(BB)-2A-Puro (px459) V2.0. Plasmid map for px459 (Addgene) featuring PuroR for Puromycin resistance, AmpR for ampicillin resistance. gRNA scaffold is downstream of U6 promoter. We cloned the gRNA oligo duplex sequence into the plasmid using BbsI insertion sites. Size of plasmid: 9175bp

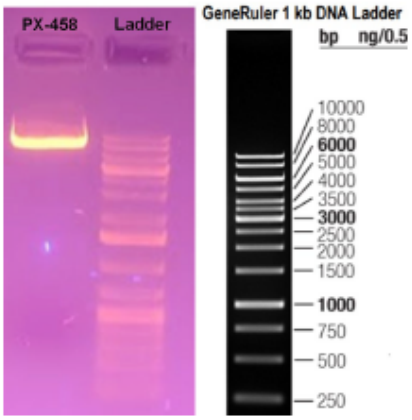

Figure 4: Digested Plasmid pX-459. Plasmid px459(Addgene), size 9175bp digested with the help of BbsI restriction enzyme. GeneRuler 1kb DNA Ladder (Thermo Fisher) used as reference.

Generation of CD11b knockout cell lines with CRISPR-Cas9 gene editing system showed low cell viability post transfection

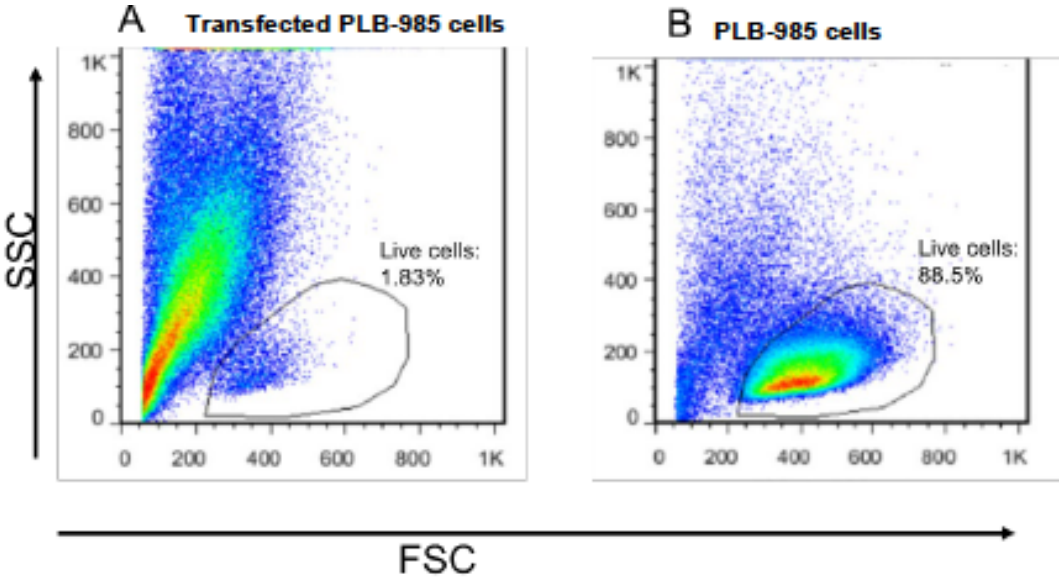

Figure 5: Representative FACS plots of PLB-985 cells transfected with plasmid pX-459 construct. A) Cells were transfected with plasmid pX-459(Addgene) containing Cas-9 protein sequence, gRNA targeting CD11b, and Puromycin cassette. B) PLB-985 cells negative control (cells did not undergo transfection)

We used the CRISPR-Cas9 gene editing system to generate PLB-985 CD11b knockout cell lines, by cloning the oligo duplex coding for the gRNA, targeting CD11b I- domain, in vector px459 vector. We transfected PLB-985 cells using Neon Electroporation System (Thermo Fisher) with the following parameters, 1350V, 1 Pulse, incubated in RPMI 1640 supplemented with GlutaMAX and 10% fetal bovine serum (FBS) at 37°C for 24 hours. We selected for successful transfectants using a puromycin selection assay checking for live cells through flow cytometry and comparing cell viability to PLB-985 cells (negative control) (Fig.5 A, B). Cell viability for the PLB-985 cells (negative control) was normal at 88.5%, while for the transfected cells cell viability was 1.8%, which was considerably low. The low transfection efficiency led us to suspect that the electroporation process was too harsh on the cells, or the plasmid might be triggering TLRs within the cells (Yu et al., 2016, Xia et al., 2015) and was therefore toxic, causing cell death. We continued to culture the successful transfectants, with the purpose of generating a homogenous CR3 knockout cell line, but the samples had to be discarded due to contamination issues. To get better insight into our low cell viability after transfection and puromycin selection, we transfected the PLB-985 cells, both in the presence of our (px459 plasmid / gRNA) construct and lacking it. We did not perform a puromycin selection after electroporation to avoid exposing the cells to more stress, allowing us to test whether cell death was a result of electroporation or the presence of plasmid only. We saw after electroporation lacking the construct, 77.3% of our cells survived (Fig.6 B), while for cells

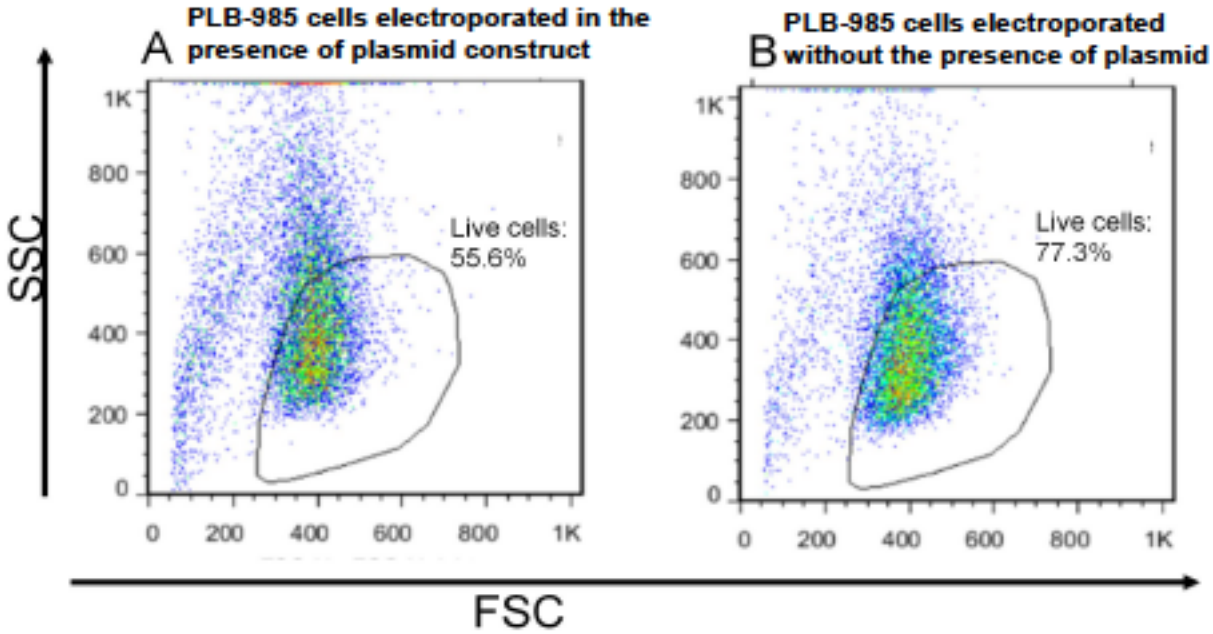

Figure 6: Representative FACS plots of transfected PLB-985 cells testing for DNA toxicity, and death due to electroporation. A) PLB-985 cells were transfected with plasmid px459 (Addgene) containing Cas-9 protein sequence, gRNA oligo duplex targeting CD11b, and Puromycin cassette. B) PLB-985 cells underwent transfection without the presence of plasmid px459.

transfected with the construct 55.6% of the cells survived (Fig.6 A). The results show that neither electroporation nor plasmid toxicity were the reason for the low transfection efficiency of 1.8%. Gating strategy in Supporting Information (Fig.S3). We planned to test the killing efficiency of the successful CD11b knockout NLCs in the cytotoxicity assay, comparing it to the killing efficiency of unmutated NLCs, but the low cell viability post transfection did not permit that. We established that our unmutated NLCs were able to kill the parasite in the following experiment.

NLCs kill T. vaginalis in the presence of human serum

T.vaginalis is a non-invasive microorganism and recruits inflammatory cells to the infection site(Edwards et al., 2016). To confirm that our NLCs do kill T. vaginalis, we employed acytotoxicity assay, where T. vaginalis were labeled with CellTracker Green (CTG) and NLCswere labelled with Vybrant DyeCycle Orange Stain (Vyb. Orange) (Fig. 7). We then coculturedthe cells for 2 hours, in the presence of 10% human serum, and tested for live-dead cells throughflow cytometry, in the presence of beads to ensure that an equivalent volume of each sample wasanalyzed.

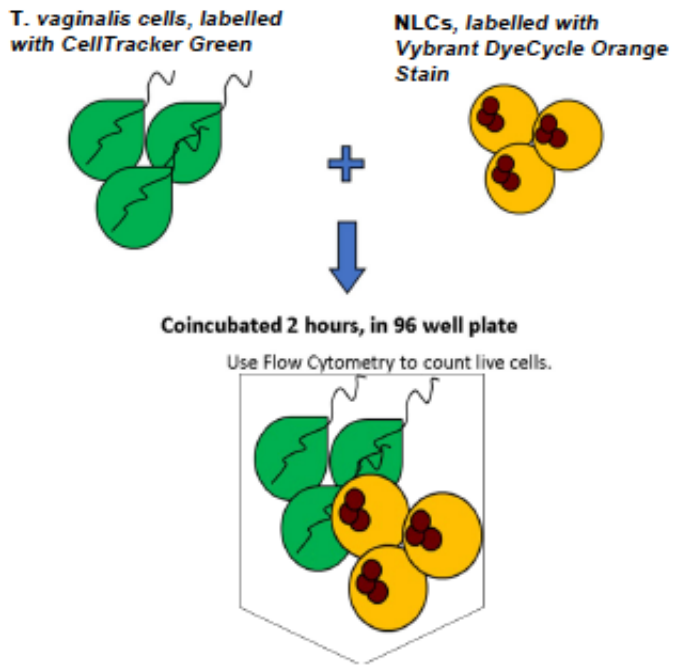

Figure 7: Schematic for T. vaginalis cytotoxicity assay: T. *vaginalis* were labelled with CTG. NLCs, differentiated in complete media, supplemented with G-CSF and DMSO, for 7 days, were labelled with Vyb. Orange. Cells were cocultured for 2 hours in the presence of 10% human serum and analyzed by flow cytometry to assess the survival of T. *vaginalis*.

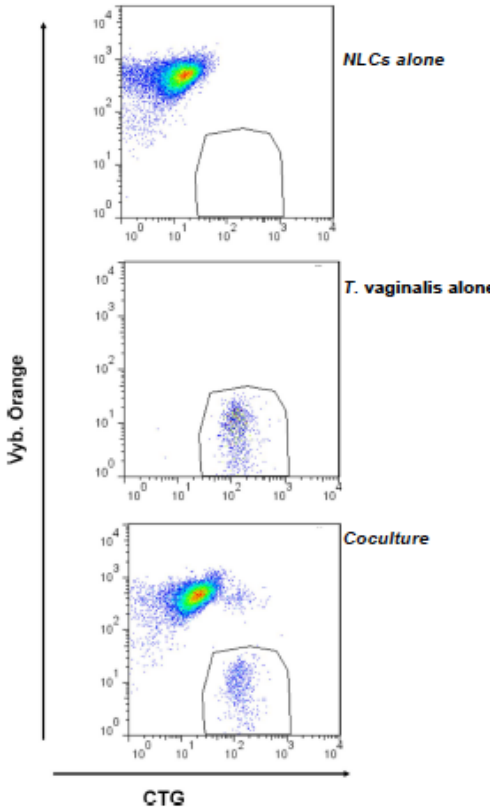

Figure 8: Representative FACS plots of cytotoxicity assay. Results show FACS plots where NLCs were present at 16:1 ratio of T. *vaginalis*. Cells were cocultured in the presence of 10% human serum. Surviving T. *vaginalis cells* were defined as CTG^{+}Vyb.Orange^{-}. Gating was done based on live parasites in the parasites alone condition

We calculated the percent T. vaginalis killing by comparing the numbers of Vyb. Orange-CTG+ cells in T. vaginalis alone conditions (Fig.8) to the conditions where NLCs were present. In conditions where NLCs were present at 16:1 ratio of T. vaginalis, the killing efficiency was approximately 50%, while in in conditions where NLCs were present at 0.5:1 ratio of T. vaginalis the killing efficiency was 25% (Fig.9). The results show that NLCs can kill T. vaginalis in the presence of human serum. Studies have shown that human serum is necessary for killing of T. vaginalis cells by performing a similar cytotoxicity assay without the presence of human serum and noticing complete abolishment of cell death as a result of trogocytosis (Mercer et al., 2018).

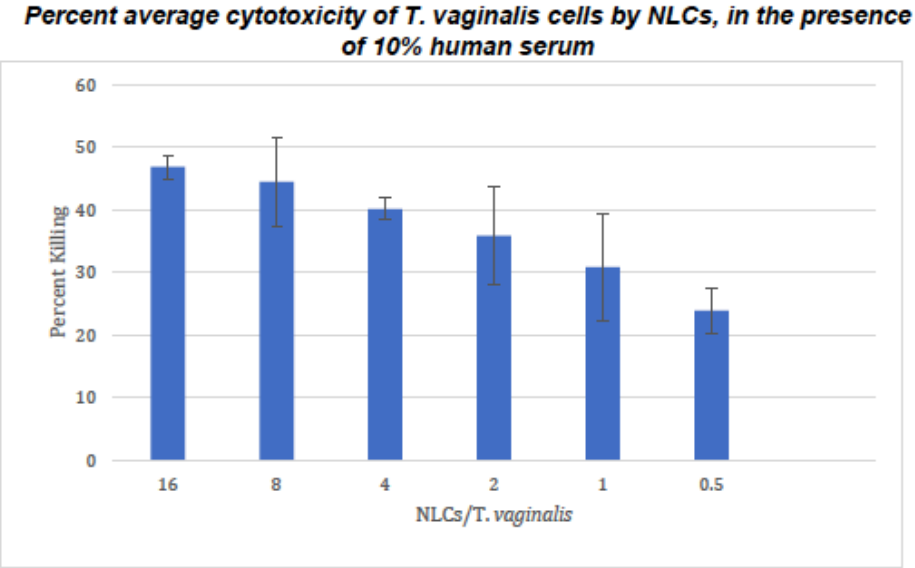

Figure 9: Percent cytotoxicity of T. *vaginalis* in the presence of 10% human serum.
Percent cytotoxicity determined by counting the number of surviving T. *vaginalis* at various NLC/T. *vaginalis* ratios. Cells were cocultured in the presence of human serum. The NLCs cells were on day 7 of differentiation. All data are represented as mean ± SD.

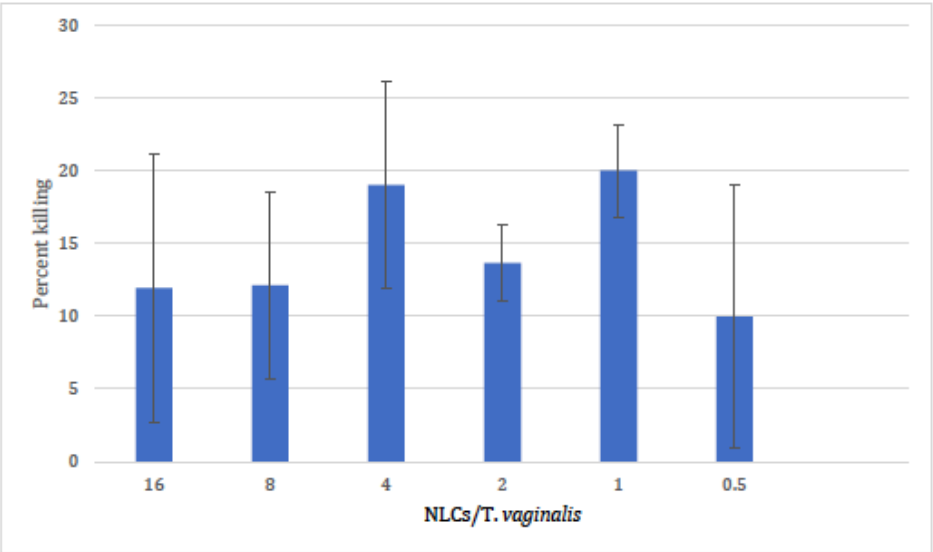

Figure 11: Percent cytotoxicity of T. *vaginalis* in the presence of 10% heat inactivated human serum.
Percent cytotoxicity determined by counting the number of surviving T. *vaginalis* at various NLC/T. *vaginalis* ratios. Cells were cocultured in the presence of heat inactivated human serum. The NLCs cells were on day 7 of differentiation. All data are represented as mean ± SD.

NLCs kill T. vaginalis in the presence of heat inactivated human serum

To test whether the complement system does play a role in killing of T. vaginalis we repeated the cytotoxicity assay in the presenceof heat inactivated human serum, which was incubated at 65°C, shaking every 5 min, for 30 min. Heat inactivation in studies is performed to inactivate serum complement, and study the role ofcomplement in immune interactions (Mankovich et al.,2013). Wecalculated the percent T. vaginalis killing by comparing the numbers of Vyb. Orange-CTG+ cells in T. vaginalis alone conditions (Fig.10) to the conditions where NLCs were present. We noticed that heat inactivation of the human serum decreased killing levels, by almost 30%, but did not lead to complete abolishment, suggesting that the complement system does play a role in mediating trogocytosis. The data also suggest that antibody-mediated trogocytosis might be happening. We saw the killing levels were affected with the highest being around 20%, for a ratio of 4:1 NLCs/T. vaginalis cells.

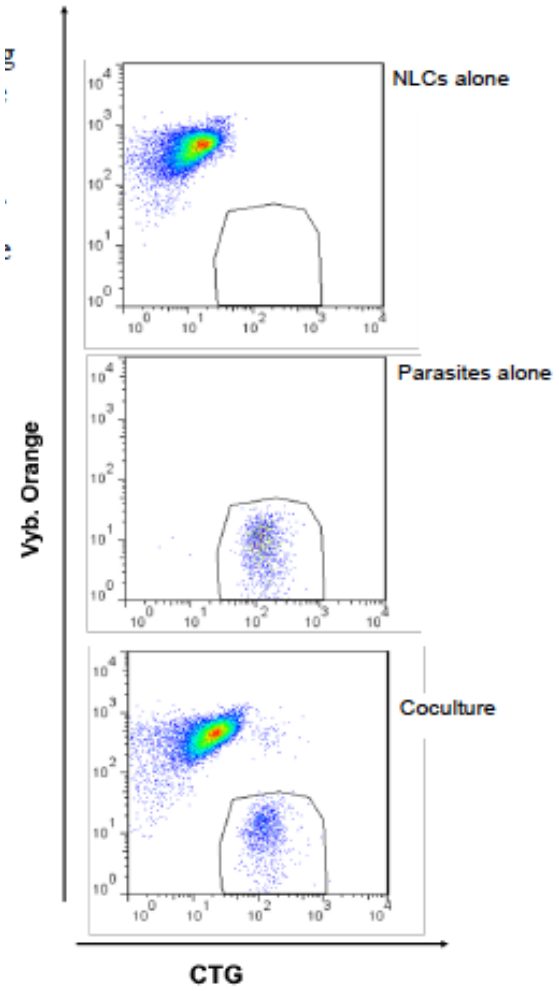

Figure 10: Representative FACS plots of cytotoxicity assay, with heat inactivated serum. Results show FACS plots where NLCs were present at 16:1 ratio of T. *vaginalis*, in the presence of 10% heat inactivated human serum. Surviving T. *vaginalis cells* were defined as CTG^{+}Vyb.Orange^{-}. Gating was done based on live parasites in the parasites alone condition.

Materials and Methods

Promyelocytic cell lines and culture

The PLB-985 cell line was used for all the experiments described throughout the manuscript. Promyelocytic cell line PLB-985 was recovered from the Collins lab at UCD and cultured as follows: Cells were cultured in complete media RPMI with HEPES and GlutaMAX supplemented with 10% fetal bovine serum (FBS), penicillin (100 U/mL) and streptomycin (100mg/mL) at 37°C with 5% CO2. The cells were grown in 30 ml culture flasks and passaged every 3 days, maintaining a cell density between 1* 105 to 1*106 cells/ml. The cells were induced to differentiate into neutrophil like cells by culturing in RPMI 1640-complete media supplemented with 1.3% DMSO, 100ng/ml G-CSF for 6-8 days.

Immunolabeling for CD11b and CD18

To ensure differentiation of PLB-985 cells into neutrophil-like cells, the expression levels of CD11b and CD18 surface markers were measured. 100K cells per condition were harvested while at a cell density between 105 to 1*106 cells/ml and washed with phosphate-buffered saline (PBS). For detection of CD11b cells were stained with FITC anti-human CD11b antibody (ICRF44), or mouse IgG1, κ FITC at a final concentration of 1ug/ml. For detection of CD18 cells were stained with FITC anti-human CD18 antibody (CBR LFA-1/2), or mouse IgG1, κ FITC isotype control at a final concentration of 1ug/ml. The cells were incubated for 30 min at 4°C in FACS Buffer (0.5% bovine serum albumin and 0.05% sodium azide in PBS). The samples were then washed with FACS buffer, resuspended in 200µl of FACS Buffer, and fluorescence was acquired with BD FACS Calibur flow cytometer, and FACS data was analyzed with Flow-Jo. To determine the percentage of cells expressing the target, we set thresholds using mouse IgG1, κ FITC isotype for CD11b and CD18, and unstained PLB-985 cells at late exponential stage as negative controls.

Guide RNA

The online CRISPR Design Tool: E-CRISP, was used to design the gRNA sequence: 3'-CACCGCTGCTTGGGCGGACACACA-5' within the CD11b gene, targeting the I domain at location 659bp-679bp, as well as 3'-CACCGCCCCTTGCTGAGCACTGTG-5' which targets CD11b at location 1087bp-1107bp. Paired sense and antisense gRNA oligomers acquired from Integrated DNA Technologies (IDT) were annealed to each other to create an oligo duplex, at a concentration of 100uM, in the presence of T4 Polynucleotide Kinase (10X) (Thermo Fisher) and T4 Ligation Buffer (10X) (ThermoFisher). The sample mixture was incubated in a thermocycler at 37°C for 30 min, then at 95°C for 25 min decreasing the temperature by 5° every minute until it reached 25°C. The oligo duplex was finally diluted at 1:200 in water and stored at 20°C.

Plasmid Construction

Plasmid pSpCas9(BB)-2A-Puro (px459) V2.0 size of 9175bp, was acquired by Addgene, and contains a selectable marker cassette, puromycin and bacterial resistance cassette ampicillin. Plasmid px459 was digested at a concentration of 1ug/ml, with restriction enzyme BbsI at a concentration of 1mg/ml, in the presence of NEB Buffer (CutSmart) at a concentration of 5ul/ml, and incubated at 37°C for 15 min. The sample was treated with Calf Intestine Alkaline Phosphatase (CIAP) at 1ul/ml. The sample was mixed with Loading Dye (Thermo-Fisher) for a final concentration of 1X and loaded onto a 1% agarose gel alongside the ladder GeneRuler 1kb DNA Ladder (Thermo Fisher), which was loaded at a

concentration of 0.2ul/10mm. The gel was visualized under UV-light, to confirm size of px459 plasmid. The site of the gel containing the plasmid was cut off and the plasmid was extracted using the QIAquick Gel Extraction Kit. The duplex oligonucleotides were then cloned into the Bbs1 site of px459px459 plasmid. 100ng of the extracted plasmid was ligated with 1uM of the gRNA oligo duplex, in the presence of T4 Ligation Buffer (10X) (ThermoFisher) and T4 DNA Ligase Buffer (10X) (New England Biolabs) to create the px459 plasmid / gRNA construct. The sample mixture was incubated at 25°C for 30 min and heated at 65°C for 10 min to inactivate the enzymes. Sample was stored at stored at -4°C.

Isolating the px459 construct for transfection

DH-5 alpha competent cells were acquired from (BioPioneer Inc) and underwent heat shock at 42°C for 45 sec, allowing for pores to be created in the plasma membrane of the bacteria which allow for plasmid DNA to enter the cell. They were cultured in Super Optimal Broth (SOC) media at 37°C for 45 min and plated in Luria Broth (LB) plates supplemented with 100mg/mL ampicillin (amp), incubating overnight. Single colonies were isolated and cultured in 5ml of LB supplemented with 100mg/mL amp for 8 hours. The culture was then added to 250 ml of LB + 100mg/mL amp and incubated overnight at 37°C. The culture was pelleted down while at log phase according to guidelines specified on the ZymoPURE II Plasmid Maxiprep acquired from Zymo. The bacterial plasmid consisting of the (px459 plasmid / gRNA) construct was isolated using the ZymoPURE II Plasmid Maxiprep Kit and stored at -25°C awaiting transfection of PLB-985 cells.

Generation of genetically modified cells

We planned to knock out CD11b through CRISPR-Cas9 using a uniquely designed gRNA (3'-CACCGCTGCTTGGGCGGACACACA-5'). Cells were cultured in RPMI 1640, supplemented with GlutaMAX and 10% fetal bovine serum (FBS) in a 6 well plate. Neon Electroporation System was used for transfection of the (px459 plasmid / gRNA) construct containing Cas-9 sequence, gRNA oligo duplex, a Puromycin resistance cassette and Ampicillin resistance cassette in PLB-985 cells. Before transfection, DNA was resuspended in Resuspension Buffer R (Thermo Fisher), at a concentration between 5-30ug/100µl. PLB-985 cells were harvested while at a cell density between 0.7-1.2*106 cells/ml, acquiring 1*106 cells/1ml of media. Cells were washed with PBS and resuspended in Resuspension Buffer R and DNA, at a density of 20*106 cells/ml. The sample was electroporated with the following parameters, 1350V, 1 Pulse using a 100µl tip, and incubated in 2ml of RPMI 1640 supplemented with GlutaMAX and 10% fetal bovine serum (FBS) at 37°C for 24 hours. Cells were rescued 24 hours after transfection, by washing with PBS and resuspending in RPMI at a final density of 1*106 cells/ml.

Culturing transfectants

The plasmid used for transfection contains a puromycin resistance cassette, which allows for selection of successful transfectants. The cells were cultured in RPMI 1640-complete media supplemented with Puromycin at a concentration 0.75ug/ml. Cells were incubated at 37°C with 5% CO2. Cell viability was tested after 24 hours incubation in the presence of 0.75ug/ml Puromycin. 100µlof cells were washed with PBS and resuspended in 100µlof FACS Buffer (PBS with 5% FBS and 0.1% sodium azide). Cell death was acquired with BD flow cytometer and analyzed with Flow-Jo. If cell viability scored lower than the 10% threshold, the cells were rescued and resuspended in complete RPMI at a cell density of

1*106 cells/ml. If cell viability was higher than 10%, the cells were resuspended in RPMI at a cell density of 1*106 cells/ml with 0.75ug/ml Puromycin for another 24 hours. For continued care of transfectants, viability of cells was checked every 2 days.

Single cell dilution

Transfectants were cultured in 100µlof complete RPMI at a cell density of 5 cells/ml in a round bottom 96 well plate, incubated for 3 days at 37°C with 5% CO2. Plates were checked for single colonies every 3 days under the light microscope. Every 3 days, media in the wells was changed by removing and supplementing back the top 50ul, without disturbing the pellet. As the colonies grew, they were transferred to a 24 well plate.

Culturing T. vaginalis cells

T. vaginalis strain was used for all the experiments described throughout the manuscript. T. vaginalis G3 strain was recovered from the Johnson lab at UCLA and cultured as follows. Cells were grown in iron-supplemented (180 µM ferrous ammonium sulfate, and 28 µM sulfosalicylic acid) Diamond's TYM medium (pH 6.0) with 10% horse serum at 37°C without shaking in a tightly sealed 15ml conical tube, with every day transfer at late exponential phase, maintained at an approximate concentration of 1 x 105–2 x 106 cells/ mL.

Cytotoxicity assay

A cytotoxicity assay was utilized to determine the T. vaginalis death by neutrophils through differential dye staining. T. vaginalis were labeled with CellTracker™ Green CMFDA Dye (Thermo Fisher) at 1:2500 for 30 minutes according to the manufacturer's instructions in supplemented Diamonds TYM media without serum, and then washed and allowed to recover in complete Diamonds TYM media for 45 min in a conical tube. Cells were then plated at 1.5 x 104 cells/well in 100 µl in u-bottom 96 well plates with NLCs in complete RPMI. NLCs were labelled with Vybrant™ DyeCycle™ Orange Stain (Thermo Fisher) at 1:2500 for 5 minutes according to the manufacturer's instructions, in complete RPMI, and then washed twice with RPMI and plated in a 96-well u-bottom plate with the parasites at the indicated ratio in the presence of 10% human serum. Cells were incubated for 2 hours at 37°C with 5% CO2, analyzed by flow cytometry and 15 µl of counting beads (Life Technologies) were added to each sample before analysis. Cell counts were normalized to 2,000 beads and percent T. vaginalis killing was calculated as ([number of T. vaginalis in T. vaginalis–alone condition – number of T. vaginalis in coculture condition] / number of T. vaginalis in T. vaginalis–alone condition) x 100. The assay was conducted in the presence of normal and heat inactivated human serum. Human serum was thawed on ice and supplemented into media at the time of coculture for all experiments. Heat inactivated serum was incubated at 65°C, shaking every 5 min, for 30 min.

Discussion

Despite high infection rates and dangerous consequences, the immune response against T. vaginalis parasite is yet to be fully understood. A limited public health response paired with little research conducted on the matter, have led to its classification as a "neglected infection" (Taylor et al., 2014, Muzny et al., 2018). Characterizing the mechanism through which our immune cells keep the parasite at bay with hopes of developing more efficient therapy solutions as well as preventative treatments has become of outmost importance.

It has been shown that neutrophils are the most abundant inflammatory cells in the vaginal

discharges of patients infected with T. vaginalis (Ryu et al., 2004), fighting T. vaginalis through trogocytosis (Mercer et al., 2018). Trogocytosis has been described as a contact-dependent killing mechanism in which neutrophils take "nibbles" off the parasite's membrane, preceding cell death (Mercer et al., 2018). Studies have shown the parasite is opsonized, made "tasty" ,by protein iC3b and immunoglobulins found in human serum (Mercer et al., 2018). Also, Fc-blocking treatments can partially inhibit trogocytosis of T. vaginalis (Mercer et al., 2018), which might suggest that trogocytosis is mediated by the adaptive as well as complement system. Neutrophils have been shown to engage in similar "nibbling" mechanisms against antibody opsonized cancer cells in a process named trogoptosis (Matlung et al., 2018). CR3 complement surface receptor composed of CD11b/CD18 was shown to be important for the conjugate formation between effector and target cell, namely antibody opsonized cancer cell and neutrophil, as well as the "nibbling" process leading to trogoptosis and therefore cell death (Matlung et al., 2018). Trogoptosis is not entirely the same as trogocytosis, it has been described as an accumulation of trogocytic events which eventually lead to cell death due to membrane damage. Matlung has shown that blocking CD11b inhibits trogoptosis of antibody opsonized cancer cells, though it has yet to be shown whether the same result would hold for trogocytosis of T. vaginalis. Studies have also shown that iC3b binds to CD11b through a protein domain called the I- domain (Diamond et al., 1993). We hypothesize that CD11b as part of the complement system, can trigger the process of trogocytosis of T. vaginalis. To test whether CD11b does play a role in triggering trogocytosis, we will use CRISPR-Cas9 systems in neutrophil like cells to target the I domain within CD11b integrin, with the help of a uniquely designed gRNA.

Humans are the only hosts infected by T. vaginalis, making a mouse model very difficult to test because it requires treating the mice with estradiol and dexamethasone to obtain persistent infection, which led to lower numbers of vaginal neutrophils (Cobo et al., 2011). Also, neutrophils' short lifespan after isolation (Kubes at al., 2013) makes them challenging to work with, which is why we chose to use cell line PLB-985 as a model to study neutrophil functions (Rosales et al., 2018). PLB-985 cells can be differentiated into neutrophil-like cell in the presence of G-CSF and DMSO, the cell line acquires a similar morphology and expresss the same surface markers as neutrophils (Ashkenazi et al., 2009, Rincon et al., 2018). We have shown that our NLCs express the same surface markers as neutrophils, CD11b and CD18 as part of CR3, which matches findings from other studies where the presence of CD11b and CD18 was confirmed through immunolabelling (Rincon et al., 2018, Ashkenazi et al., 2009). It is important to mention that the cells line does not completely recapitulate the functions of human neutrophils (Rincon et al., 2018, Ashkenazi et al., 2009). We established through an antibody assay against CD11b, that almost 97% of the cells differentiated with complete media supplemented with G-CSF and DMSO for 7 days, express CD11b on their surface and are therefore differentiated (Fig.1). We have also established that CD18 is expressed constitutively in PLB-985 cells (Fig.2), through an antibody assay targeting CD18, with 99.7% of the PLB-985 cells expressing CD18 on their surface. The presence of CD11b and CD18 on our NLCs, confirmed that the cell line would be a good experimental model for our purposes.

To test whether the complement system and CD11b play a role in triggering the process of trogocytosis, we plan to use CRISPR/Cas-9 to knock out CD11b. CRISPR/Cas-9 requires a unique gRNA that is complementary to its target, in our case the I domain within CD11b, to lead the Cas-9 nuclease. We designed the gRNA using the online tool E-CRISP, targeting the start of the I domain at location 659bp-679bp. We are counting on the cell's Non-homologous end joining (NHEJ) repair mechanism (Xu et al., 2017) to introduce a mutation leading to complete functional deletion of CD11b. We cloned the gRNA oligoduplex into plasmid px459 (Fig. 3), which expressed the Cas-9 nuclease and the puromycin resistance cassette, which is useful when selecting for successful transfectants.

The successful NLC knockouts will be used in a cytotoxicity assay (Mercer et al., 2018) to test their efficiency in killing T. vaginalis cells, which would tell us if the receptor CR3 is involved in the process of trogocytosis. We first established that our cultured NLCs did indeed kill T. vaginalis by labeling NLCs with Vyb. Orange Dye and T. vaginalis cells with CTG, coculturing them in the presence of human serum for two hours (Fig. 7) and quantifying cell viability through flow cytometry. We found that culturing the NLCs and T. vaginalis cells at a ratio of 16:1 NLCs/T. vaginalis resulted in the highest killing efficiency, at about 50%, while culturing at a ratio of 0.5:1 NLCs /T. vaginalis, resulted in a killing efficiency of about 25%. These results confirmed that unmutated NLCs do kill T. vaginalis which matches with results from other studies (Mercer et al., 2018) where neutrophils dyed with Carboxyfluorescein succinimidyl ester (CFSE) are coincubated with T. vaginalis dyed with Cell Tracker Red (CTR) and cells are then assessed by flow cytometry to assess the cell viability of T. vaginalis. It is important to note that the study conducted by Mercer and team used human neutrophils instead of a cell line, resulting in a much higher killing efficiency at almost 100%, for culture ratio of 16:1 neutrophils /T. vaginalis. The PLB-985 cell line does not completely reflect the neutrophil's functional efficiency (Rincon et al., 2018, Ashkenazi et al., 2009), which would explain the difference in killing efficiency between our results and those reported by Mercer and team.

We also tested whether the complement system plays a role in mediating trogocytosis of T. vaginalis by performing the cytotoxicity assay in the presence of 10% heat-inactivated human serum. Heat inactivating human serum is performed to inactivate complement, but if there are immunoglobulins present, there is a chance for antibody-mediated trogocytosis to happen, which might explain the killing that we see in the presence of heat inactivated human serum (Mankovich et al., 2013). We saw the killing levels decreased on average, with the highest being around 20%, for a ratio of 4:1 NLCs/T. vaginalis cells, indicating that parasite opsonization by human complement serum proteins is necessary for efficient killing levels of T. vaginalis cells by NLCs.

To test whether CD11b plays a role in triggering trogocytosis we planned to generate a CD11b knockout NLC cell line and quantify their killing efficiency compared to unmutated NLCs through the cytotoxicity assay. Unfortunately, we did not perform the cytotoxicity assay with CD11b knockout NLCs, due to issues with the transfection process, highlighted below. We used our plasmid construct (px459 plasmid / gRNA) to generate CD11b knockouts by introducing the plasmid across the cell membrane through electroporation in PLB-985 cells. After the cells underwent puromycin selection, the number of cells (successful transfectants) was low at around 1.8% which led us to suspect that either the electroporation was leading

to massive cell death, or the plasmid was activating TLRs within the cell triggering cell death (Yu et al., 2016, Xia et al., 2015). We tested for cell viability, electroporating the PLB-985 cells with the px459 plasmid / gRNA construct or lacking it. In either case the cell viability after electroporation was high, with 77.3% for cells that underwent electroporation lacking the construct and 55.6% for cells that underwent electroporation in the presence of the construct, leading us to believe that neither was the case for the low transfection efficiency we were seeing. Due to low cell viability after puromycin selection we decided to switch strategies and use CRISPR-RNPs, which have also demonstrated reduced off-target mutagenesis as well as cell death (Liang et al ., 2015, Kim et al., 2014). Furthermore, RNPs avoid the risk of integration of the vector into the host genome, since the Cas9 is completely cleared after 24 hours from transfection, making it a more practical system for our purposes (Liang et al ., 2015, Kim et al., 2014). The Cas9 and gRNA are delivered in the cell as a ribonucleoprotein (RNP) complex, through electroporation, instead of using a plasmid and the cell's transcription machinery (Liang et al ., 2015, Kim et al., 2014, Xu et al., 2017). The knockouts will then be tested for their killing efficiency, and we will also use a third party to sequence them to confirm mutation. Once we have identified the CR3 mutants we plan to perform addback experiments using a lentivirus (Campeau et al., 2009). The addback experiment would assure us that the lower killing efficiency in our mutants, if that is the case, is specifically due to deleted CR3 gene, not from off-target effects introduced by the Cas-9 nuclease.

Determining whether CR3 is involved in the process of trogocytosis of T. vaginalis would help us gain insight into the molecular players mediating trogocytosis. Future studies would include testing the relationship between trogocytosis and specific Fc Receptors such as FcγRI, FcγRII, FcγRIII, as well as complement receptors CR1 and CR4, with hopes of showing how the innate and adaptive immune systems cooperate to fight the parasite. It is likely that the innate immune system plays a major role when the parasite is first encountered, while the adaptive system is activated after the generation of specific antibodies. Uncovering the molecular players of the immune system used to fight T. vaginalis will hopefully provide knowledge and better inform further vaccine and therapy strategies to mitigate the adverse consequences of T. vaginalis infections.

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Supplementary information

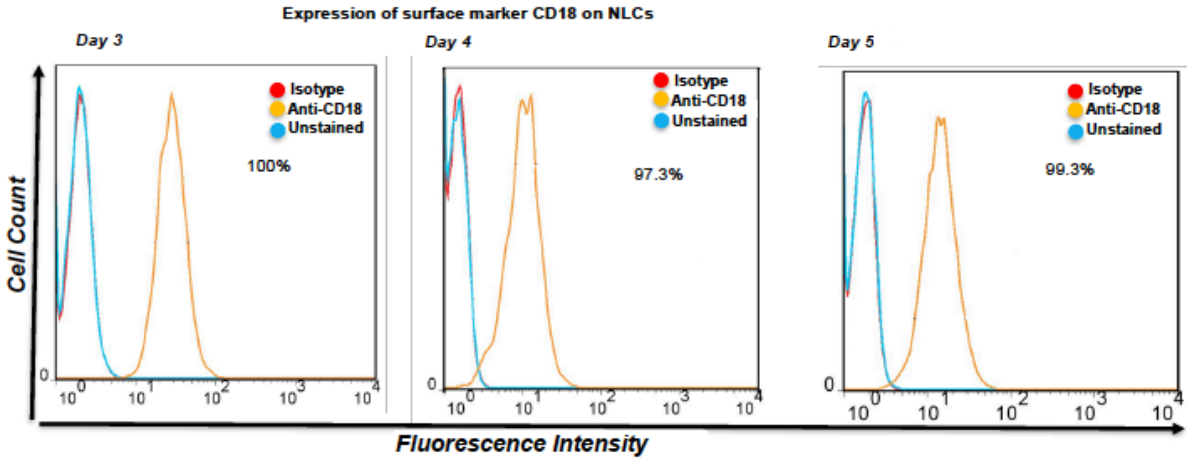

Figure S.1: Expression of CD18 surface marker on NLCs, day 7 of differentiation. Flowcytometry results for antibody staining with FITC antihuman CD18 antibody (Biolegend) yellow. FITC isotype control: mouse IgG1 (Biolegend) (fluorescence intensity baseline [blue]). Unstained NLCs (negative control [red]). PLB-985 cells differentiated in media with G-CSF and DMSO and tested for presence of surface marker CD18 on day 3, 4, 5. Data analyzed with Flow-Jo.

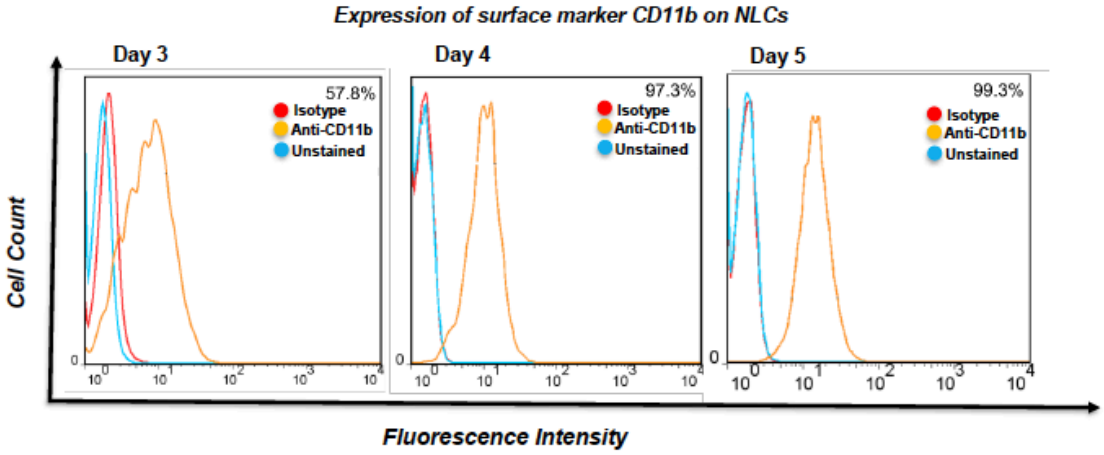

Figure S.2: Expression of CD11b surface marker on the surface of NLCs. PLB-985 cells differentiated in media with G-CSF and DMSO and tested for presence of surface marker CD11b on day 3, 4, 5. Flow cytometry results for antibody staining with antihuman CD11b antibody (Biolegend) yellow. FITC isotype control: mouse IgG1 (Biolegend) blue, used as fluorescence intensity baseline. Negative control, unstained PLB-985 cells, red.

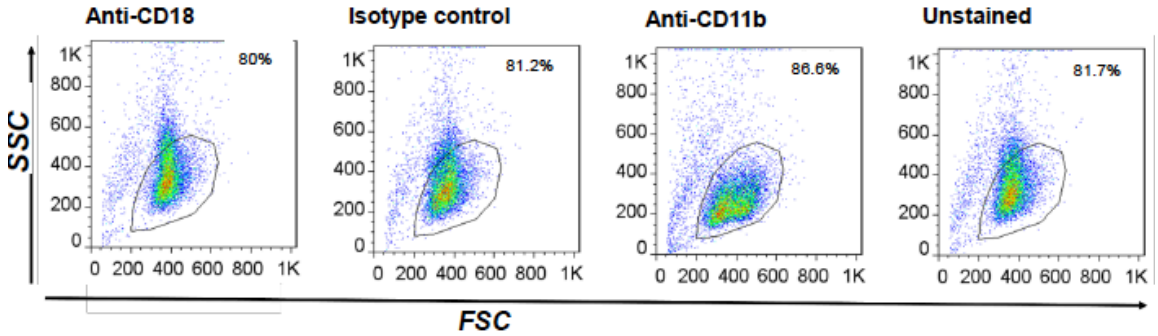

Figure S.3: Representative scatter FACS plot for antiCD11b and anti CD18 immunolabelling. Gating strategy defining populations shown in FACS fluorescence graph plots in Fig.1 and Fig.S1 and Fig. S2.

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Mismatches(#):0
Gaps( ):796
Unattempted(.):0

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  1 NNNNNNNNNNNNNNNNNNGCTGTTAGAGAGATAATTGGAATTAATTTGACTGTAAACACAAAGATATTAGTACAAAATACGTGACGTAGAAAGTAATAATTT 100

  1 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ 1

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101 CTTGGGTAGTTTGCAGTTTTAAAATTATGTTTTAAAATGGACTATCATATGCTTACCGTAACTTGAAAGTATTTCGATTTCTTGGCTTTATATATCTTGT 200

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  1 ~~~~~~~~~~~~~~~~~~GCTGCTTGGGCGGACACACA~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ 20
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301 ACCGAGTCGGTGCTTTTTTGTTTTAGAGCTAGAAATAGCAAGTTAAAATAAGGCTAGTCCGTTTTAGCGCGTGCGCCAATTCTGCAGACAAATGGCTCT 400

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                 *         *         *         *         *         *         *         *         *         *
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                 *         *         *         *         *         *         *         *         *         *
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                 *         *         *         *         *         *         *         *         *         *
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801 GCGGGGGGGGGGGGGG 816

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Figure S.4: Visual representation of oligomers (20 bp) targeting I-domain within CD11b, aligned with our px459 construct. Oligomers are inserted in the vector at position 214-238bp. Sequencing done by Source Bioscience and data analyzed with A plasmid Editor (ApE).

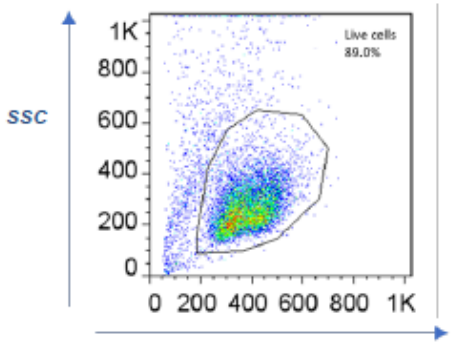

Figure S.5: FACS plot for late exponential stage PLB-985 cells. Gating strategy defining populations shownfor FACS plots in Fig.6.

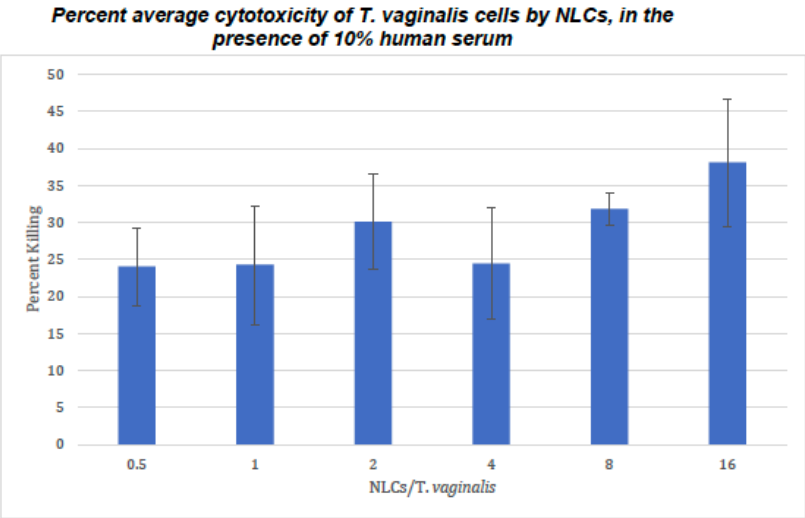

Figure S.6: Percent cytotoxicity of T. *vaginalis* in the presence of 10% human serum. Percent cytotoxicity determined by counting the number of surviving T. *vaginalis* at various NLC/T. *vaginalis* ratios. Cells cocultured in the presence of human serum. The NLCs cells were on day 7 of differentiation. All data are represented as mean ± SD.

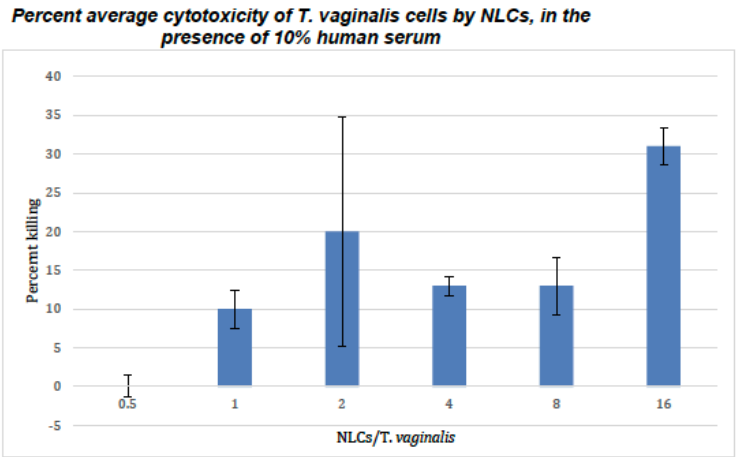

Figure S.7: Percent cytotoxicity of T. *vaginalis* in the presence of 10% human serum. Percent cytotoxicity determined by counting the number of surviving T. *vaginalis* at various NLC/T. *vaginalis* ratios. Cells cocultured in the presence of human serum. The NLCs cells were on day 7 of differentiation. All data are represented as mean ± SD.

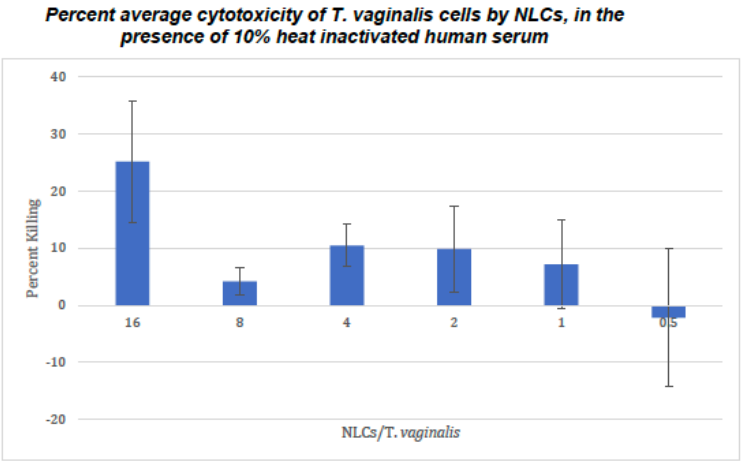

Figure S.8: Percent cytotoxicity of T. *vaginalis* in the presence of 10% heat inactivated human serum. Percent cytotoxicity determined by counting the number of surviving T. *vaginalis* at various NLC/T. *vaginalis* ratios. Cells were cocultured in the presence of heat inactivated human serum. The NLCs cells were on day 7 of differentiation. All data are represented as mean ± SD.

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The Effect of Median Judges on Supreme Court Legitimacy

Abstract

While perceptually separate from the other two branches of the federal government, the Judicial Branch's Supreme Court is viewed as an institution abstaining from politics and serving as the largest check on the Executive and Legislative powers. However, intermingling of these branches raises concerns of association that the appointments and the Justices' rulings, post-appointment, are politically aligned with the ideological subscription of the appointers. As a result, close attention to public opinion on the levels of support towards specific rulings, known as specific support, and support towards the institution, or diffuse support, is necessary to be evaluated in a highly polarized environment but with the existence of a tie-breaking median Justice. The objective of this study is to examine the extent to which public support, both specific and diffuse, varies given respondents' answers to mock Supreme Court decisions with and without the vote of a moderate Justice. The results of this study find that individuals are more likely to be in favor of the decisions that host a Median Justice especially when the decision falls in line with their personal ideology. However, the Median Justice plays a minimal role for individuals when decisions are not in line with their beliefs, additionally the interaction with diffuse support might be influenced by their support for specific decisions. This research adds

Introduction

The Supreme Court stands as a symbol of impartiality and justice unparalleled to other federal institutions in the United States. However, as argued by many, including Justice Kagan in 2018, the confidence citizens have in the Court is largely contingent on the belief that Justices are separate from politics. When the two merge, as Kagan states, the Court becomes perceptually partisan in its decision making, the risk of losing citizens' support is incredibly high (Millhiser 2018). The potential for a reduction of faith in the Supreme Court's decisions and appointments can greatly influence the efficacy of the work the institution produces. The confirmation of Brett Kavanaugh, appointed by President Trump, was met with public and congressional outrage. With accusations of assault against the soon to be Justice met with counter-allegations of Democrats attempting to keep conservative Justices off the bench, the appointment seemed to fall on a political divide (Irons 2019).

Divisions in partisan-led support for specific Supreme Court members and overall approval of the court vary. Following the approval of Justice Gorsuch and the nomination of Kavanaugh, 72% of Republican respondents approved the court in comparison to 38% of Democrats, indicating a partisan split (Irons 2019). Depending on the Administration, their appointments, and the decisions or policies that make their way to the Supreme Court to be found constitutional or unconstitutional, the approval from the citizens is in flux. Previous literature argues that the differing levels of support, specific to the decision or long term in its assessment of institutional legitimacy, are met with a whole host of mitigating factors. Considering the findings of previous scholarship that indicate the perceptual political or ideological alignment of Justices reducing the faith of citizens' confidence in the institution or the legitimacy of the decisions produced, an empirical analysis controlling for the swing vote can be conducted. This analysis can better assess the influence of ideological alignment

and political alignment on citizens' confidence in the Supreme Court. This research specifically delving into the existence of the Median and the influence on public opinion and Supreme Court legitimacy will aid in the understanding of what judicial and Supreme Court legitimacy looks like in a currently highly polarized and politically contentious United States.

In this study, we argue that the existence of a median Justice in a Supreme Court holding can influence the level of public support for the decision and overall legitimacy of the Supreme Court. More specifically, when individuals are not ideologically aligned with the Supreme Court decision, they are more likely to support it when the Median is the swing vote in the decision. Additionally, they are more likely to feed into the idea that with the existence of a truly non-partisan Justice, the Court becomes more legitimate as a federal institution. As a result, in line with Justice Kagan, the existence of the moderate Median Justice will have a positive relationship on legitimacy overall. However, when individuals are met with decisions they ideologically agree, the existence of this moderate Median does not matter in questions of Supreme Court legitimacy.

To test this argument, we conducted an experiment on Amazon's Mechanical Turk to empirically assess the effects of the existence of a moderate Median Justice on public willingness to support specific Court decisions. The findings indicate that the existence of a moderate Median sitting on the decision does influence respondents' overall perception of Court legitimacy especially when the individual is ideologically aligned with the decision that is presented to them. Additionally, the congruence of personal and decision ideology combined with the existence of the Median in the holding increased the likelihood of the respondent supporting the decision.

Median Judges and Court Legitimacy

As one of the highest respected branches of the United States Federal Government, the judiciary has been viewed as a separate but just as important, if not the most important, branch due to its apparent divide from the otherwise polarized political atmosphere. While justices are supposed to remain as impartial as possible, individuals interpreting the outcomes of landmark and even less contentious cases take into account that justices are held to a different standard than otherwise elected officials. However, in the years following the contentious Bork defeat and Thomas victory in attaining a seat in the highest court in the nation, questions as to whether public opinion has played a role in determining who is appointed acknowledge that the general public may influence this attainment (Gibson and Caldeira 2009). Considering this case, in particular, has led scholars to assume that public opinion may influence the greater legitimacy struggles faced by the institution, in turn, affecting the overall acceptance of rulings by the justices despite its otherwise partitioned political existence.

To better operationalize the level of confidence, or support, individuals have for these institutions, two measures are proposed. The first measure of confidence is known as diffuse support and the second being specific support. Authors find that diffuse support indicates overall support in the legitimacy of the Supreme Court, or a high court, whereas specific support deals with individuals' support after specific decisions have been made by the justices (Gibson et al 1998, Baird 2001, Gibson et al 2003, Gibson et al 1992, Gibson et al 1995). While some scholars have found that loyalty to the institution remains high, the fluctuation of specific support can depend on the strength of the individual's ideological

beliefs and belief in the court to remain impartial on particularly contentious cases. Though, it is generally recognized that loyalty to the institution overall can exist without confidence in it (Gibson et al 2003). While this makes diffuse support most important in understanding the loyalty individuals have to the output of the court, it notes that specific support, in flux, may be easier to measure given the particular design scholars undertake (Gibson et al 1995).

Adding to these levels of diffuse and specific support is the social reinforcement given to individuals who may know more or less about the court. Previous scholars have cited this phenomenon as positivity bias. This bias is associated with receiving positive messages about courts and the law increasing legitimacy directly among constituents (Gibson et al 1998, Gibson et al 2014, Gibson et al 2009). While some tend to find that this is able to be recalled by exposure to judicial symbols, activating a positive connotation with the courts and legal proceedings, others find that this positivity bias may arise prior to activation and only be associated when seeing decisions, without symbol exposure (Gibson et al 2014). Strikingly enough, Gibson, Lodge, and Woodson find that the exposure to these symbols in tandem with a decision an individual is likely to find contentious can influence their level of acceptance with particular rulings (2014). The general consensus remains that symbols, or activation of the positivity bias generally, increases the loyalty and acceptance of particular decisions though it may not be as striking as previous scholars have predicted.

While biases and long-term diffuse support have been cited as possible explanations as to why individuals are more or less inclined to accept specific rulings, the content of the rulings has also been a point of academic research providing alternative reasoning towards specific acceptance. Many of these specific studies analyze whether providing information about particular judges and the citations in their decisions influence whether an individual finds one decision or another to be more legitimate (Menounou 2017, Farganis 2012, Bonneau et al 2016, Baird 2001). Authors have generally agreed on the findings that when these reasons for the decision, such as citing external sources beyond domestic courts or decisions utilizing more legalistic jargon, are in tandem with what the citizens want in particular, it increases support (Menounou 2017, Farganis 2012, Bonneau et al 2016, Baird 2001). Because justices and the courts are associated with legalistic measures that individuals may not understand but find necessary to respect, their likeliness to not accept rulings remains low. However, the outlier in this instance may be found in the communities directly affected by the outcomes in which they find that the decision is extrajudicial (Bonneau 2016). Though, when looking at conventional methods of decision making and legalistic backing to decisions, the public is more likely to pay attention to the reasoning and the legitimacy of the court is increased as a result (Farganis 2012).

Questions of legitimacy are incredibly important in consideration of the highly contentious cases that may reach the courts. Adherence to and acceptance of rulings can influence the outcome of landmark cases as the final ruling is understood as the last interpretation of the law and constitutional provisions. One of the hallmark cases concerning the presence and effect of legitimacy on acceptance of the ruling held was Bush v Gore (Gibson and Caldeira 2009, Gibson et al 2003). Due to the ruling arguing against a recount of the Presidential votes in a state with uniquely different measures in casting ballots, and operating under the assumption there would be an entirely different outcome to the election, this ruling, in particular, was seen as the largest threat to Supreme Court legitimacy. Gibson, Caldeira,

and Spence question whether confidence is an adequate measure of this legitimacy following this case in particular (2003). Utilizing General Social Survey answers from 2001, authors Gibson, Caldeira and Spence recognize constraints in the wording of the survey questions and in their ability to be able to test whether approval of specific decisions has a long enough half-life to affect the legitimacy of the institution at all, or whether it comes from a higher trust (2003). The study attempts to solve this by asking about the confidence in specific actors, overall approval, support for the Court, specific support and loyalty to the institution. The study finds that individuals are typically in favor of the court and are loyal to it regardless of decisions and the favor they hold (Gibson, Caldeira, and Spence 2003). When the court has long standing legitimacy and loyalty as a byproduct, specific cases alone are unlikely to make a large impact on the overall legitimacy. The ability to utilize confidence as a measure has aided the study but should be controlled for short-term and long-term effects and the half-life scenario presented by the authors prior.

This finding of a lack of strong fluctuation in support is also laid in the groundwork produced by earlier studies. As indicated by Gibson and Caldeira's previous study using responses from the National Social Survey, they agree with the aforementioned findings. While political values may predict attitudes towards particular cases, the ebbs and flows of support are not incredibly different on a case by case basis (Gibson and Caldeira 1992). Though the study does note that opinion leaders, conservative or more liberal judges, ruling in non-predictive ways may influence the acceptance of particular cases by the public at large.

Understanding that justices may be removed from some level of the political process, it is clear that they are not infallible when it comes to biases that may exist beyond their scope of deemed impartiality until cases are presented. Due to this, previous researchers have found that differing levels of support for the court by citizens may exist when particular judgments are held that may not agree with their own personal biases (Gibson and Caldeira 1992, Gibson and Caldeira 1995). In a more recent study, Bartels and Johnston posit the notion that individuals may perceive Supreme Court decisions as being legitimate or illegitimate, and place this assumption on the body of the court as a factor for determining legitimacy (2013). Subjective ideological disagreement is coined as providing individuals with this bias against or for the institution based on whether it agrees with their specific ideological alignment. Arguing that politics and ideological divides are accepted as inherent characteristics in this system moves the study to utilize public polling and interviews conducted in 2005 (Bartles and Johnston 2013). With this taken into account, individuals are found to believe that the court is no longer strictly conservative as prior research articulated. Additionally, the lines between politics and the court have been blurred and the acceptance of ideology making its way into decisions is accepted as commonplace and objectivity is impossible to attain in decisions (Bartles and Johnston 2013). Legitimacy and respondents' personal ideologies are positively related as liberal courts are seen as uniquely legitimate by liberal identifying individuals.

This is coupled with findings that the public is becoming more attentive to the court's rulings, and confirmation biases of political alignments are becoming increasingly common among those concerned with the rulings in particular (Gibson and Caldeira 2009). In an attempt to answer what the effect of politicized confirmation battles on the legitimacy of the Supreme Court and the broader court system in the United States is, authors Gibson and Caldeira,

rely on aggregate time-series data from the General Social Survey, small collections of individual surveys, media polls, simulations, and studies on the individual level change to see if the controversy over the nomination of Justice Alito reduces the overall legitimacy of the court (2009). The authors find that controversial appointments "wake up" dormant attitudes about the reliability of the court to be distinct from political ideology, harming the legitimizing symbols of impartiality the court is otherwise associated with. This is viewed as potentially harmful to the impartial mindset associated with it and, by doing so, can reduce the faith of citizens more knowledgeable about the court's confidence in legitimate rulings (Gibson and Caldeira 2009).

While long-term legitimacy for the Supreme Court seems to remain relatively stable, the support of specific case decisions may be in flux. Recognizing the highly politicized atmosphere the court has gained has placed higher importance on the association of legalistic and neutral characteristics of the Court with their decisions. Understanding confirmation bias led by ideological alignment, the positivity theory offered by previous scholars, and positive connotations being held with purely legalistic rulings raises the concern as to whether judges associated with being "median" on the court can influence the level of acceptance of decisions among citizens. Utilizing, perhaps, less ideologically charged rhetoric in their decision making, and serving as swing votes in deciding cases, the importance of their holdings on cases may be able to increase specific support among those who would not otherwise agree with the case decision.

The previous theoretical approach fails to take into account this analysis of the influence of median justices contributing to ideologically polarizing Supreme Court Decisions. Previous studies stop at the assessment of respondents' ideological beliefs and their willingness to accept decisions made by the court and whether this interacts with the level of diffuse support. We argue that perception of ideological alignment in the decisions presented to respondents, as found previously, can influence the levels of specific support recorded. Additionally, in finding this specific support to be in flux, we expect to find some effect on this level of support if the individual may not ideologically agree with the decision but the median is part of the agreement. Presumably, as found by previous research, reduction of the perceived political nature of the Supreme Court will likely increase the relative specific support in favor of the decision when the respondent and decision are at odds (Gibson and Caldeira 2009, Gibson et al 2014, Baird 2001,).

The above theoretical discussion can be summarized into three empirically testable hypotheses.
H1 : Individuals are more likely to be in favor of decisions that host a moderate median justice even when the decision is opposite of their ideological alignment, compared to decisions that lack a moderate median justice.
H2 : Specific legitimacy of the court will decrease when there is no median contributing to the decision that is not aligned with the respondents' ideological beliefs, compared to cases with a moderate median contributing to the decision.
H3: Long Term diffuse support in the Supreme Court as an institution will remain constant, regardless of the decisions it produces.
Alternatively, the null hypothesis for H1 will also be examined, insofar as public opinion is not more likely to be in favor of specific court decisions if it aligns with their political ideology.

The null hypothesis for H2 will be that absence of a median justice on the decision will have no effect on the respondents' level of support for the support contingent on the decision.

Experimental Design

This study is based on a nationally representative sample of respondents online utilizing the Amazon Mechanical Turk platform. The survey questionnaire was active on March 26th 2020 and the subject sample size of 718 responses was met within the day though the survey was to be active for thirty days. Incomplete and duplicate submissions have been dropped from the coding process to provide unique responses for the data. The Mechanical Turk respondents were offered the choice to participate in the study regarding the U.S. Supreme Court and their engagement resulted in a $0.50 compensation to be automatically paid within three days of completion. The average time of completion for the survey was 7.6 minutes.

Mechanical Turk is increasingly being used by researchers in the social sciences. Studies have found that samples that come from MTurk are "at least as representative of the U.S. population as traditional subject pools, with gender, race, age, and education all matching the population more closely than college undergraduate samples and internet samples in general (Paolacci, Chandler, and Ipeirotis 2010), and the quality of the data gathered through the platform are as reliable as those collected through other experimental methods (Buhrmester, Kwang, and Gosling 2011). As a result, we find that this provides an adequate body of responses to confidently provide inferences regarding the proposed hypotheses from the data provided.

The initial pre-test questionnaire included demographic questions, questions related to political ideology and engagement, and questions aimed at assessing overall knowledge about the U.S. Supreme Court. Subjects were then randomly assigned to one out of four experimental conditions. For each condition, subjects were asked to read a brief vignette that discusses a recent Supreme Court decision and the voting patterns of that decision. Experimental conditions vary, including an ideologically moderate justice in the Court or no moderate justice. The experimental Court decisions were also identified as liberal or conservative, resulting in a 2x2 design (liberal/median, liberal/no median, conservative/median, conservative/no median). After reading the vignette, all subjects were asked to respond to a post-survey questionnaire. These included questions aimed at measuring the subject's attitudes toward the Supreme Court decision, and their attitudes toward the U.S. Supreme Court as an institution. Following this, the post-test survey was administered asking respondents about their levels of support for the decisions they received, to find if specific support changed based on the existence or non-existence of the moderate justice. The survey questionnaire can be found in Appendix 1.

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Variable Operationalization

Specific support is identified as the independent variable in this study. This variable was operationalized through the responses provided in the post-treatment questionnaire detailing the support for the decision and willingness to accept the legal impacts of the decision. Diffuse support serves as the dependent variable in this study. This variable was operationalized through the main independent variable and the conditional variable. The interactions between these variables and the variables individually are assessed. This interaction is necessary to analyze the data through an OLS linear regression model.

An interaction variable labelled Median Congruence is the interaction of the median variable and the congruence dummy variable. Based on the randomizers in the experiment, the existence of the median is coded as a 0, the existence of the median is coded as a 1. From the same information, a variable was created based on the decision direction, 1 for liberal and 0 for conservative. For the knowledge questions, separate variables were created for each question, these were counted as 1 if correct and 0 if it was not correct. From the ten knowledge questions, these variables remained separate and then the overall knowledge variable was created combining the 10 variables into one score. Higher values indicated a higher knowledge variable score. The ideology was coded as 1 for liberal and 7 for very conservative, the sample is skewed liberal though this is controlled for in the dataset. Agreement with the decision was coded into a variable, with the ideology and decision direction combined, Ideological Congruence variables ranged from -1, if respondents received a decision opposite to their ideological identification and 1 if it was the same as their ideology. If the respondent did not identify as liberal or conservative, this was coded as a 0. A dummy variable of congruence was created, 1 indicated the decision was the same as the respondents' ideological alignment and 0 if it did not. The Acquiescence Variable was based on specific support questions, the last question was inverted for higher scores to be more supportive of the court and these questions were added together and averaged to receive an overall score. The other four questions measuring diffuse support remained the same to indicate higher scores meaning stronger support based on the responses to the questions.

Questions regarding general knowledge about the Supreme Court are coded as a single variable that measures the full knowledge of the respondent. The model also includes any demographic factors that may influence the level of knowledge respondents had of the Supreme Court. The existence of the median in the court decision and respondents' opinion on diffuse support, or overall legitimacy of the Supreme Court, were coded based on the treatment provided to the individual. The respondents' recorded ideological beliefs as liberal or conservative and the ideology of the treatment received was made into a new variable. The treatment variables are coded into two different variables to account for the ideological leaning of the decision and the existence of a median, based on the 2x2 model of the

vignettes. The coding booklet providing the analysis of the data set acquired can be found in Appendix 2.

An interaction variable labelled Median Congruence, to identify the level of interaction between the Median variable and Congruence Dummy variable. Based on the randomizers in the experiment, the lack of the median is coded as a 0, the existence of the median is coded as a 1. From the same information, a variable was created based on the decision direction, 1 for liberal and 0 for conservative. For the knowledge questions, separate variables were created for each question, these were counted as 1 if correct and 0 if it was not correct. From the ten knowledge questions, these variables remained separate and then the overall knowledge variable was created combining the 10 variables into one score. Higher values indicated a higher knowledge variable score. The ideology was coded as 1 for liberal and 7 for very conservative, the sample is skewed liberal though this is controlled for in the dataset. Agreement with the decision was coded into a variable, with the ideology and decision direction combined, this Ideological Congruence variable ranged from -1, if they got a decision opposite to their ideology and 1 if it was the same as their ideology. If the respondent did not identify as liberal or conservative, this was coded as a 0. A dummy variable of congruence was created, 1 indicated the decision was the same as the respondents' ideological alignment and 0 if it did not. The Acquiescence variable was based on specific support questions, the last question was inverted for higher scores to be more supportive of the court and these questions were added together and averaged to receive an overall score. The other four questions measuring diffuse support remained the same to indicate higher scores meaning stronger support based on the responses to the questions.

Results

The demographics portions of the questionnaires began with gender identification. From the responses provided, 405 individuals identified as male as the majority provided in the data set. In accordance to age categorization, respondents typically fell between the ages of 30-49 with those in the 18-19 category following. Fewer respondents were identified above the age of 50. Education levels were also factored in with a majority of respondents holding a Bachelor's Degree or some college experience without a degree. Ideological alignment recorded found a majority of respondents to be "Somewhat Liberal", 160 of the recorded responses, "Very Liberal", with 132 responses, and "Neither Liberal nor Conservative" with 124 recorded responses. Of the respondents, the overwhelming majority, 598, voted in the 2016 election with 338 voting Democratic in comparison to 242 voting Republican, 82 voting for Other, and 56 not responding.

Using the previously identified single variable for respondent knowledge of the Supreme Court, respondent answers were coded into a single variable of overall Knowledge. The mean of these responses, indicated in table 5, is 6.68 out of 10 full points. As previous scholarship indicates, knowledge of the court may remain low unless highly contention issues or assignments to the court are brought to the forefront of the media and, as a result, to the constituents (Gibson and Caldeira 2009). Regardless of the recognized knowledge of the makeup of the court, the interaction this has with specific and diffuse support may be influenced by alternative assumptions of impartiality or specific agreement or disagreement with presented cases (Gibson et al 1998, Baird 2001, Gibson et al 2003, Gibson et al 1992, Gibson et al 1995).

In compiling the results from the coded responses from respondents, responses that identified as neither liberal nor conservative were dropped from the data set reducing the number of observations to 594. When respondents identified as neither liberal nor conservative in their ideology, identifying the treatment case holdings being congruent with the ideological beliefs of the respondent would skew the data set. As a result, the mean duration for completion was 470 seconds or 7.8 minutes for the observational responses. The responses were analyzed through an Ordinary Least Squares Regression model, which is the regression traditionally used for the analysis of experimental data.

In Table 1, we present 3 models, each model representing one of our dependent variables, namely Agreement with the court decision, Acquiescence with the court decision, and diffuse support for the court.

Table 1: Effect of existence of a moderate median and of ideological congruence on Agreement with court decision, Acquiescence, and Diffuse Support

VARIABLES	(1) Agreement	(2) Acquiescence	(3) Diffuse Support
Median x Congruence	-0.01	0.33**	0.43*
	(0.34)	(0.15)	(0.24)
Congruence	0.95***	0.17*	-0.25
	(0.25)	(0.1)	(0.17)
Median	0.2	-0.11	-0.07
	(0.23)	(0.1)	(0.17)
Knowledge	- 0.06*	0.08***	0.27***
	(0.04)	(0.02)	(0.03)
Ideology	0.03	0.05***	0.06**
	(0.04)	(0.02)	(0.03)
Constant	4.32***	2.28***	1.98***
	(0.32)	(0.15)	(0.24)
Observations	594	594	594
R-squared	0.06	0.09	0.16

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

In measuring the Agreement of respondents to the treatment decision received, the interaction variable, including the existence of the median, is not statistically significant, and neither is the dummy Median variable. The findings indicate that it does not matter to respondents if the median takes part in the decision but rather that the decision is ideologically aligned with the respondent. Alternatively, the Congruence Dummy is statistically significant at the .01 level and is moving in the expected positive direction. This further indicates that what matters most to respondents is for them to receive a decision they personally agree with than the existence of the median. The other statistically significant variable is Knowledge, higher knowledge levels appear to be in less agreement with the decisions overall.

The Acquiescence Variable is identified as the Specific Support independent variable. Within this collection of the data, Median Congruence is statistically significant. If respondents are to receive a decision they ideologically agree with that holds a median in the decision, the level of Acquiescence is higher. For one unit of change with the Median Congruence, there is a .3 change in Acquiescence. The Congruence Dummy variable is also statistically significant and is moving in the expected positive direction,

indicating that even when decisions are in ideological agreement with the respondent but do not hold a median justice there are higher levels of Acquiescence. However, compared to the Median Congruence variable, this is a weaker relationship. Congruence makes them acquiesce but in addition with the median, they acquiesce almost double the amount. The existence of the Median on its own appears to play no role as it is not statistically significant in this relationship. Knowledge is also found to be statistically significant, indicating that the higher level of knowledge is correlated to higher levels of acquiescence though the value plays a smaller role in achieving Acquiescence than others. Ideology is also identified as statistically significant. Interestingly, the more liberal a respondent self-identities as, the more likely they are to accept the decision overall.

For the Diffuse Support variable, the Interaction variable is significant. For those who agreed with the decision ideologically and had a median justice in the holding, there was more diffuse support recorded for the court. Knowledge also appears to be statistically significant. Higher levels of knowledge are seen to be in a positive relationship with long term institutional support. Liberal alignment, similarly to the specific support variable, was found to be statistically significant in contributing to the levels of recorded diffuse support recorded through the Ideology variable. The diffuse support appears to be conditional, on its own the Median and Congruence variables are not statistically significant but in tandem they are. The existence of the median appears to give more legitimacy to the decision but this effect is limited to cases when the Court's audience ideologically agrees with the decision made by the Court.

Discussion and Conclusion

As previously discussed, the polarity of ideological and political divides has led to questioning the level of impartiality and, as a result, legitimacy for the Supreme Court as an institution in the eyes of its constituents. This study intends to join the literature base concerning the mitigating factors influencing both specific and diffuse support. This is done in the context of assessing whether the inclusion of a Median Justice in the holding influences this in the eyes of the Court's constituents.

Addressing the hypotheses presented in the study, the analysis of the results begins with analyzing the variations in specific support dependent on the existence of a Median Justice. The findings indicate that it matters more for decisions to be aligned with the respondent's ideology than for the Median to be a part of it. However, when the Median is included in the decision and the decision falls in the same ideological direction of the respondent, the level of specific support is higher. The existence of the Median on its own appears to play no role in the specific support, providing evidence that is contrary to the second hypothesis regarding the lack of ideological alignment with a decision may be mitigated through the existence of the Median Justice. Finally, the hypothesis concerning diffuse support was assumed to remain relatively high as articulated through previous scholarship. However, this could be a result from minor fluctuations in diffuse support that coexist with the more dynamic specific support. Findings indicated that those who were more knowledgeable had higher levels of perceived legitimacy for the Supreme Court, as has been found previously. Additionally, respondents identifying as more politically liberal were found to have higher levels of institutional support. From the data, no clear relationship between the existence of the Median or its interaction with congruence of ideology play a role in influencing this.

Although the findings of this study present a relationship between the existence of acquiescence to decisions hosting a Median Justice and is in line with the respondents ideological alignment, further research would need to be conducted to better understand the extent of this relationship. The study's experiment was run as a pilot limited to compensation for 718 respondents, and to be able to measure the ideological alignment of these responses, this was further limited to 594 responses. Additionally, due to the confinement of the pilot study's compensation and the utilization of Amazon's Mechanical Turk platform, future studies utilizing a higher volume of individuals and a different method of data collection could be utilized. This could provide a more accurate and representative sample to better translate the study outcomes to the U.S. population at large in answering this question regarding Supreme Court legitimacy. Moreover, the limitation of the treatment cases provided to the respondents fell under one of the topic areas found to be interesting enough to respondents though not as politically charged as a holding regarding a more highly politicized topic such as immigration. Future studies could utilize a wider array of cases and provide more than one case to a respondent with varying ideological leanings on top of the existence of the Median Justice

To conclude, this study provides support to the hypotheses presented regarding the influence of the existence of a Median Justice on public perception of Supreme Court legitimacy. While this specific portion of the discussion regarding Supreme Court legitimacy is less covered in the literature review, this will provide a foundation to the discussion of what the influence on specific and diffuse support looks like in a highly politicized United States.

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Appendix 1

Questionnaire provided to respondents:

PRE-TEST QUESTIONNAIRE

First, we would like to learn a bit about you. Please respond to the following questions.

1) What gender do you identify with?
   a) Female, b) Male, c) Other

2) In which age group of the following do you belong?
   a) 18-29, b) 30-49, c) 50-69, d) 70 and over

3) What is the highest level of school you have completed or the highest degree you have received?
   a) 8 grades or less, b) 9-12 grades, c) 12 grades, d) Some college but no degree, e) Associate degree in college, f) Bachelor's degree, g) Master's degree, h) Professional school, i) Doctorate degree, j) Other [Specify]

4) Which state do you reside in? _____

5) When it comes to politics, would you describe yourself as liberal, conservative, or neither liberal nor conservative?
   a) Very liberal, b) Somewhat liberal, c) Closer to liberals, d) Neither liberal nor conservative, e) Closer to conservatives, f) Somewhat conservative, g) Very conservative

6) Did you vote in the 2016 presidential elections?
   a) Yes, b) No

7) If yes, which party did you vote for?
   a) Republican, b) Democrat, c) Other

8) If no, which party would you have voted for if you had voted?
   a) Republican, b) Democrat, c) Other

9) Out of the three following issues, which one do you consider to be the most important to you?
   a) Whether the government should be allowed to monitor citizens' searches on the internet, without a warrant from a judge, including the internet searches of U.S. citizens, to watch for suspicious activities
   b) Whether the state governments should be allowed to require consumers to pay sales tax on items they buy on the internet and other purchases across state lines
   c) Whether children of foreigners and undocumented immigrants who just happened to be born in the U.S. should be automatically given American citizenship.

10) For each of the issues, please indicate what your position on the issue is
Strongly disagree_____Neither_____Strongly Agree

Now we would like to ask you some questions about the United States Supreme Court.

11) Who is the Chief Justice of the U.S. Supreme Court?
   a) Roberts, b) Ginsburg, c) Thomas, d) Kavanaugh, e) Do not know

12) Who was the first female justice of the U.S. Supreme Court?
   a) Ginsburg, b) Kagan, c) O'Connor, d) Sotomayor, e) Do not know

13) Is there an African-American justice currently on the Supreme Court?
   a) Yes, b) No, c) Do not know

14) Can the U.S. Supreme Court declare acts of Congress unconstitutional?
   a) Yes, b) No, c) Do not know

15) Some judges in the United States are elected; others are appointed to the bench. Do you happen to know if the justices of the U.S. Supreme Court are elected or appointed to the bench?

a) Elected, b) Appointed, c) Do not know

16) Some judges in the United States serve for a set number of years; others serve a life term. Do you happen to know whether the justices of the U.S. Supreme Court serve for a set number of years or whether they serve a life term?

a) Life term, b) Set number of years, c) Do not know

17) Do you happen to know who has the last say when there is a conflict over the meaning of the Constitution - the United States Supreme Court, the United States Congress, or the president?

a) The U.S. Supreme Court, b) The U.S. Congress, c) The president, d) Do not know

18) Do you happen to know if the U.S. Supreme Court has made decisions on abortion?

a) Yes, b) No, c) Do not know

19) Do you happen to know if the U.S. Supreme Court has made decisions on rights of African-Americans?

a) Yes, b) No, c) Do not know

20) Do you happen to know if the U.S. Supreme Court has made decisions on the maximum income tax rate?

a) Yes, b) no, c) Do not know

EXPERIMENTAL CONDITIONS

Please read through the following article excerpts regarding Supreme Court decisions and answer the following questions

1) Monitor searches – Liberal direction – Median exists

Electronic Privacy Debate Returns to the Supreme Court Meeting Contentious Ruling
SC Today

Last week the U.S. Supreme Court announced its decision on whether the government should be allowed to monitor citizens' searches on the internet, without a warrant from a judge, including the internet searches of U.S. citizens, to watch for suspicious activities. The Court decided that such monitoring is unconstitutional because it violates citizens' right to privacy.

The 5-4 decision was mostly along party lines, with the four liberal justices and the Court's moderate justice joining in the majority, and the four conservative justices dissenting.

2) Monitor searches – Liberal direction – No median

Liberal Justices Rule Against Electronic Privacy and Monitoring Case
SC Today

Last week the U.S. Supreme Court announced its decision on whether the government should be allowed to monitor citizens' searches on the internet, without a warrant from a judge, including the internet searches of U.S. citizens, to watch for suspicious activities. The Court decided that such monitoring is unconstitutional because it violates citizens' right to

privacy.
The 5-4 decision was along party lines, with the five liberal justices of the court joining in the majority, and the four conservative justices dissenting.

3) Monitor searches – Conservative direction – Median exists

Electronic Privacy Debate Returns to the Supreme Court Meeting Contentious Ruling
SC Today

Last week the U.S. Supreme Court announced its decision on whether the government should be allowed to monitor citizens' searches on the internet, without a warrant from a judge, including the internet searches of U.S. citizens, to watch for suspicious activities. The Court decided that such monitoring is constitutional, because it does not violate citizens' right to privacy. The 5-4 decision was mostly along party lines, with the four conservative justices and the Court's moderate justice joining in the majority, and the four liberal justices dissenting.

4) Monitor searches – Conservative direction – No median

Conservative Justices Rule In Favor of Electronic Privacy and Monitoring Case
SC Today

Last week the U.S. Supreme Court announced its decision on whether the government should be allowed to monitor citizens' searches on the internet, without a warrant from a judge, including the internet searches of U.S. citizens, to watch for suspicious activities. The Court decided that such monitoring is constitutional because it does not violate citizens' right to privacy. The 5-4 decision was along party lines, with the five conservative justices of the court joining in the majority, and the four liberal justices dissenting.

POST-TREATMENT QUESTIONNAIRE
Now we would like to get an idea about your attitudes toward this Court decision. Please respond to the following questions.
1) Do you agree with the decision made by the U.S. Supreme Court?
a) Strongly agree, b) Agree, c) Neither agree nor disagree, d) Disagree, e) Disagree strongly
2) Because of this decision would you support or oppose efforts to overturn this decision with a constitutional amendment?
a) Strongly support, b) Support, c) Somewhat support, d) Somewhat oppose, e) Oppose, f) Strongly oppose
3) Because of this decision would you support or oppose efforts to get more judges on the Supreme Court who agree with you on the issue of the decision?
a) Strongly support, b) Support, c) Somewhat support, d) Somewhat oppose, e) Oppose, f) Strongly oppose
4) Because of this decision, would you support or oppose efforts to remove judges who voted the wrong way on this case?
a) Strongly support, b) Support, c) Somewhat support, d) Somewhat oppose, e) Oppose, f) Strongly oppose

5) Do you accept the decision made by the court? That is, do you think that the decision ought to be accepted and considered to be the final word on the matter or that there ought to be an effort to challenge the decision and get it changed?

a) Strongly believe the decision ought to be accepted and considered the final word on the matter,
b) Somewhat believe the decision ought to be accepted and considered the final word on the matter,
c) Somewhat believe there ought to be an effort to challenge the decision and get it changed, d) Strongly believe there ought to be an effort to challenge the decision and get it changed.

Now we would like to ask you some more general questions about the U.S. Supreme Court:

6) If the United States Supreme Court started making a lot of decisions that most people disagree with, it might be better to do away with the Supreme Court altogether.

a) Strongly agree, b) Agree, c) Neither agree nor disagree, d) Disagree, e) Disagree strongly

7) Judges on the United States Supreme Court who consistently make decisions at odds with what a majority of the people want should be removed from their position as judge.

a) Strongly agree, b) Agree, c) Neither agree nor disagree, d) Disagree, e) Disagree strongly

8) The United States Supreme Court ought to be made less independent so that it listens a lot more to what the people want.

a) Strongly agree, b) Agree, c) Neither agree nor disagree, d) Disagree, e) Disagree strongly

9) It is inevitable that the United States Supreme Court gets mixed up in politics; therefore, we ought to have stronger means of controlling the actions of the United States Supreme Court.

a) Strongly agree, b) Agree, c) Neither agree nor disagree, d) Disagree, e) Disagree strongly

**From the identified importance of three topic areas, government monitoring of internet searching, paying internet sales tax, and American Citizenship, an overwhelming 350 responses indicated the most importance or interest was on cases regarding government monitoring of internet searches. Indications of the position held by the respondents on the issue of government monitoring of internet search histories, 295 responses were in the “Strongly Disagree” category, followed by 145 “Somewhat Disagree” responses and 105 “Somewhat Agree” responses. Assessing the identification of ideological alignment and the responses from the federal monitoring of internet search histories, from the “Strongly Disagree” category, those who identified as “Somewhat” or “Very Liberal” were in the majority of the responses with those “Neither Liberal nor Conservative”, following.

On Being Social Media and Being Responsible

Manning Jeremy

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Abstract

Social Media companies and their products operate within an as of now unidentified moral structure. I have categorized responsibility to be attributable to different entities. People are responsible and Businesses can be held responsible. Whereas a standard business has a clear product and function, social media companies are different in that their product is essentially users interacting with a platform. I hypothesize that social media companies exist as a third entity whose morals are different from the first two. This means the way we hold them accountable for their actions is different. I aim to first show what it means to be a moral agent. Second, under what conditions can a moral agent have things attributed to them? Lastly, I will discuss the reactive attitudes we have towards holding things responsible. These questions will be answered by exploring the concept of a business becoming an individual or a collective having the same moral responsibility as an individual. I will also investigate the intersection of a business and its user base and how that affects its agency.

When we think of social media, we think of tech-enabled applications that enhance the connectivity of the world. The way in which these applications accomplish this is as subjective as the people that use them. Facebook acts as a living message board akin to a community board in a village. Twitter is the same with the caveat that the way in which messages are transmitted is limited and categorized as an event. Instagram is at its basic function for the exchange and promotion of photography and digital media.

Social media occupies the public consciousness primarily as entities dedicated to entertainment and distraction. In actuality, they are a multi-billion dollar industry. They acquire and develop technologies, behave as large corporations, and most importantly provide almost unlimited advertising space for the commercial realm. The limits of a social media application are limited by its userbase. It is important to note that this paper will distinguish between "social media company" and "social media application". The company is the corporate body that actually manages the affairs and acts as a business does. The application is what a user must directly interact with; the product.

The Metaphysics of Social Media

To begin, I will create a descriptive account of the social media application. This is the product created by a company that a user directly interacts with. To describe an app is to describe the interaction between its user and the technology enabling that interaction. As an example, we'll use Twitter.

To understand the complex way responsibility and accountability work in Social Media, I must first form a conceptualization of what it means to be social media.

Technologically Enabled Space for Interactions

Social Media is primarily marked by its quality of being entirely non-physical. It is easily distinguished from other forms of social interactions. Users do not interact physically but on a platform that requires access to utilize. Users of a social media platform do not interact

directly with that platform. Instead, the platform creates an environment conducive to interpersonal interactions between users.

Enables Some Actions and Restrains Actions

It follows then, that social media platforms want users to do something. Each application has a goal it wishes to accomplish through its use. As an example, Twitter is designed to allow the seamless transfer of user-generated information in the form of short messages, images, and other content. To be social media is to be a derivative of this concept. The apparent goal is to allow users to interact with each other with fairly little friction.

In practice, these interactions appear to be free and unrestrained. Careful examination reveals that a platform, in essence, “tells” its users what to do whereas social structures tell the user how to behave. For example, the existence of a “like” button is a handy metric tool for tracking engagement of a particular post. I cannot share a post with another user if a share button did not exist. Clearly, this is something the app wants. In fact, entire platforms are constructed around these functionalities alone.

What I’d like to take the time to assess is that social media platforms don’t (and rightfully shouldn’t) advertise the functions they don’t allow users to do. These more or less fall into the domain of social restraint. There is a designed intent with a platform that may differ from the user intent with that platform. Designed intent is the functionality provided by the platform. User intent is the use or misuse of the functionality provided. Facebook wants me to add friends, message people, and read articles posted by other users because it provides those functionalities. Facebook does not want me to use its platform to recruit terrorists. Between the designed intent and user intent is where the focus of my project on responsibility resides.

Actions are Detectable

The interactions that occur on the platform are designed to be permanent and discoverable by users. It is inherent that social media be social, in as much as what you do on the platform can be seen by other users. Facebook has its wall, Twitter has its feed, and Tumblr has its version of the microblog. A person’s profile functions more or less like an archive of every activity they’ve conducted on the platform.

The twitter application is primarily used to create messages with text limits that are posted to a user’s profile and visible by others. Other users can view and reply to this message in addition to co-opting this message and posting it to their own profile; the retweet. What differentiates Twitter from a chatroom or message board is a matter of perspective and function. Messages are “tweets” which can be viewed by anyone, not by a selective cohort or community. In theory, one could use twitter as a chatroom of sorts if they only chose to interact with specific people, however, what I describe here is the designed intent of the platform.

Forms Social Groups

All social media platforms form or attempt to form social groups. Whereas the internet is the greatest human project in history to connect people, social media acts as the redundant condenser of people. It brings people together and directs them to their interests and people of like minds.

As described already, the implicit interactivity of social media and the permanence of actions leads to formations of social groupings. These groupings can be intentional or occur by happenstance.

Has a Project

The mark of commerce and business in the 21st Century is that of the project. The grandiose end goal for why your product exists. It is not enough to have a cool thing that does something relatively harmless and entertaining. This thing must be guaranteeing the liberal flow of information, being the front page of the internet, connecting the world, or saving the world in some way. With a governing project established, the platform sets out to achieve the completion of that project. It is here, I think, that most of the ethical challenges social media platforms face come from. How can we guarantee the liberal flow of information without restricting some freedoms? How can the question of privacy be answered on something overtly public?

With these concepts established, I aim to explore who, if anyone, is really responsible for actions that occur in social media. I will use the notion of collective responsibility to discuss the question of under what conditions can we hold social media responsible? I will also discuss what kinds of things we can attribute to social media and what kinds of social attitudes are appropriate for response.

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Cooling periods enhance specific pathogen free (SPF) poultry egg hatchability

Abstract

A central component of the poultry Aspergillosis vaccine research conducted at Cal Poly Pomona is the successful incubation and hatching of specific pathogen free (SPF) eggs. In an attempt to improve the percentage of SPF poultry eggs that hatched during incubation (hatchability), a simulated natural nesting cooling period was implemented once daily in two of four incubation groups. 159 SPF chicken eggs were acquired by a commercial supplier. Two incubation groups (n = 80) were maintained at a constant temperature of 37.5 °C. Two other incubation groups (n = 79) experienced a once daily 60 minute decrease in temperature (21.1°C), simulating the cooling an egg may experience when a hen leaves their nest. Eggs were incubated in a cabinet incubator within the BSL-2 facility, and all other incubation parameters were controlled (humidity, temperature, turning interval etc.). Candling to evaluate egg development occurred after the 1st and before the 3rd week of incubation. Heart rate was evaluated noninvasively before the 3rd week of incubation. The incubation groups without a cooling period had a hatchability rate of 82.5% and 90%, while the hatchability of the two groups with the cooling period was 94.9% and 100% respectively. In the absence of other unknown factors, this evidence suggests that including a daily 60 minute cooling period during incubation increases SPF poultry egg hatchability rates.

Introduction

Creating the most realistic nesting conditions is essential to ensure a successful hatchability rate. Temperature can have one of the largest impacts on the incubation period. If the temperature deviates from its optimum level of 37°C through 38°C, then post-hatch growth and organ function of the chickens can be impaired [1]. However, research has shown that a temporary drop in temperature from the optimum level can be seen as beneficial, while a permanent change in temperature decreases the hatchability rate immensely [2]. There is limited to no data around the effects of daily cooling periods where temperatures are dropped to room temperature (21.1°C) for a limited time. This experiment sheds light on the effect of a limited cooling period throughout incubation for 60 minutes daily.

The purpose of this study is to optimize the hatchability of SPF chickens in this vaccine testing facility, in order to create an affordable and effective aspergillosis vaccine. This research will also investigate if cooling periods increase hatchability, as they mimic more natural nesting conditions. This study will examine if heart rate or egg weight loss contributes to hatchability. By emplacing cooling periods, it will be determined if there are any negative side effects, such as dysfunctions or disorders. It is hypothesized that the trials with a cooling period will have higher hatchability rates, due to a more accurate simulation of natural nesting.

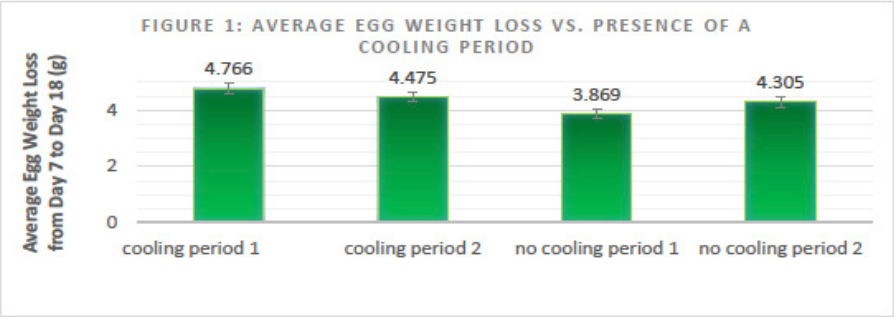
Methods

The incubation protocol consisted of the 159 SPF chicken eggs being incubated at approximately 37.5°C in an environment with 50-60% humidity, from day 1 to 17. At day 18, the temperature remained the same but the humidity was increased to 65-75% until they hatched on day 21.

The increased humidity aids in the chickens' ability to pip. Throughout the incubation process, the eggs remained in the Brinsea OVA-Easy Advance Series II Incubator. The incubator was set to tilt every 180 minutes up until day 18. The eggs were rotated by hand once a day 90 degrees until day 18 as well. The eggs were rotated to promote embryo growth and to prevent premature adhesion of embryo membranes to the shell. Eggs were candled and weighed after the 1st week and before the 3rd week. Heart rate was also taken on day 18, using the Avitronics Egg Buddy Digital Egg Heart Monitor. Observing heart rate helped with the candling process because eggs in later development stages are difficult to observe movement or indication of growth. Re-candling took place after each candling session if there was any uncertainty with an egg. Culling is an important step in the incubation process. If eggs containing dead embryos are left in the incubator, bacteria may develop and ferment, which could cause an explosion and contamination of the entire clutch of eggs. Culling took place after the two rounds of candling (day 7 and 18) as well as for the eggs that did not hatch (day 23). Euthanasia was used for chicks displaying signs of suffering. Three chicks were euthanized in the first treatment group with a cooling period. One chick exhibited curled toes and could not mobilize normally. This was diagnosed as curled toe paralysis, caused by a B2 deficiency in laying hen. The second chick was resting on its hocks, swollen feet, and bleeding and bruising at joint. This was diagnosed as slipped tendons, caused by a manganese deficiency in laying hen. The third chick never gained motor skills. This was diagnosed as a neurological issue, due to a vitamin E deficiency in laying hen. None of these signs were present in cooling period treatment group 2, so it is believed deficiencies in the nutrition of the laying hen caused these issues.

Results

Both experimental groups with a cooling period had a higher hatchability rate than those without a cooling period. Group 1 with a cooling period had a 94.9% hatchability rate. Group 2 with a cooling period had a 100% hatchability rate. Comparatively, group 1 without a cooling period had an 82.5% hatchability rate. Group 2 without a cooling period had a 90% hatchability rate. Weight loss results from experimental groups with and without cooling periods are indicated in Figure 1. Both cooling period treatment groups exhibited the largest amount of egg weight loss towards the end of the incubation period, compared to the other treatment groups. There is a statistically significant increase in weight loss in groups with a cooling period compared with those without ($p < 0.001$). There is not a statistically significant difference between the presence of a cooling period and heart rate ($p = 0.139$). Cooling period treatment group 1 had an average heart rate of 245.50 BPM. Cooling period treatment group 2 had an average heart rate of 235.65 BPM. No cooling period treatment group 1 had an average heart rate of 230.80 average BPM. No cooling period treatment group 2 had an average heart rate of 249.93 BPM.



Discussions

Our hypothesis supported the increased hatchability rate of the treatment groups with the cooling periods compared to the treatment groups without a cooling period. This may be due to the cooling period stimulating more natural nesting conditions. Several non-domesticated avian species require cooling periods to maintain viability. Poultry have been heavily domesticated and incubated in commercial operations to the point that a cooling period is not required. The improved hatchability in this study may provide evidence of some remnant adaptive advantage still provided by a periodic cooling. There was a significant increase in weight loss in groups with the cooling period. We are unable to identify the specific losses that occurred. The live chick weight of each group did not differ after hatching. This would suggest that nutritional and or aqueous faction of the egg may be responsible for the significant weight difference. Evaporative loss is unlikely because it has be reported to decrease hatchability rates significantly. Heart rate was also not significantly different between the cooling period and non-cooling period groups. If fluid loss was evident that may also impact the intravascular fluids and cardiovascular system of the embryos. This was again not the case, suggesting that cooling periods may facilitate an increase in chick embryo metabolism and the use of energy stores within the chick. This increased metabolism and/or utilization of egg nutrients could be a positive factor that may explain the improved hatchability and increased weight loss noted in the cooling period groups. Additional studies are needed to identify the mechanisms and physiologic principals at play as well as investigating more specifically how emulating natural conditions impacts hatchability.

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Reshaping the Debate on the Decriminalization of Sex Work

Abstract

The criminalization of sex work has a major negative impact on those working within the industry. From being unable to seek legal recourse to facing stigma in their career prospects, sex workers face negative consequences as a result of being a part of an illegal industry. In this paper, I analyze an expansive study on the impact legalized sex work has on human trafficking rates. I then discuss how the economic theories discussed in the study relate to arguments about the decriminalization of sex work. I argue that two arguments in favor of maintaining the criminalization of sex work are misguided in at least one way. The first of these arguments points to a correlation between increased rates of human trafficking and decriminalized sex work. The second of these arguments relies on the claim that sex work is inherently dehumanizing. I address four problems that arise from the data analyzed and from arguments made by proponents against legalized sex work, focusing on the conflation of two ethically different actions. In order to come to a conclusion on whether sex work should be decriminalized and whether it has any relevant impact on rates of human trafficking, the current data needs to distinguish between human trafficking and sex work, arguments need to appropriately weigh the lived experiences of sex workers and benefits they would incur from its decriminalization, and concerns regarding dehumanization in the sex work industry need to answer to analogous worries about dehumanization in any work industry.

1.0 Introduction

"'The police are not here to help you,'" one sex worker confided in a 2003 survey of sex workers in New York City, referencing the common abuse and dismissal sex workers face at the hands of law enforcement (Thukral and Ditmore 2003, 47). Their careers are not legal, so they are unable to seek help from law enforcement. "After a [sex worker] was gang raped, they said 'Forget it, she works in the street,'" another sex worker shared, further describing the dehumanization they faced at the hands of law enforcement due to the illegality of their work (Thukral and Ditmore 2003, 47). Law enforcement often does not want to help sex workers, and, even if they did, there is no legal recourse for sex workers. The criminalization of sex work has had and continues to have a profoundly negative impact on those involved in the industry, particularly the sex workers themselves. From fear of criminal conviction to the stigma sex workers face due to their career prospects, criminalization ultimately harms sex workers and detracts from their ability to earn a safe living. Additionally, the criminalization of sex work overshadows the positive experiences of sex workers.

Two arguments in favor of maintaining the criminalization of sex work are misguided in at least one way. The first of these arguments points to a correlation between increased rates of human trafficking and decriminalized sex work. The second of these arguments relies on the claim that sex work is inherently dehumanizing. In order to come to a conclusion on whether sex work should be decriminalized and whether it has any relevant impact on rates of human trafficking, the current data needs to distinguish between human trafficking and sex work, arguments need to appropriately weigh the lived experiences of sex workers and benefits they would incur from its decriminalization, and concerns regarding

dehumanization in the sex work industry need to answer to analogous worries about dehumanization in any work industry.

In this essay, I will first outline the distinction between human trafficking and sex work, which is often missing in the first type of argument. I will then analyze a study that focuses on two popular economic theories referenced when discussing sex work and human trafficking, namely the scale and the substitution effect. I will discuss how these effects are weighed against each other to determine whether sex work should be decriminalized. I will then discuss two prominent advocates' views on the decriminalization of sex work. I will then address four problems with the arguments and with using these economic theories as a framework for arguing against decriminalizing sex work: the theories fail to distinguish between human trafficking and sex work, conflating two actions that are ethically different; it is indeterminate if these effects can be weighed in an unbiased manner in regard to sex work; the study relies on the assumption that sex work operates in a similar way to other illegal markets; and the arguments that cite dehumanization as a factor need to answer to dehumanization in any industry. I will also question the use of these economic theories to compare sex work and human trafficking in general, which treats them as two ways of referring to the same type of commodity. Rather, it seems that legal sex work and illegal sex work would be more logically compared in this manner, because sex work and trafficking are two ethically different actions. I will also offer possible reasons for disparities in rates of human trafficking that may not point towards decriminalized sex work.

1.1 Distinction Between Human Trafficking and Sex Work

Human trafficking is defined by the Department of Homeland Security as involving "force, fraud, or coercion to obtain some type of labor or commercial sex act" (What Is Human Trafficking? [DHS]). A fundamental aspect of human trafficking is an absence of consent. Human trafficking can come in many forms, the three most common of which are forced labor, sex trafficking, and debt bondage (What Is Human Trafficking? [Human Rights Commission]). The largest population of trafficked persons are those trafficked into forced labor, which includes, but is not limited to: "domestic servitude, agricultural work, manufacturing, janitorial services, hotel services, construction, health and elder care, and hair and nail salons" (What Is Human Trafficking? [Human Rights Commission]). At its core, human trafficking is enslavement – it is a violation of human rights.

Sex work is the exchange of sexual services for money or goods (Overs 2002, 2). Sex work is consensual, which is a distinction that is lost in the conflation of the two topics. At its core, sex work is the willing transaction of sexual services between consenting adults (Clearing Up Some Myths About Sex Work). Sex work is the umbrella term for selling services of a sexual nature, such as nude dancing, providing erotic massages, escorting, performing in pornography, offering erotic services via phone or webcam, and engaging in sexual intercourse (Mensah 2007, 2). Using the term consensual sex work and forced sex work is misleading and does not capture the true natures of sex work and human trafficking, respectively (Bruckert, Caouette and Clamen 2013, 2). Sex work and human trafficking are not two different types of the same commodity or action; they are two entirely different actions.

2.0 Scale and Substitution Effect

The scale effect and the substitution effect are economic theories that have been referenced by groups and advocates against human trafficking, such as the Coalition Against Trafficking in Women International and Girls Educational & Mentoring Services (GEMS), to support the view that sex work should not be decriminalized because of the effect that decriminalization has on rates of human trafficking. The data I will be focusing on in this section is the expansive study completed by Seo-Young Cho, Axel Dreher, and Eric Neumayer, which also cites and references other studies that use these economic theories in relation to sex work and human trafficking. This study is relevant because of the objective nature in which it describes its findings, in addition to the broad range of countries included in this study. The study also takes into account both the scale effect and the substitution effect, which they consider to be the opposing effect (Cho, Dreher and Neumayer 2013, 7).

The Scale Effect

The scale effect focuses on the growth or expansion of a market (Cho, Dreher and Neumayer 2013, 6). The exogenous growth and endogenous growth theory – the central component of neoclassical economic growth models – states that growth and expansion of markets rely on either internal (endogenous) or external (endogenous) forces (Laincz and Peretto 2006, 264). These forces include, but are not limited to, increases in education, health, or human capital, changes to government policy, the creation of new businesses, and innovation (Chirwa and Odhiambo 2018, 64). When the scale effect is applied to sex work and human trafficking, as Cho, Dreher, and Neumayer have done for their study, it follows that the market where both are possible would expand due to an increase in human capital, new business, and change in government policy. We can consider the market for streamed video in a similar way. Streaming services such as Netflix, Hulu, Prime Video, and, more recently, Disney+ are all a part of the market for streamed video. This market would expand as a result of these same forces. With the creation of new businesses and increased human capital in these businesses, such as the recent creation of Disney+, the market for streamed video expands.

The Substitution Effect

The substitution effect is the change in demand for a particular object or service if a less expensive or generally preferable object or service of equal (or close to equal) value is available (Allen 1950, 679-681). The demand for the original object will fall when demand for the substitution object rises. When the substitution effect is applied to sex work and human trafficking, it follows that, if sex work were to be decriminalized, legal sex workers would be favored over illegally trafficked persons, thus reducing rates of human trafficking in that area (Cho, Dreher and Neumayer 2013, 4).

2.0 Scale and Substitution Effect

Cho, Dreher, and Neumayer's study attempts to quantify the values of the scale effect and the substitution effect in relation to sex work and human trafficking. Their study analyzes data from 150 countries concerning the legal status of sex work and the reported rates of human trafficking flows to the country (Cho, Dreher and Neumayer 2013, 5). The study also includes focused research on sub-samples of relevant data, such as whether the country is a democracy.

The study's main focus is the analysis of the impact that the legality of sex work has on international human trafficking rates. The study relies on the assumption that sex work operates in a similar way to other illegal markets, where the market is not eradicated because of its illegality due to the remaining supply and demand, but legality continues to have an impact on the market (Cho, Dreher and Neumayer 2013, 7). The decriminalization of sex work will increase demand for sex work and supply of sex workers because they are able to enter the market without fear of prosecution. Therefore, the net amount of sex workers in the market and consumers of sex work will increase in a world where sex work is decriminalized. Their study claims that there will still be a fraction of sex workers who are trafficked persons because recruitment of legal sex workers is difficult due to the nature of the work (Cho, Dreher and Neumayer 2013, 9). The amount of trafficked persons will not decrease to zero because of the potential for insufficient supply resulting from increased demand and the unchanged "unattractive nature" of being a sex worker (Cho, Dreher and Neumayer 2013, 9).

Cho, Dreher, and Neumayer contend that the data available for rates and numbers of trafficked persons is not fully reliable, nor is it consistently accurate across all countries being studied. They utilize the most accurate sources available to them for their studies, which comes from the United Nations Report on Trafficking in Persons: Global Patterns. The report provides reported inflows of human trafficking from 1996 – 2003 and also includes data from years when sex work laws were changed. Because of the inconsistency of the data, the researchers rely more on reported increases or decreases in the degree and rate of human trafficking rather than the actual numbers of trafficked persons themselves (Cho, Dreher and Neumayer 2013, 11). The dependent variable in this study is the incidence of human trafficking into a country and the independent variable is the legal status of sex work.

The results were categorized into five categories of human trafficking inflows: Very High, High, Medium, Low, and Very Low (Cho, Dreher and Neumayer 2013, 43). The probability of being placed in the "High" category was 13.4 percentage points higher for democracies than non-democracies (Cho, Dreher and Neumayer 2013, 17). The probability of being placed in the "High" category also increased by 12.8 percentage points if sex work was decriminalized (Cho, Dreher and Neumayer 2013, 18). The probability of being placed in the "Low" category decreased by 5.3 percentage points in countries with decriminalized sex work (Cho, Dreher and Neumayer 2013, 18).

Their study found that countries where sex work is decriminalized experience higher rates of human trafficking than countries where sex work is illegal (Cho, Dreher and Neumayer 2013, 16). Their study also found that trafficking rates increase significantly with the decriminalization of sex work and decrease with implementation of stricter sex work laws (Cho, Dreher and Neumayer 2013, 34). The study also showed that democracies, countries with higher GDP, and countries with larger populations were more susceptible to facing increased rates of human trafficking due to a decriminalization of sex work (Cho, Dreher and Neumayer 2013, 16). They did not evaluate the costs and benefits to sex workers because the scope of this study was meant to focus on rates of human trafficking in relation to the legal status of sex work (Cho, Dreher and Neumayer 2013, 26). Cho and Dreher's study also considered how Germany and Denmark's human trafficking rates changed following changes to the respective country's sex work laws (Cho, Dreher and Neumayer 2013, 11).

From 1996 – 2003, each of these countries changed its laws regarding sex work. Sweden criminalized prostitution and experienced a decrease in human trafficking and Germany expanded the legalization of sex work and experienced an increase in human trafficking (Cho, Dreher and Neumayer 2013, 11).

Arguments that Consider the Effect Decriminalized Sex Work Has on Human Trafficking

Directors of two major organizations dedicated to supporting victims of human trafficking and decreasing incidences of human trafficking, the Coalition Against Trafficking in Women International and Girls Educational & Mentoring Services (GEMS), argue that sex work should not be legalized because of its impact on rates of human trafficking. Janice G. Raymond, Co-Executive Director of the Coalition Against Trafficking in Women, published an article for the CATW offering ten arguments against legalizing prostitution. One of Raymond's main arguments against decriminalizing sex work is that it promotes sex trafficking (Raymond 2004, 2). Raymond claims that legalized or decriminalized sex work may be the root of human sex trafficking, citing the U.S. Department of State's statement that lenient laws – specifically legalized or decriminalized sex work – cause increased difficulties in enforcing anti-trafficking laws (Raymond 2004, 2). She further argues that because decriminalization and legalization leads to an expansion of the sex industry – and, as a result, human trafficking – sex work should not be legalized (Raymond 2004, 3). Raymond also claims that, because decriminalized sex work does not protect those within the industry and instead protects consumers of the industry, it should not be decriminalized (Raymond 2004, 6). Raymond cites a 2001 study that interviewed 146 victims of trafficking and found that 80% of those interviewed had suffered violence; the consumers, on the other hand, were offered protection such as cameras to ensure their safety (Raymond 2004, 6). Raymond also claims that, because of the nature of sex work, women do not enter into the industry voluntarily (Raymond 2004, 8). Sex work, as Raymond states, inherently lacks consent because women lack other options and are forced to enter the sex industry (Raymond 2004, 8).

Rachel Lloyd, executive director of Girls Educational and Mentoring Services, argues that, because the decriminalized sex industry correlates with increased rates of human trafficking, the focus should not be on legalizing or decriminalizing sex work (Lloyd 2015). Lloyd, a former sex worker, claims that the nature of the industry and the strain of the work forced herself and other sex workers to use drugs, alcohol, and other substances simply to get through the night (Lloyd 2015). She claims that violence is inherently a part of sex work, and that the industry is dependent on vulnerability (Lloyd 2015). While Lloyd does not necessarily support the criminalization of "victims" in the industry, she also does not believe that decriminalization is beneficial (Lloyd 2015).

3.0 The Problem with the Data and the Subsequent Arguments

While the findings of the study and its subsequent uses in arguments are plausible, there are four issues to address:

1. The study and the two subsequent arguments presented fail to distinguish between human trafficking and sex work, which conflates two actions that are ethically different.
2. It is indeterminate if the scale effect and the substitution effect can be weighed against each other in an unbiased manner.

against each other in an unbiased manner.
3. The study relies on the assumption that sex work operates in a similar way to other illegal markets.
4. The arguments presented by Raymond and Lloyd about whether sex work can truly be voluntary due to the perceived inherent violence, lack of choice, and dehumanization are subject to responding to analogous worries about dehumanization in any work industry.

I will consider each of these issues in turn.

3.1 The Conflation of Two Ethically Different Action Types

Cho, Dreher, and Neumayer's study fails to distinguish between sex work and human trafficking. While these two actions may both fulfill the desire for commercially available sex, these are two ethically different actions. Decriminalized sex work and sex trafficking are not two ways of referring to the same commodity (Gasdaglis, Draft 2 Comments). The substitution effect and the scale effect do not apply logically to sex work and human trafficking because they are two completely different actions, with two completely different ethical considerations. These economic theories could be more logically applied to legal sex work and illegal sex work, rather than sex work as a whole and human trafficking.

To say that the substitution effect and the scale effect apply logically to human trafficking and sex work is to misunderstand the fundamental aspects of each. Sex work is a consensual action; human trafficking is enslavement (Bruckert, Caouette and Clamen 2013, 2). The legal status of sex work concerns whether a sex worker – a consenting, voluntary, willing participant in the sex industry – is providing a legal service or an illegal service. Legal sex work would not function as an exact substitution for trafficked persons. The consumption of commercial sex from sex workers, regardless of the legal status of sex work, is vastly ethically different than the consumption of enslaved persons. Consider the following analogy:

Marijuana is legal in Person A's hometown and illegal in Person B's hometown. Person A purchases legal marijuana but would not purchase illegal marijuana. Person B purchases illegal marijuana. The ethical difference between Person A's purchase of marijuana and Person B's purchase of marijuana is that Person A's purchase is in accordance with the law and Person B's purchase is not. Both of these purchases obtain the same good – marijuana. The ethical difference between the two purchases is negligible. They are ethically different in that Person A's purchase is legal, and Person B's purchase is not.

Now, take into consideration a third person, Person C. Person C purchases a person to grow marijuana for them. Regardless of the legal status of marijuana, Person C's purchase is vastly ethically different than that of Persons A or B. Person A and Person B are purchasing the same good. Person C, however, is purchasing an ethically different good. The good that Person C is purchasing is not marijuana; the good that Person C is purchasing is an enslaved person. Person C is enslaving a person. Person A purchases legal marijuana. Person B purchases illegal marijuana. Person C enslaves a person, which is not only always illegal, but is, more importantly, an ethically different action.

The legal status of marijuana does not affect Person C's actions. The legal status of marijuana would change whether a purchase was made by Person A. The legal status of marijuana would change whether Person B's purchase was legal. Legalized marijuana would not operate as a substitution for Person C's purchase because this purchase is ethically different.

Human beings are not a commodity or a good to be purchased. Enslavement is a very different moral wrong than purchasing an illegal product. Comparing sex work and human trafficking ignores this very important ethical difference. Sex work is legal in Person A's hometown. Person A pays for legal sexual services. Person A would not pay for illegal sexual services. Sex work is illegal in Person B's hometown. Regardless, Person B pays for illegal sexual services. Person C, operating in a radically morally different manner than Persons A or B, enslaves a person. Legal sex work has no bearing on Person C's actions because they are acting in an ethically different way. The substitution effect does not apply to human trafficking and sex work as is portrayed in Cho, Dreher, and Neumayer's study. Purchasing enslaved persons is ethically different than purchasing a service or product from a sex worker. Legal sex work would not be a substitution for enslaved persons because sex work and human trafficking are fundamentally morally different. Sex work and human trafficking are too fundamentally different, so much that these economic theories cannot be applied.

Using the same reasoning, the scale effect would be more aptly used in terms of the market for commercial sex from a sex worker operating legally or from a sex worker operating illegally (without licensing, evading taxes, etc.). The market for sex work would be expanded, thus leading to an increase in demand for sex work. The supply can either come from a sex worker operating legally or a sex worker operating illegally. Additionally, whether the consequences of the scale effect are reasonable cause for decriminalizing sex work as a whole is questionable, even if human trafficking was considered the same good as is the case in this study. Consider the following analogy (Gasdaglis, Small Group Meeting 3):

Kidnapping a person and forcibly removing their blood plasma is ethically incorrect. The person is not consenting to having their plasma removed. A person voluntarily selling their blood plasma is ethically neutral. The person is consenting to the removal of their blood plasma but does not necessarily want to do it. The person needs to sell their plasma to pay the bills. Donating blood plasma because you know there is a need for it simply because you want to do a good deed is ethically virtuous. In a world with a demand for plasma, it is possible to ethically donate plasma. Additionally, it is also possible that a world with an increased market for blood plasma would have a higher incidence of illegally retrieved plasma. However, the voluntary donation or sale of blood plasma should not be criminalized because of the scale effect. This same analogy could be applied in the case of sex work. The existence of a black market for illegally trafficked persons used for the purposes of sex does not mean that voluntarily sold sex, regardless of whether the person necessarily wants to do it, should be criminalized.

3.2 Bias in Assigning Value

Cho, Dreher, and Neumayer completed their study without considering the positive impact that decriminalization would have on those in the industry. They contended that the question of benefits to sex workers was beyond the scope of their research, but any discussion of the legal status of sex work should take into consideration all parties affected (Cho, Dreher and Neumayer 2013, 26). Sex workers are a major party left out of this discussion. The criminalization of sex work has a profoundly negative impact on the lives and livelihoods of sex workers.

Assigning value to the scale effect and the substitution effect without considering the experiences of sex workers allows for an unspoken bias against sex work that tips the scales in favor of thinking that the scale effect outweighs the substitution effect. It is indeterminate how accurately value can be assigned to the scale effect, the substitution effect, and the positive effects sex workers experience, with the most room for error on the latter. While the data for rates of human trafficking is, to an extent, unreliable, it still has the advantage of having a numerical value assigned to it. The substitution effect is harder to quantify. Firstly, it is hard to determine the exact ratio at which trafficked persons are being substituted for legal sex workers (assuming that we are ignoring the ethical difference between the two). Secondly, the benefits incurred by those in the industry are subjective and influenced by a person's view of sex work.

The substitution effect was not as thoroughly researched as the scale effect, largely due to difficulty in assigning value compared to the scale effect. Even harder so is the quantification of benefits experienced by sex workers in the wake of more lenient sex work policies. While the bias in Cho, Dreher, and Neumayer's study may have relied on a failure to acknowledge the benefits incurred by sex workers, bias in the arguments made by others, such as those posed by Raymond and Lloyd, are more pronounced. For example, both Raymond and Lloyd acknowledged an inherent wrong with sex work. In this way, it is easier to ignore the ethical difference between human trafficking and sex work and, as a result, believe that the substitution effect is reason enough to criminalize sex work. Using quantitative data leaves out the testimony and perspectives of the group that is arguably most impacted by sex work laws: the workers themselves.

3.3 Does Sex Work Operate Like Other Illegal Markets?

This study relies on the assumption that sex work operates in a similar way to other illegal markets from an economic standpoint. However, economist Allison Schrager's analysis of risk involved in a variety of markets, including legal and illegal sex work, explains how the nature of sex work allows it to operate differently than expected. Schrager analyzed legal sex work in brothels in Nevada. The typical illicit market scenario did not apply to sex work based on Schrager's findings. For illegal drugs, exotic animals, etc., illegal markets are usually more popular because they are less expensive (Schrager). In the case of sex work, the legal market was more popular and allowed for increased salaries for sex workers. The illegal market for sex work still existed for much cheaper – $350 an hour versus $1,400 an hour on average (Schrager). However, even though illegal sex work did not face a 300% markup and was oftentimes more convenient, customers were more willing to participate in the legal sex work industry because of the decreased risk involved (Schrager).

Schrager's findings specific to sex work call one of the fundamental assumptions of the study into question. The study assumes that sex work will operate similar to the market for illegal drugs or exotic animals (Cho, Dreher and Neumayer 2013, 7). Under this assumption, the researchers expected the illegal market to grow in popularity almost proportionate to the legal market. Through Schrager's findings, it could be argued that, in contrast to how the researchers expected the scale effect to play out, the scale effect of decriminalized sex work could actually result in decreased popularity of illegal sex work and persons trafficked for sex due to the decreased or complete lack of risk (Schrager). With the market expansion of sex work as a whole and the increased supply of legal sex workers, consumers would be more likely to flock to legal sex work. Illegal sex work may be primarily appealing because legal sex work is difficult to find. With legal sex workers being readily available, routinely tested for sexually transmitted infections, and operating in legal brothels without fear of criminal prosecution, the illegal market may shrink drastically contrary to the expectations of Cho, Dreher, and Neumayer.

3.4 How Would Raymond and Lloyd Respond Worries About Any Work Being Voluntary or Dehumanizing?

The arguments presented by Raymond and Lloyd about whether sex work can truly be voluntary due to the perceived inherent violence, lack of choice, and dehumanization are subject to responding to analogous worries about the perceived inherent violence, lack of choice, and dehumanization in any work industry. Raymond makes the claim that people do not enter the sex work industry voluntarily because of the nature of the work, in addition to claiming that sex work entails the absence of consent because it is a "last resort" and people are forced to enter the industry due to a lack of other options (Raymond 2004, 8). Similarly, Lloyd, reflecting on her own past as a sex worker, claims that the nature of the industry and the strain of the work were harmful because they pushed workers to use drugs, alcohol, and other substances (Lloyd 2015). Lloyd claims that violence is inherently a part of sex work, and that the industry is dependent on vulnerability (Lloyd 2015).

Let us assume that most people do not want to be sex workers. What makes this different than any other job that most people do not want? Most people do not want to be janitors, retail workers, or restaurant workers. The jobs are underpaid, strenuous, and are undertaken due to a lack of other options. How is a sex worker who entered the industry because they needed to pay bills different than a janitor who entered their career because they needed to pay the bills? Higher-paid sex workers may have entered the industry due to lack of options but would not choose another option due to the high level of pay they receive in comparison to other jobs that people may not want. Even though jobs in retail or custodial services are not attractive to potential employees, they are not subject to the same scrutiny regarding its legal status based on whether people want the job.

Additionally, there are other careers that have known problems with treating workers poorly and dehumanizing them, but these discussions usually result in a call for a change in the circumstances that dehumanize workers, rather than a call for a change in the legal status of the workers. For example, Emily Guendelsberger published an article for Time Magazine that discusses the dehumanizing work expectations of Amazon warehouse employees, drawing from her own time employed in the warehouse. Employees were treated like "robots," walking fifteen miles a day and being held to strict productivity standards that monitored everything, even how long their restroom breaks were

(Guendelsberger). Rather than criminalize the workers who are trying to make a living, Guendelsberger aims her directives at a change in working conditions. Why is this not the narrative with sex work? It is unclear how proponents in favor of the criminalization of sex work would respond to these concerns.

4.0 Possible Reasons for Disparities in Rates of Human Trafficking

The question still remains as to why there is such a disparity in the rates of human trafficking that seem to be attributed to the legal status of sex work. It is more likely due to factors known to lead to trafficking in general. Coupled with the fact that sex work laws do nothing specifically to inhibit trafficking, it also seems that the answer to combatting human trafficking lies not in sex work policy but in policy directed at the following causes.

Cho, Dreher, and Neumayer's study briefly discusses four potential determinants of human trafficking: international movement of people, social vulnerability, crime, and policies combatting crime (Cho, Dreher and Neumayer 2013, 20). The study found that democracies have higher instances of human trafficking, which may be attributed to their tendency to have more open borders rather than sex work policies (Cho, Dreher and Neumayer 2013, 15). This allows for easier international movement of people, one of the four main potential determinants of human trafficking. The study also found that higher income countries were more susceptible to increased rates of human trafficking. This could be due to extreme poverty in high-income countries, allowing for social vulnerability (Ortiz-Ospina). While the country itself may boast a high-income that seemingly mitigates social vulnerability, wealth inequality may explain this discrepancy. In the United States, the top twenty percent of the population hoards 77% of total household wealth, leaving 23% of wealth to be distributed amongst the middle and lower class (Sawhill, Isabel V.; Pulliam, Christopher).

Discrepancies in what would be expected in states with legal sex work versus illegal sex work could also be explained by considering factors that lead to and allow for human trafficking. If the positive correlation between decriminalized sex work and increased rates of human trafficking were to hold true, then Nevada – where sex work is legal in some counties – should have more reported cases of human trafficking than California. However, this is not the case. California has the highest number of human trafficking cases reported in the entire United States, with Texas, Florida, and New York following closely behind (Hotline Statistics). Despite being the only state to have some legal sex work, Nevada ranks 8th in reported cases of human trafficking by a large margin; California reported 1,656 cases of human trafficking in 2016 while Nevada only reported 313 (Human Trafficking by the Numbers). Texas reported 1,000 cases, Florida reported 767 cases, and New York reported 492 cases (Human Trafficking by the Numbers). The legal status of sex work is not the largest determinant of the number of human trafficking cases a state will experience.

Location and population density, however, are large determinants of how heavily a state will be impacted by human trafficking. California's proximity to an international border, numerous airports and harbors creating international ports of entry, large indigenous and immigrant populations, large population in general, and its strong economy make the state very attractive and susceptible to traffickers (California Human Trafficking Fact Sheet). California is also more susceptible to human trafficking because of underground cross-border tunnels created by Mexican cartels, which allow for more international movement and, in turn, larger numbers of human trafficking (California Human Trafficking Fact Sheet).

Nevada has a much lower population density than states with higher numbers of reported cases of human trafficking. Nevada does not share a border with Mexico, which allows less ability for international movement than other states. Nevada has a drastically smaller immigrant population than California or Texas. From Mexico alone, California has an immigrant population of approximately 4,197,000, Texas has an immigrant population of approximately 2,541,00, and Nevada has an immigrant population of approximately 227,000 (U.S. Immigrant Population by State and County). These numbers imply that future research should focus on other factors that allow for increased rates of human trafficking completely separate from the legal status of sex work, as it seems to depend more on access and ease for traffickers than sex work policies.

5.0 Conclusion

Currently available studies and debates regarding the decriminalization of sex work are susceptible to four important issues, the most prominent of which is that they fail to distinguish between sex work and human trafficking. The conflation of sex work and trafficking merges two ethically different actions. Additionally, arguments that point to the nature of sex work need to provide responses to the dehumanizing nature of other work.

Instead of focusing on what impact, if any, sex work policies have on human trafficking, effectively combatting human trafficking would require policies that tackle factors that leave an individual, state, or country susceptible to trafficking. In order to come to a conclusion on whether sex work should be decriminalized and whether it has any relevant impact on rates of human trafficking, the current data needs to be reshaped to create a clear distinction between human trafficking and sex work, arguments need to appropriately weigh the lived experiences of sex workers and benefits they would incur from its decriminalization, and concerns regarding dehumanization in the sex work industry need to answer to dehumanization in any work industry.

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Reshaping the Debate on the Decriminalization of Sex Work

Abstract

Los Angeles County's growing homeless epidemic is a continuous challenge, especially among the chronically homeless. This literature review aims to explore engagement and retention of chronically homeless individuals, and compares methods used within Los Angeles County. A systematic literature search of multiple databases resulted in thirteen articles being reviewed. The literature reveals themes that contribute to barriers within the system relating to engagement and retention. LA County has begun to implement methods under the Measure H guidelines to aid the chronically homeless. Evaluating past practices within LA County, the literature shows that Measure H is likely to succeed with maintaining engagement and retention amidst this community. It will be reached by the implementation that promotes meaningful connections, reduced wait times, and the support of behavioral changes.

Keywords: Chronic Homelessness, Rehabilitation, Measure H, Engagement, Retention.

Introduction

Rehabilitation centers play an essential role in providing treatment to those who are chronically homeless with underlying substance abuse and mental health issues. "HUD defines individuals as chronically homeless when they are (A) disabled, (B)live in a shelter, safe haven, or place not meant for human habitation for: twelve continuous months with no breaks or 4 separate occasions in the last three years that total twelve months, (C) Occasion separated by at least seven nights and stays in institutions of fewer than ninety days do not constitute a break. Secondly, an individual who has been residing in an institutional care facility for fewer than ninety days and met all of the criteria in paragraph (1) of this definition, before entering that facility; or thirdly…A family with an adult head of household (or if there is no adult in the family, a minor head of household) who meets all of the criteria in paragraphs (1) or (2) of this definition, including a family whose composition has fluctuated while the head of household has been homeless" (Form 1445, n.d.).

To be defined chronically homelessness an individual must be homeless for at least six months. Typically, they tend to show more evidence of addiction, mental illness, and physical health problems compared to the other types of homelessness (Ibabe, et al. 2014). The overabundance of chronic homeless individuals is steadily increasing within Los Angeles County. In response to this crisis the Board of Supervisors (BOS) established the Los Angeles County Homeless Initiative (HI) within the Chief Executive Office (Lo, et al. 2019). An indispensable factor in alleviating this community is through the continuous engagement and access of rehabilitation centers. Despite the immediate demand for treatment amidst the chronically ill, numerous centers encounter impediments that generate deficiencies. Distinguishing components that hinder adequate sustainable recovery is fundamental to dwindle this community within the County. This review discusses the sustenance of rehabilitation centers to service chronic homeless individuals and prevalent impediments within the system and concludes with current methods implemented within the County that addresses barriers within rehabilitation centers.

Method

Gathering the research literature involved the use of different combinations of keywords such as homeless, chronic homeless, rehabilitation, treatment, Measure H, engagement, and retention. All were used in various combinations to conduct database searches. These databases include research from PubMed Central, EBSCO, ScienceDirect, SpringerLink Journals, Wiley, and ProQuest. Various government sources were also searched including Los Angeles Homeless Service Authority, Los Angeles County data, and the use of public health records. The combined search produced a systematic review of twenty-seven articles and resulted in seventeen articles to extract data from. The literature reveals themes relating to engagement and retention, past programs to address chronic homeless within LA County, and including current implementations.

Engagement and Retention

Chronic homelessness in LA County embodies 'twice the portion of total homelessness in the nation as a whole' (Nicholas et al, 2017). Los Angeles County accounts for seventeen percent of the nation's chronically homeless. Evaluating the engagement and retention among the chronically homeless is essential to understand the current barriers in the system. Engagement is defined as "mutuality between provider and client" while retention is described as "provider recommendations and client's acceptance or rejection" (Padgett et al., 2008). An early study conducted in 2008, analyzes formerly chronic homeless individuals with co-occurring substance abuse and mental illness engagement and retention amidst treatment. This study provides an inside perspective on past treatment and services received through a qualitative study and found that maintaining engagement and retention among the chronically homeless is a considerable hindrance and a constant struggle (Padgett et al., 2008). In this study, seventy-two interviews were conducted of which thirty-nine were formerly homeless psychiatric individuals. The purpose of this study was to identify themes within individuals' personal experiences to support efficient policies and practices. Resulting in the development of "grounded theory model of engagement and retention in mental health and substance abuse services." This theory was developed around several themes conducted in the interviews which include; person-centered factors, and system factors (Padgett et al., 2008). Table 1 reviews the systematic literature review that focuses on the relationship between engagement and retention among various care approaches. Identifying common barriers within the rehabilitation centers as well as approaches that have been proven successful.

Table 1 Systematic Review: Engagement and Retention

Study	Study Purpose	Care Approach	Sample Size	Relevant Findings	Limitations
Stanhope, V., & Henwood, B. F. (2014). Activating people to address their health care needs: Learning from people with lived experience of chronic illnesses. *Community Mental Health Journal, 50*(6), 656-663.doi:http://dx.doi.org.proxy.library.cpp.edu/10.1007/s10597-013-9686-3	To determine the relationship of costs of care and improving the quality of care.	- Assertive Community Treatment - Housing First	Qualitative interviews of participants in six-week program.	Identified external and internal barriers. - External barriers include individuals not addressing their health needs. - Internal barriers:	- Participants in this study were exclusively male. - Participants self-selected themselves to be a part of the program.

Schout, G., De Jong, G., & Zeelen, J. (2010). Establishing contact and gaining trust: An exploratory study of care avoidance. *Journal of Advanced Nursing, 66*(2), 324-333.	Evaluate care providers who are successful in establishing trust with their clients.	n/a	Observations and interviews were conducted amongst care providers and clients.	Care providers who have a non-judgement approach establish client engagement and retention.	- Clients were not reliable and questionnaires were generally weak. - Identification of successful care providers are not clear-cut and can vary.
Padgett, D., & Henwood, K. (2012). Qualitative Research for and in Practice: Findings from Studies with Homeless Adults Who Have Serious Mental Illness and Co-Occurring Substance Abuse. *Clinical Social Work Journal, 40*(2), 187-193.	Comparing the efficiency of two different programs.	-Treatment First -Housing First	Qualitative interviews of DSM Axis I disorders individuals.	- Improve training to care providers. - Increase of one-on-one therapy is needed. - Treatment first participants often went AWOL, while Housing First had a lower turnover rate.	- More research in regard to care provider and client relationships - More research is needed on the Housing First Program and its long-term effects.
Padgett, D., Henwood, B., Abrams, C., & Davis, A. (2008). Engagement and retention in services among formerly homeless adults with co-occurring mental illness and substance abuse: Voices from the margins. *Psychiatric Rehabilitation Journal, 31*(3), 226-233.	Identify engagement and retention barriers within treatment centers.	-Continuum of Care -Housing First	Qualitative interview of 79 participants with 39 individuals who were formerly homeless.	- Lack of individual therapy. - Patient privacy needs to improve. - "Acts of kindness" and housing improve engagement and retention results.	- Less candid interviews.

Person-Centered Factors

Person-centered factors include the severity of one's mental illness and dependencies on hospital aid. When either one of these factors becomes overwhelming many individuals enter treatment and remain until they are stable (Padgett et al., 2008). Predominantly those with severe mental illness and co-occurring substance abuse problems are treated for immediate emergencies at hospitals. Rehabilitation centers which offer the proper assistance and treatment for these individuals are an underutilized resource. These individuals find it extremely difficult to remain engaged with the services and requirements, especially conforming to abstinence programs (Padgett et al., 2008). This article recognizes that many of the services provided to the homeless with mental illness follows a Continuum of Care (CoC) approach. CoC is a regional or local planning body that coordinates housing

and services funding for homeless families and individuals (Los Angeles Continuum of Care, 2020). Typically, these programs offer temporary housing upon agreement of sobriety, attendance of treatment programs, following of house rules and regulations, as well as taking prescribed medication that are considered essential.

An additional study by Padgett & Henwood conducted in 2012 compared engagement and retention through the Housing First program alongside the Treatment First program. This study evaluated formerly homeless individuals with DSM Axis 1, Axis I consists of substance use and mental disorders, who were provided immediate housing through Housing First, with no requirements of abstinence, as well as access to Assertive Community Treatment (ACT) services. Housing First is based on the practice of providing permanent housing, rather than time-limited, not making housing reward for good behavior, and removing as many restrictions to housing resources as possible (Lo, et al. 2019). In comparison to the CoC, treatment first follows similar practices where sobriety is required, as well as many rules to abide by in order to remain in housing. Research was conducted in a qualitative study funded by the National Institute of Mental Health (2004-2008) and produced by the New York Services Study (NYSS), to interview and provide an in depth look into their life experiences.

Results for Phase 1 included many traumatic experiences during childhood which lead to the development of mental illness in adulthood. Constant exposure to drug and alcohol abuse began early in life, as well as “self-medication” of mental symptoms. Many of these individuals experienced “many accounts of being hospitalized, detoxed, rehabbed, counseled, medically treated, arrested and imprisoned” (Padgett & Henwood, 2012, p.189). These results lead to Phase 2, which identified two different groups, (54%) left through Treatment First. Compared to (11%) leaving to join family members through Measure H. Participants who’s care providers were not conforming to their needs and aspirations left treatment. Many case managers under Treatment First blamed this on poor decision making and relapsing (unlike Housing First). Concerns came up for Housing First and Treatment First participants due to lack of one-on-one therapy leading to privacy concerns. A female participant explained, “I’m quiet in groups cause, you never know who can turn against you and throw it up in your face, and stuff like that. So, I’m not used to that. One on one is better for me, because I could talk” (Padgett & Henwood, 2012, p.190).

System Centered Factors

Systematic factors include an overabundance of rules and regulations that discourage engagement and retention such as; “...medication requirements, curfews, close supervision...” As well as lack of one-one-one therapy that prevented proper care due to lack of privacy among traumatic issues (Padgett et al., 2008). Stanhope & Henwood’s 2014 study also confirms this concept in their analysis of health care reform to improve the quality of care, and reduce its cost with mental health and physical health conditions. Methods included a six-week program under HF among those who classified as chronically homeless and diagnosed as mentally ill. These individuals received ACT that provided primary care physicians, as well as a community activities research framework (CBPR), and Stanford CDSMP program to facilitate before and after interviews. These interviews revealed many internal barriers such as denial of symptoms, preventing individuals from receiving

care let alone follow up care. Many feel that they are unable to talk about their health due to a lack of privacy and concerns that personal information would be passed around. Others felt embarrassed talking about their health which prevented them opening up to providers and people in their life. Many overcame this barrier by attending weekly support group sessions, where discoveries of similar commonalities arose, and peer support helped. Other internal barriers include the role in mental health the impact it has on reaching out for help (Stanhope & Henwood, 2014). This shows that the perspective of formerly chronic homeless individuals facing substance abuse and mental illnesses can identify current issues and what is working within rehabilitation centers.

A major component in establishing engagement and retention is the care that is provided. Establishing continuous trust and care is often based on the approach staff take. Many participants generally have negative expectations when it comes towards care providers. However, good experiences were greatly cherished (Padgett & Henwood, 2012). Participants were often discriminated against due to their mental health issues or being homeless. Oftentimes leaving the impression of not receiving proper care, and their general distrust towards care providers is confirmed (Stanhope & Henwood, 2014). Schout, Jong, & Zeelen examine care providers characteristics that establish trust between themselves and individuals who have severe mental illness. Studying participants' observations in a public mental healthcare practice between 2002-2007, in The Netherlands, interviewed both the participants and care providers to find themes of gaining trust from those who avoid receiving care. Care providers who show non judgment by not dwelling on the goals that aren't achieved yet are most effective in gaining trust. Those who are able to do this and connect with their client's life are the most successful. This article addresses the client's perspective on aspects of care that dwindle trust, this includes; clients that are treated as a case rather than an individual, providers who behave in a domineering manner, and which lack the time to establish a connection. Being able to connect to clients is a key component in establishing trust and re-enforces participants to continue treatment (Schout, Jong, & Zeelen, 2010).

Table 1-1 Systematic Review: Los Angeles County

Study	Study Purpose	Care Approach	Sample Size	Relevant Findings	Limitations
Crèvecoeur-Macphail, D., Bellows, A., Rutkowski, B., Ransom, L., Myers, A., & Rawson, R. (2010). "I've been NIATxed": Participants' Experience with Process Improvement. *Journal of Psychoactive Drugs: SARC Supplement No. 6. Research to Policy: California Substance Abuse Research Consortium Meetings 2009, 42*(Sup6), 249-259.	To determine the performance of NIATx process improvement program within Los Angeles County.	-NIATx	Qualitative evaluation of care providers involved in the Phase II of NIATx program.	-Changes implemented were quick and efficient. -Maintaining the program was difficult, due to lack of training on data collection. -Lack of resources to fund the program was also an issue.	n/a

Ashwood, J., Kataoka, S., Eberhart, N., Bromley, E., Zima, B., Baseman, L., . . . Burnam, M. (2018). Evaluation of the Mental Health Services Act in Los Angeles County: Implementation and Outcomes for Key Programs. *Rand Health Quarterly, 8*(1), 2.	Determines the Mental Health Services Act effects on expanding FSP and PEI programs across Los Angeles County.	-Full-Service Partnership (FSP) -Prevention and early intervention (PEI)		-These programs are reaching highly vulnerable homeless population. -Those serviced by the program improved mental health.	-Improving data collection will improve quality efforts and evaluation of participants.
Rutkowski, B., Gallon, S., Rawson, R., Freese, T., Bruehl, A., Crèvecoeur-Macphail, D., . . . Cotter, F. (2010). Improving client engagement and retention in treatment: The Los Angeles County experience. *Journal of Substance Abuse Treatment, 39*(1), 78-86.	Evaluates NIATx two phase project within Los Angeles County among substance use providers.	-NIATx	Evaluated 12 county-contracted agencies.	- Straightforward methodology is important. - Collaborative work environment is crucial and interaction among peers is beneficial.	n/a
Ibabe, I., Stein, J., Nyamathi, A., & Bentler, P. (2014). Predictors of substance abuse treatment participation among homeless adults. *Journal of Substance Abuse Treatment, 46*(3), 374-381.	Determines the relationships of the chronically homeless, substance abuse, and individuals who are emotionally distressed.		Participants included 853 Los Angeles homeless individuals.	-Treatment centers that only focus on one aspect don't show much improvement. -Housing for these individuals have shown to improve health status.	-This study does not represent all homeless individuals within the county.
Lo, J., Garmisa, S., White, K., & Wythe, R. (2020, February 18). Performance Evaluation. Retrieved April 11, 2020, from https://homeless.lacounty.gov/evaluations/	Evaluates the implementation of Strategy E6: Street-based outreach.	-Measure H -Housing First -Motivational Interviewing	-Qualitative interviews of managers, staff, and research on evidence-based practices. -Quantitative data analysis of various systems.	-Based on sample size, E6 strategies matches available resources. -The County does not have system-wide data system to monitor data.	n/a

Los Angeles Continuum of Care. (n.d.). Retrieved April 19, 2020, from https://www.lahsa.org/coc/	Overview of Continuum of Care model and Los Angeles County.	-Continuum of Care	n/a	-Coordinates housing and various services to homeless individuals within a regional or local level.	n/a
Homeless Quarterly Report by Theme - Outreach. (n.d.). Retrieved April 19, 2020, from https://data.lacounty.gov/stories/s/gdbp-2j9k	Overview of homeless individuals served through the outreach program under Measure H.	-Measure H	n/a	-Over 20,000 homeless have been contacted. -Less than 2,000 have been placed in permanent housing.	n/a
Form 1445 - Chronic Homeless Status Documentation. (n.d.). Retrieved April 19, 2020, from https://www.lahsa.org/documents?id=1445-chronic-homeless-status-documentation.pdf	Definition of chronically homeless.	n/a	n/a	-Individual has a disability. -Have lived in a place not meant for human habitation, safe heaven, or shelter for twelve consecutive months. -Etc.	n/a
Diagnostic and Statistical Manual of Mental Disorders (DSM–5). (n.d.). Retrieved May 07, 2020, from https://www.psychiatry.org/psychiatrists/practice/dsm	Definition of DSM Axis 1	n/a	n/a	Axis I consist of substance use and mental disorders.	n/a
Hamai, Sachi. "Homeless Inactive Quarterly Report NO. 12." *Ceo.lacounty.com*, 20 Feb. 2019, homeless.lacounty.gov/wp-content/uploads/2019/02/Homeless-Initiative-Quarterly-Rpt-No.12-.pdf.	Overview of current plans within the County and future plans that are to be implemented.	-Measure H	n/a	-Starting June 2019, 120 newly hired outreach team members will receive training and orientation.	n/a

L.A. County Makes $460 Million Investment in Fight Against Homelessness Year 3 Measure H Spending Plan Funds Expansion of Housing and Prevention. (2019, May 14). Retrieved May 13, 2020, from https://homeless.lacounty.gov/news/l-a-county-makes-460-million-investment-in-fight-against-homelessness-year-3-measure-h-spending-plan-funds-expansion-of-housing-and-prevention/	Goes over the approved budget plan for the fiscal year of 2019-2020.	-Measure H	n/a	-Monthly meeting will be conducted to review outcomes and problem-solving barriers. -Starting June 2019, 120 newly hired outreach team members will receive training and orientation.	n/a
Nicholas, W., Song, S., Graves, E., Simon, P., & Frye, D.,... (2017, February). Measure H: Preventing and Reducing Homelessness in Los Angeles County Health Impact Assessment. Retrieved April 16, 2020, from http://www.publichealth.lacounty.gov/chie/reports/Measure_H_HIA_Final.pdf	To determine the potential impacts of Measure H and the potential health impacts.	-Measure H	n/a	-Preventative care is effective to preventing initial homelessness. -Evidence suggests that a system-wide approach will be successful.	n/a
Treatment, C. (1999, January 01). Chapter 3-Motivational Interviewing as a Counseling Style. Retrieved May 08, 2020, from https://www.ncbi.nlm.nih.gov/books/NBK64964/	To determine the effects of motivational interviewing and client motivation.	n/a	- Eleven clinical trials	-Nine clinical trials agreed that MI is more effective than standard care.	-Article suggest that MI is effective in treating substance abuse, however only five clinical trials supported this claim.

Addressing Substance Abuse

"Health problems are more prevalent among the chronically homeless. In Los Angeles County almost two-thirds of the chronically homeless have a mental illness, about half have substance use disorders and 40% have a physical disability" (Nicholas et al, 2017). Los Angeles County consists of over 300 treatment programs, of which were evaluated to identify consistent problems within the system. Table 1-1 indicates the different ways Los Angeles County has addressed rehabilitation centers in regards to engagement and retention as well as current methods to address homelessness. Rutkowski et al (2010) evaluates the effects of implementing the Network for the Improvement of Addiction Treatment (NIATx) model to improve substance abuse treatment centers in Los Angeles

County, California. After several years of evaluation, similar disparities of "access to treatment, early treatment dropout, and unsuccessful client retention" were identified. Bringing together LA County government leaders, advisors, research developers from University of California, Los Angeles (UCLA), and "technology transfer specialists" to address these program issues. The success of the community-based model known as NIATx was essential to improving processes in LA County (Rutkowski et al., 2010)

The Network for Improvement of Addiction Treatment (NIATx) is the process of treatment providers identifying policies within their system that should be improved in order to provide better service to their clients (Crevecoeur-Macphail et al., 2010). NIATx five principles involve; understanding clients' individual needs by getting feed-back, focusing on key problems, identifying a "change leader" to apply changes, look for ideas from outside organizations, and apply "rapid cycle testing" to allow for adjustments and improvements of new changes (Crevecoeur-Macphail et al., 2010). For LA County NIATx focused on walk-throughs to evaluate the process from the client's point of view. This process is important to evaluate the strengths and barriers of providing efficient timely care that keeps clients engaged. To identify current barriers a "change team" was implemented not only to point out but make action plans to improve. Followed by "rapid-cycle testing" for change teams to apply improvements where needed, as well as make quick modifications. This allows for NIATx to collect and analyze data to follow improvements from beginning to end (Rutkowski et al., 2010).

Los Angeles County Process Improvement Pilot Project

The NIATx model was implemented in a two-phase process to help aid the continued deficiencies evaluated within Los Angeles County treatment programs known as the Los Angeles County Process Improvement Pilot Project. Phase I was conducted from 2005-2006 including an 11 month period to evaluate whether treatment centers with no financial support, minimal coaching, and technical assistance could implement NIATx process improvement methods. Results included several themes, 'seeing things from the client's perspective can yield insight into process problems, multiple improvements can be made in a short period, the change process can motivate and engage the interest of both staff and clients, the results surpassed initial objectives and expectations, simple improvements can yield big dividends, data can provide a basis for decision making, and there is value in "sticking with it" to sustain efforts to improve the client's treatment experience.

Phase II was implemented in 2007 through 2008 which followed Phase I but had more specific protocols which included, "a formal application process for participating agencies, and in-depth". Phase II allowed for many treatment centers discovering ways to provide better care by understanding what their clients go through with no financial assistance. Results allowed centers to develop strategies to address overall problems such as; decrease waiting time from initial contact, decreasing no-shows, increase post-admission session-by-session attendance, and increase 30-day continuation in a residential setting. NIATx use of data driven decision making, allowing many facilities to evaluate their current issues, and make improvements. Both phases involved only a small sample size of agencies within LA County, not making it credible to base the entirety of LA County on (Rutkowski, et al., 2010).

Upon the implementation of Los Angeles County Process Improvement Pilot Project, substance abuse facilities processes did improve, however weakness within the project showed with facilities to continue using the data collected while being trained under NIATx. Facilities who previously didn't use data before the project ultimately reverted back to not using data, because of the lack of resources and understanding (Crevecoeur-Macphail et al., 2010). "A study of homeless individuals in Los Angeles found that only 20% of those with either mental illness or substance abuse disorders had received any treatment within the last 60 days. There is also evidence that among substance abusing adults, those who are chronically homeless have worse mental health outcomes over time than those who are not" (Nicholas et al, 2017, p.23).

Addressing Mental Health

The focus on mental health was mandated in California through Proposition 63, also known as the Mental Health Services Act (MHSA). Funds were provided by a 1 percent increase in tax to those whose income was over 1 million. This act intended to address 'accessible, recovery-based, community mental health services.' Key programs that were funded by MHSA includes Prevention and Early Intervention (PEI), aiming to prevent the severity of one's mental illness, as well as Full-Service Partnership (FSP) which is similar to HF by providing stable housing with a focus those with severe mental health symptoms.

Scott Ashwood et al., (2018) evaluates PEI and FSP impact in Los Angeles County by examining who is being reached. FSP showed that the majority of enrollments within this service were actively engaged among children, transition-age youth (TAY), and adults. Due to FSP being located primarily in poverty areas, those who are enrolled tend to have severe mental illnesses and serve a high rate of homelessness. Results also included that racial/ethinic minorities were mostly served within the program, and qualitative interviews revealed that many individuals were dealing with mental health, physical health, and social issues at the same time. Those who were treated by FSP showed a decrease within the following; homeless rates, incarceration, and inpatient hospital stays (Ashwood et al., 2018)

PEI was founded to be more concentrated on children and TAY, Los Angeles County Department of Mental Health (LAC DMH) was able to provide care to 130,000 of these individuals through this service. PEI also showed efficient treatments that helped lower symptoms over time. Those who came into the program at or above the clinical cut point, resulted in more than half not showing significant symptoms after care. Also, of all the ethnic minorities hispanic and asian youth showed significant improvements within PEI's service (Ashwood et al., 2018).

Potential Impacts of Measure H

Los Angeles County's former plans to address the homeless population has shown little success compared to the amount of homeless currently there. Studies show that around 20% of those who initially become homeless will go on to be chronically homeless (Nicholas et al, 2017). In efforts to minimize the homeless population within the County, Measure H is a tax plan that will increase sales tax by one-quarter of one cent within Los Angeles County for ten years. Los Angeles County approved this tax increase in 2017 through Measure H. This will generate $350 million in annual revenues to fund Los Angeles County Homeless Initiative (Lo et al., 2019). Measure H will have three level foundations; primary prevention which seeks to prevent health conditions before they occur, secondary prevention which seeks to detect health conditions within its early stages to either slow or

stop their progression. Lastely, tertiary prevention which helps pre-existing health conditions and aids through recovery and rehabilitation. The last prevention case is aimed to help those who are chronically homeless, by focusing on treatment services that promote a sustainable life (Nicholas et al., 2017). The first year of Measure H, outreach teams were able to help nearly 18,000 homeless individuals with an increase to more than 22,000 people in the 2018-2019 fiscal year (Homeless Quarterly Report by Theme., n.d.).

Under Measure H there are many action plans that address the various needs of the homeless, among these Strategy E6 which is the effort to address the chronically homeless population. Partnership between The Los Angeles Homeless Services Agency (LAHSA), the Department of Health Services (DHS), and Department of Mental Health (DMH) developed this system change to direct the 200 teams implementing Strategy E6 across the County. Strategy E6 is intended to "coordinate and integrate network street-based homeless outreach teams to identify, engage, and connect unsheltered individuals to interim and/or permanent housing and supportive services" (Lo et al., 2019). As of May 14, 2019 the Los Angeles County Board of Supervisors approved a $460 million plan for the fiscal year of 2019-2020 to minimize the homeless population. "This investment includes $126 million for shelter/interim housing, $85.4 million for rapid re-housing, $77.3 million for permanent supportive housing, $28.4 million for outreach and $23 million for prevention" (Measure H Spending Plan Funds., 2019, p.1). These funds are integrated to support this street-based program, which plays a critical factor in aiding the homeless population. Homeless outreach aims to help these individuals by providing direct on location services, establishing meaningful connections for those who are disconnected from services, addressing individuals problems through treatment, and through educating with services and support systems available (Lo et al., 2019).

Measure H: Engagement and Retention

Street-based outreach staff provide case management and care coordination services that will be essential in the aid for those with mental health, and/or substance abuse, and physical health impairments. Measure H best practice in regard to person-centered factors includes recognizing individuals' preferences and needs to plan treatment around their strengths and resources. This also includes not assuming their needs so that each individual can drive their own problem-solving and decision-making process (Lo et al., 2019). As of June 10, 2019 over 120 newly-hired outreach team members will attend training and orientation from LAHSA & the Health Agency departments. homeless individuals experiencing substance abuse, mental illness, and/or trauma. The street-based outreach program plans to implement MI training to staff to support behavioral changes driven by homeless individuals (Lo et al., 2019). Miller and Rollnick evaluate the impact of MI as a means of helping individuals remove their doubt of achieving their personal goals. This type of counseling technique uses self motivation and behavioral changes. It has shown to play an essential role in one's recovery, especially those who struggle with substance abuse. Miller and Rollnick's methods included eleven clinical trials using MI. Resulting in efficient and effective treatment, and among these clinical trials five showed reduction of substance-use patterns.

System factors within Los Angeles County are known to be unorganized systems not having clear guides for individuals to move forward. Due to the 10% increase of homeless individuals from 2017 to 2019, a clear and organized system between already complex dynamic agencies is essential. The street-based outreach implementation of a clear and organized system is a part of establishing system changes to be effective in response to the crisis. Among establishing trust is for staff to provide what is known as warm handoffs. This includes driving and/or accompanying clients to appointments to help create and maintain trust with providers. Care providers are trained to maintain engagement and retention by addressing unique motivations and needs of each individual. However, the street-based outreach program doesn't have a system wide measure to ensure that best practices within training and retention remain consistent (Lo et al., 2019). According to the Housing Initiative quarterly report this street-based system was able to recruit 10,905 individuals with the addition of the 15,039 individuals already engaged in previous reports, totaling 25,944 homeless individuals within Los Angeles County. From this initial engagement 17,673 individuals gained access to services, 1,468 individuals received interim housing, and 1,018 individuals were placed into a permanent housing program. There is a gap of those who are initially approached to receiving services. This street based program only reaches and serves homeless individuals who happen to be in the streets at a given point or time, there is a possibility for a disconnect between this approach and homeless individuals who are not reached due to these circumstantial services.

Health Impact Evaluation Center Los Angeles County Department of Public Health considered those who are homeless to contain a behavioral condition in the individual until the turn of the 21st century. The majority of services provided to aid the chronically homeless comply with a continuum (CoC) approach by rewarding them incrementally based on sobriety, personal responsibility, in hopes to achieve permanent housing. Complying to these conditions individuals whose behavior follows these guidelines will qualify for permanent housing which resulted in significant barriers to self-sufficiency. The majority of the homeless population is not classified chronic, however LA County's rate of chronically homeless is immensely high compared to the U.S. Measure H focuses on alleviating the chronic homeless population through Permanent Supportive Housing (PSH) twelve experimental and quasi-experimental studies which resulted in reduced hospital stays, reduced homelessness, and provided long term stable housing (Nicholas et al, 2017). PSH is strictly based on health interventions, based on HF principles, aimed to assist chronically homeless reach health and wellness. Providing them connections to different health-related services that support based on each individual's needs. This process of rehabilitation will help alleviate addictions, mental health issues, and physical conditions that they face. (Nicholas et al, 2017). Kirk Slaughter, after four years of being homeless, having benefited from the program shares his experience.

> "I'm an actual person that represents these statistics. Before I was homeless I had a life…I was a grad student from USC, I was working, I paid my taxes. But due to bipolar disorder, substance abuse and wrong choices, my life took a turn. Just six months ago I was living under a bridge. But my case manager and her team pulled me up and got me into emergency housing – and now I have my own place with a key. I'm going to re-enter society and I am a changed man thanks to all of you" (Measure H Spending Plan Funds., 2019, p.1)

Conclusion

Chronic homelessness is a rooted problem within Los Angeles County that has yet to be alleviated. Emphasis on rehabilitation centers is needed in order to support chronically homeless individuals to transition back into society. Engagement and retention in the literature resulted in qualitative interviews of both care providers and homeless individuals. Many of these interviews were based on participants that were involved in rehabilitation services as well as housing opportunities. Throughout the literature Housing First was relevant in each study and showed that this program was successful in retaining engagement among the homeless. Among this literature more research needs to be conducted on participants who are amidst treatment as well as follow up before, during, and after treatment. Focus on those with severe mental illness and co-occurring substance abuse problems through continuous engagement and services is a critical resource that is known to be underutilized. Establishing trust in care providers, as well as focusing on one-on-one therapy, along with addressing individuals personal needs and wants is critical in establishing efficient treatment. The focus on these improvements alongside supportive housing aid is proven to be most effective. The implementation of the street-based program within Los Angeles County focuses on the barriers amongst rehabilitation centers and has set up effective strategies to provide effective care. Research of the impacts and results of the street-based outreach through Measure H still needs to be implemented. There is no current plan to collect data amongst those who are being treated. Establishing a means of data collection, such as the NIATx program, will create an analytic review of the homeless population within the county. Street-based outreach has connected many individuals to preventative care, however over one thousand homeless individuals have actually been housed. Chronically homeless individuals with increasing mental health issues and substance abuse need to have access to rehabilitation centers and housing cohesively in order to achieve a sustainable life.

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The Potential Role of Complement Receptor 4 in the Trogocytic K illing of Trichomonas vaginalis by N eutrophil-Like Cells

Project Summary

Trichomonas vaginalis (Tv) is a parasite that causes the most common non-viral sexually transmitted infection worldwide, and annually infects 3.7 million people in the United States. Tv is associated with fertility and pregnancy issues, such as infertility, spontaneous abortion, and cervical cancers. Vaginal smear samples have shown high levels of immune cells called neutrophils in Tv-infected women. Neutrophils have been shown to swarm Tv and "nibble" the parasite to death. This "nibbling" is called trogocytosis and has been shown to be contact-dependent, however the molecules mediating contact between neutrophils and Tv are unknown. Opsonins are proteins that circulate in blood and attach to the surfaces of pathogens, signaling for destruction. It has been shown that the opsonin iC3b can bind to Tv and bind to surface receptors on neutrophils such as complement receptor 4 (CR4), therefore we hypothesize that iC3b crosslinks Tv to neutrophils via CR4. We believe that the deletion of CR4 in PLB 985 cells will decrease the trogocytic activity of the resultant NLCs, and thus their ability to kill Tv. CR4 is made of two subunits, CD11c and CD18. In this study, we showed that both subunits are present in neutrophil-like cells (NLCs), a suitable model for studying trogocytic killing of Tv as primary neutrophils are short-lived. Using a progenitor cell line that can be differentiated into neutrophil-like cells, we have shown the generation of a heterogenous CD11c-knockout cell population using CRISPR/Cas9 gene editing. This study shows that CD11cknockouts were achieved and that experiments determining the role of CD11c in the trogocytic killing of Tv parasites by neutrophils are possible. Determining the role of CR4 in neutrophil trogocytosis of Tv, will better characterize this novel antimicrobial process, which may better inform novel preventative Tv therapies. Current trichomoniasis treatments are non-specific antibiotics that are used to cure infection, though antibiotic resistance against that will protect the many people who are infected annually, especially women as they suffer more severe health outcomes due to Tv infection.

Introduction

Trichomonas vaginalis (Tv) is a microaerophilic flagellated protozoan parasite that attacks the epithelial cells in the vaginal lumen and urethra (Kissinger 2015). Genital inflammation from Tv occurs in the inner vaginal wall or urethra and can increase the risk of concomitant STI infections, such as HIV (Kissinger 2015). Tv causes trichomoniasis, the third most common sexually transmitted infection. Trichomoniasis annually affects 3.7 million people in the U.S. and 276.4 million people globally (Miller 2005, Kissinger 2015). Roughly 50-70% of Tv-infected people are asymptomatic and therefore do not seek treatment, exacerbating the spread of Tv (CDC 2017). Tv reportedly infects women at higher rates than men (CDC 2017, Yang 2018, Fichorova 2009), though this might be due to men being more asymptomatic than women (CDC 2017). Tv infection is associated with an increase of infertility, low-weight births, cervical cancers, and spontaneous abortions (CDC 2017, Yang 2018, Fichorova 2009). Trichomoniasis disproportionately affects underserved communities. For example, prevalence rates among African women are around 13.3%, while only 1.3% in white women (CDC 2017).

The most common treatment for trichomoniasis is Metronidazole, a curative non-specific antibiotic, that happens to work on protozoans with anaerobic metabolism, that lack mitochondria and oxidative phosphorylation enzymes, such as Tv (Mercer 2018, Samuelson 1999). Metronidazole, however, does not prevent reinfection, and recent reports claim that up to 10% of Tv strains are already Metronidazole-resistant (Dunne 2003, Miller 2005, Schwebke 2006, Leitsch 2016). The lack of consistent efficacy of Metronidazole highlights the importance of developing new curative treatments for Tv, or preventative treatments like a vaccine. As of 2014, trichomoniasis was classified as a "neglected infection" due to lack of Tv research being conducted in the United States (Secor 2014). For vaccine development, the mechanism by which neutrophils clear Tv needs to be better characterized.

The immune system has two response branches, the innate response and the adaptive response, to clear pathogens (Chaplin 2010). The innate response is non-specific and acts quickly, while the adaptive response is specific and develops slowly (Chaplin 2010, Rosales 2018). The most abundant immune cell in the blood is the neutrophil, an innate response immune cell. Neutrophils are normally the first immune cells that are present at the site of infection (Chaplin 2010, Rosales 2018). Neutrophils have three main killing mechanisms they use to clear pathogens: phagocytosis, NETosis, and degranulation (Liew and Kubes 2019). However, it was recently shown that neutrophils have a novel mechanism called trogocytosis that they use to kill Tv (Mercer 2018). Neutrophils "nibble" Tv until the parasite's membrane is breached and the parasite dies (Mercer 2018). It was also shown that trogocytosis is contact-dependent, similar to phagocytosis, but the molecular mechanism is currently unknown (Mercer 2018). Trogocytosis is not unique to Tv, it has previously been shown that neutrophils use a trogocytosis-related process called trogoptosis, where antibodies aid in the lytic cell death of cancer cells via opsonization (Matlung 2018).

Complement proteins are a set of soluble proteins that are found in the serum of human blood, with various functions such as chemoattraction or pathogen surface attachment (Chaplin 2010). Complement proteins serve as a crosslink between the pathogen they attach to and immune cells with complement receptors (CRs) (Chaplin 2010). There are four complement receptors that are reported to be present on neutrophils and that bind to variants of complement receptors such as iC3b (Dustin 2016). In vivo studies involving Trichomonas vaginalis are difficult to conduct due to the human-specific nature of Tv and the lack of a reputable murine model, as the mice are unable to maintain a robust infection for in vivo studies (Cobo 2011). Neutrophils, by nature, are easily activated and their effector function results in neutrophil death and thus they are notoriously short-lived (Rosales 2018). Primary neutrophils begin to display signs of apoptosis by the first 12 hours after collection (Rincon 2018). Therefore, researchers have commonly used promyelocytic cells, such as PLB 985 and HL-60, for studies involving neutrophils. Promyelocytic cells can be manipulated and differentiated into neutrophil-like cells (NLCs) (Boulven 2006). Although differentiated promyelocytic cells are not truly neutrophils, they are neutrophil-like cells as they express surface markers found on neutrophils like CD18 and CD11c, as well maintaining the effector functions of neutrophils such as phagocytosis, degranulation, NETosis, and trogocytosis (Gupta 2014, Rincon 2018).

In this study, we used PLB 985 cells to study if complement receptors play a role in

the trogocytic killing of Tv parasites. Complement receptor 4 (CR4), which is composed of two subunits, an alpha chain called CD11c and a beta chain called CD18, is a complement receptor of interest due to its ligand (Dustin 2016). The only known ligand for CR4 is iC3b, with CD11c containing an i-domain where iC3b binds, and CD18 contains an i-like domain similar to the i-domain found in CD11c ((Xu 2017). We hypothesize that iC3b coats the surface of the Tv parasite and then CR4 on a neutrophil-like cell surface will bind to the Tv-attached iC3b resulting in the NLC performing trogocytosis on the parasite. To determine the role of CR4 in the trogocytic killing of Tv, we designed a target sequence that will serve as the guide RNA for the Cas9 endonuclease. The implementation of the CRISPR/Cas9 gene-editing technique will allow for the functional deletion of the CD11c gene and its respective protein via Cas9 cleavage followed by the highly error-prone DNA repair mechanism called non-homologous end-joining (Lino 2018). We hypothesize that once a homogenous CR4 knockout cell line is generated, these NLCs will no longer be able to induce trogocytosis of Tv. The role of CR4 in trogocytosis of Tv parasites will be determined via a trogocytic microscopy assay, in which we will observe if there are changes in trogocytic activity by NLC's that lack CR4.

Material and Methods

PLB-985 Ce ll Culture

PLB 985 and HL-60 cells were obtained from UCLA (Dr. Patricia Johnson 2018) and UC Davis (Dr. Sean Collins 2019). Cells were passaged at 0.1 million cells per milliliter and media was changed roughly every three days once cells reached approximately 1 million cells per milliliter. Cells were cultured with complete RPMI with HEPES (Thermo Fisher Scientific) which is prepared with 1% Pen/Strep (Thermo Fisher Scientific), 1% Glutamax (Thermo Fisher Scientific), and 10% Fetal Bovine Serum (Thermo Fisher Scientific).

Antibody Staining

PLB 985 and HL-60 cells were stained with antibodies by preparing each condition with 3 samples (unstained, targeting antibody stained, and isotype control antibody stained) of 100,000 cells. Both targeted antibodies and isotype control antibodies were stained with 1 ug/mL concentration of antibodies suspended in FACS Buffer (1X PBS solution, 5% FBS, and 0.1% NaN3). The samples were incubated in the dark and on ice for 30 minutes prior to washing with FACS Buffer and reading on Flow Cytometer (BD FACS Calibur). Antibodies for CD11c were Alexa Fluor 488 anti-human Clone 3.9 (Biologend) and Alexa Fluor 488 anti-human Clone Bu15 (Biolegend). Antibody for CD18 was FITC anti-human CD18 Clone CBR LFA-1/2 (Biolegend). All antibodies had a mouse IgG1, K isotype. The isotype control for the Alexa Fluor 488 antibodies was Alexa Fluor 488 Mouse IgG1, K Isotype Ctrl Antibody Clone MOPC-21 (Biolegend). The isotype for the FITC antibody was FITC Mouse IgG1, K Isotype Ctrl Antibody Clone MOPC-21 (Biolegend).

Differentiation Protocol

Neutrophil-like cells (NLC) were obtained by differentiating PLB 985 cells with the use of differentiation media. Differentiation media consists of complete RPMI with HEPES (see PLB 985 Cell Culture) prepared to 1.3% HybriMax DMSO (Thermo Fisher Scientific) and Granulocyte-Colony Stimulating Factor (Biolegend) such that the G-CSF final concentration is 100 nanograms per milliliter. PLB 985 cells were plated at 0.2 million cells per millimeter for differentiation. Cells remained untouched for seven days for complete differentiation into NLCs.

Plasmid De sign

Gene of interest (CD11c) was researched on the National Center for Biotechnology Information (NCBI) and Mouse Genome Informatics (MGI) website to determine human and murine phenotypic issues, respectively. Sequences were chosen that were common across all isoforms and transcript variants listed on NCBI. The oligonucleotide sequences used for the guide RNA template were generated using eCRISP (http://www.e-crisp.org/E-CRISP/), a website for designing CRISPR constructs, so that they landed upstream in the CD11c gene or towards the middle so that they would have a greater impact in the functional deletion. The sequences for the guide RNA template was confirmed with EMBL-EBI, a database of protein sequences. Three oligonucleotide sequences were generated: CD11c
1: CACCGCCCCACCCAGCTCACCCAG CD11c
2: CACCGGTGCAGAGCCTGGTCCTGG CD11c
3: CACCGACTGGTGGACCTGGCTGTG

Px459 Ve ctor Pre paration

The designed oligonucleotide sequences required ligation into the px459 vector, which contains Cas9 and a puromycin-resistance cassette. The vector was digested with New England BioLabs CutSmart Protocol in conjunction with the Invitrogen Calf Intestinal Alkaline Phosphatase (Invitrogen) and restriction enzyme BbsI (New England BioLabs). Digested vectors were gel extracted and subsequently ligated with the generated oligonucleotide sequences CD11c 1, CD11c 2, and CD11c 3 (listed above). These plasmids were transformed into DH-5 alpha cells for colony selection on LB + ampicillin plates, followed by bacterial culture and Zymo Pure II Plasmid Maxiprep isolation and purification (Zymo Research). Presence of the oligonucleotides in the px459 vectors was confirmed through genetic sequencing. The same maxiprep was also conducted for an empty vector of px459 plasmid and px458 plasmid, which lacks the puromycin-resistance cassette but has a GFP-reporter gene.

Lipofectamine Transfe ction Protocol

For transfection with Lipofectamine, Lipofectamine LTX Reagent with PLUS Reagent was used (ThermoFisher). Transfection protocol was followed according to the manufacturer's instructions. Puromycin selection began the day after transfection protocol was carried out. Cell viability was determined using flow cytometry. This transfection method was validated with pCMV-DsRed Expression Vector plasmid (Clontech) as a positive control.

Fugene6 Transfe ction Protocol

Transfection using FuGENE 6 Transfection Reagent was used and transfection protocol was followed according to manufacturer's instructions (Promega). Transfection was conducted on HeLa, HL-60 and PLB985 cells and the px458 plasmid with the GFP-reporter gene.

Neon Ele ctroporation Transfe ction Protocol

Transfection using the Neon Transfection System (ThermoFisher) utilizes electroporation and transfection reagents. The suspension cell protocol was followed per manufacturer's instructions for PLB 985 and HL-60 cells. The electroporation protocol was included for HL-60's in the system by the manufacturers. PLB 985 cells were subjected to the same conditions as HL60, as they are synonymous in the literature.

Puromycin Se lection

Cells transfected with px459 were subjected to various puromycin concentrations (1 ug/uL, 5 ug/uL, and 10 ug/uL) initially and were narrowed down to smaller concentrations (0.06 ug/mL, 0.125 ug/mL, 0.25 ug/mL, 0.5 ug/mL, 1 ug/mL, and 2 ug/mL) in both serum and no serum conditions. Puromycin was obtained from Fisher Scientific.

Rescue Protocol

After transfection with the Neon Transfection System (ThermoFisher), cells were rescued to enhance the percentage of live cells in the culture. For Day 1, the cells were gently spun at 100x g for 10 minutes and pooled together in complete RPM1 media (without Pen/Strep). At Day 2, puromycin was added at a final concentration of 1.5 ug/mL in complete RPMI media (with Pen/Strep). Once cell viability dropped below 5%, cells were rescued and plated at 0.5 million cells per mL of complete RPMI media. Cells were counted and plated at 0.5 million cells per mL of complete RPMI media every three days. Once at least 10 million cells are available, cells were frozen and transferred to a liquid nitrogen tank at a concentration of 10 million cells in 1 mL of freezing media, which is 50% complete RPMI media, 40% fetal bovine serum (FBS) and 10% DMSO, in a cryogenic vial.

Single Cell Dilution Protocol

Once cells were rescued for roughly 10 days, a small amount of the population was subjected to a single cell dilution. Single cell dilutions were achieved by plating roughly 5 cells per 100 uL, with the understanding that most cells would be dead or dying at Day 10. The intention was that 1 viable cell will be plated with 4 dying cells and they would probably remain viable enough to survive in the small amount of media they would be occupying. Media was changed every three days by carefully removing 50 uL of the media from the top of the wells without disturbing the unseen pellet and carefully adding 50 uL of complete RPMI media back. Once a pellet was observed, it was expanded and cultured as described above.

Results

Complement receptor 4 is present on neutrophil-like cells

Neutrophils are naturally short-lived and get activated quickly as they are the first cells at infection sites and must be able to quickly and efficiently begin to rid the site of pathogens. Neutrophils are known to express CR4 on their surface, though the presence of CR4 on the surface of differentiated promyelocytic cells called neutrophil-like cells (NLCs) is unknown. It was important to determine if the subunits of CR4, CD11c and CD18, were present on the surface of NLCs. PLB 985 cells were first differentiated into NLCs using dimethyl sulfoxide (DMSO) and Granulocyte Colony Stimulating Factor (G-CSF), a cytokine that stimulates the production of granulocytes such as neutrophils (Rincon 2018). It was previously shown that NLCs express CR3 (Leka 2019, unpublished). It is known that CR3 binds iC3b and is involved in phagocytosis of smaller pathogens (Gordon 1989). CR3 has two subunits: CD11b, which also contains an i-domain, and CD18 (Gupta 2014, Rincon 2018). Complement receptor 3 is constitutively expressed and serves as an expression marker for phagocytic cells (Kim 2015). Thus, we expect CD18 to be expressed on NLCs, but it is unclear if CD11c will be present on the surfaces of the NLCs.

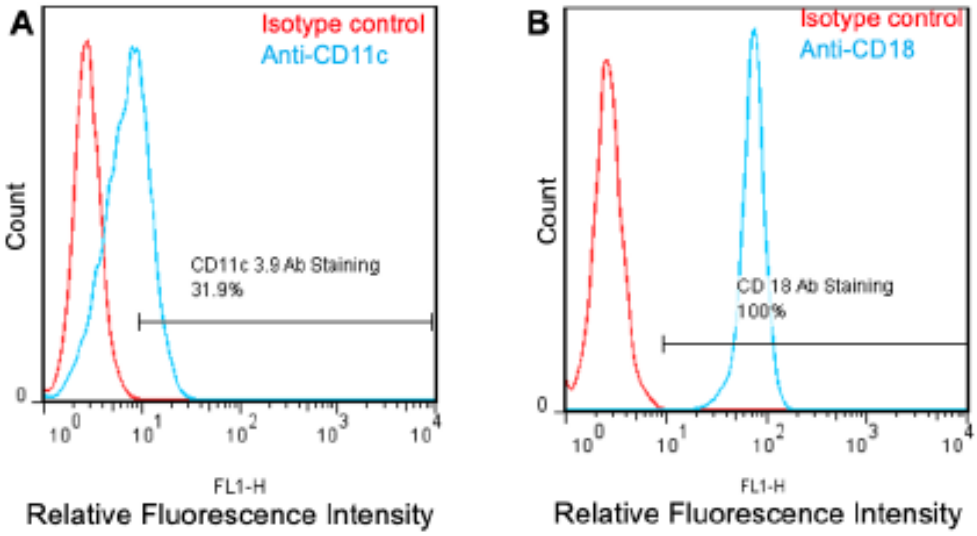

Figure 1. Complement Receptor 4 is present in neutrophil-like cells (NLCs). PLB-985 cells were differentiated into neutrophil-like cells using dimethyl sulfoxide (DMSO) and granulocyte colony stimulating factor (GCSF). Flow cytometry results of antibody-staining with (A) Alexa Fluor 488 anti-human CD11c antibody (Biolegend) is shown. Control was conducted with Alexa Fluor 488 mouse IgGI, k isotype. (B) Flow cytometry results of antibody-staining with FITC anti-human CD18 antibody (Biolegend) is shown. Control was conducted with FITC mouse IgGI, k isotype.

As CD11c contains an i-domain and is the best candidate for binding to iC3b among the CR4 subunits, it was important to show the presence of CD11c on NLCs first. After 7 days of differentiation, the NLCs were stained with Alexa Fluor 488 anti-human CD11c antibody. When compared to the isotype control, the NLCs saw a 31.9% increase in fluorescence, as indicated by a cell population shift (Fig. 1a). This indicates that CD11c was present on the NLCs. To ensure that PLB 985 cells also were able to express CD18 upon differentiation into NLCs, they were stained with FITC anti-human CD18 antibody. When compared to the isotype control for the CD18 antibody, there was an observed 100% increase in fluorescence of NLCs, as indicated by a complete cell population shift (Fig. 1b). The peak shift was more drastic in CD18 antibody stain, as opposed to the CD11c antibody stain. As mentioned before, it is known that complement receptor (CR) 3 also contains the CD18 subunit, and CR3 is constitutively expressed while CR4 is not providing a potential explanation to the high expression of CD18 in neutrophil-like cells.

Designing guide RNA template oligonucleotide for CRISPR/Cas9-containing plasmid px459

Upon determining that both subunits of CR4 are present on NLCs, we then devised a strategy to knockout CD11c since CD11c is the subunit that binds to opsonin iC3b. We first used the National Center for Biotechnology Information (NCBI) and the Mouse Genome Database (MGD) at the Mouse Genome Informatics website to determine if CD11c is essential for development and survival. We found that homogenous CD11c knockout mice have an increased susceptibility to bacterial infections, increased T cell proliferation and atypical cytokine production (Bult 2019). This could mean that CD11c is required for an immune response but not essential for cellular growth and division. CD11c knockout mice, for example, would not be able to develop past the early fetal stage if CD11c was an essential murine gene. We do not think that CD11c is an essential human gene either, as the Genetics Home Reference by the U.S. National Library of Medicine does not list any genetic conditions associated with mutations or deficiencies in the CD11c gene and CD11c is not expressed constitutively in neutrophils. This is unlike CD11b and CD18 which,

if deficient, are listed as causing systemic lupus erythematosus and leukocyte adhesion deficiency type 1, respectively (GHR 2020). While not essential, CD18 would qualify as a required gene for growth and development, as it is associated with a severely shortened life expectancy in humans, with fatality occurring during infancy (GHR 2020). If CD11c was essential in neutrophils, we would expect to see low neutrophil numbers, as they would be unable to divide or grow. If CD11c is required for neutrophil effector function, we would expect to see dysfunctional neutrophils, and therefore a severely hampered innate immune response in CD11c-deficient humans.

We elected to proceed with creating a CD11c knockout using the CRISPR/Cas9 gene-editing system, as we wanted to create a permanent functional deletion, as opposed to transient silencing. Upon consulting with the NCBI website, five transcript variants were used to determine how to design the guide RNA that the DNA-cleaving Cas9 protein would use to make specific mutations (NCBI 2019). We selected three genetic sequences for their location in the CR4 gene as well as their presence in all five transcript variants. The location of the genetic sequences was important as we hope that their location early in the gene could mean that if a frame-shift mutation occurs, anything downstream from the mutation would be altered. Once the guide RNA template oligonucleotides for CD11c were generated, they were inserted into the px459 vector plasmid, which contains the genetic sequence for the Cas9 protein, as well as a puromycin-resistance selection cassette.

Lipofectamine and FuGENE 6 transfection reagents are not productive in PLB-985 cells

Upon the generation of the px459 vector with the CD11c guide RNA template insert, we next optimized our procedure to transfect PLB 985 cells with the vector. We first attempted transfection with Lipofectamine, using a pCMV-DsRed plasmid, so that the successful transfection of the plasmid would be detectable using flow cytometry. We determined that the Lipofectamine transfection reagent (ThermoFisher) was not productive in PLB-985 cells due to the negligible amount (0.046%) of DsRed gene expression detected in the PLB 985 cells that received the pCMV-DsRed plasmid when compared to those that did not receive the pCMV-DsRed plasmid (Fig. 2a). We next attempted to transfect the PLB 985 cells using FuGENE 6 transfection reagent (Promega). For this transfection experiment, we used a plasmid similar to px459 that contained a GFP-reporter gene cassette as opposed to the puromycin-resistance cassette. This new plasmid, called px458, would make it possible to detect the presence of the transfected plasmid and was similar in size of the px459 plasmid. We found that the FuGENE 6 transfection reagent was not productive in PLB 985 cells either. We saw extremely small GFP expression (0.012%) in the cells that received the px458 plasmid compared to those that did not receive the plasmid (Fig. 2b).

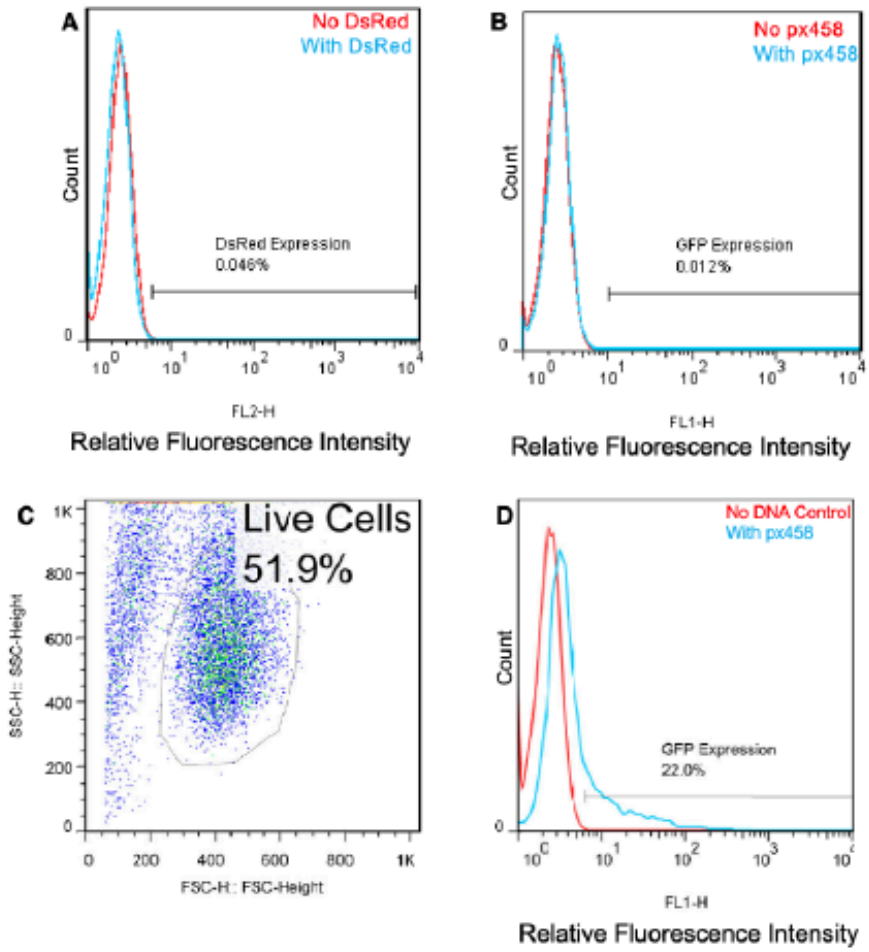

Figure 2. Neon Electroporation is productive in PLB-985 cells. (A) PLB-985 cells were transfected with lipofectamine, a transfecting reagent, and with varying amounts of a plasmid containing the fluorescent protein DsRed (225 ng and 525 ng). Flow cytometry results showing similar levels of DsRed expression is shown. (B) PLB-985 cells were transfected with Fugene 6, a transfecting reagent, with px458 plasmids, which contains a GFP-reporter gene cassette. Flow cytometry results levels GFP Expression is shown. (C & D) PLB 985 cells were transfected with the Neon Electroporation System with px458, a plasmid containing a GFP-reporter gene cassette. Flow cytometry results indicate (C) 51.9% cell viability, of which (D) 22.0% are expressing GFP two days after electroporation.

Neon Elect roporation is productive in b oth PLB 985 and H L-60 cells but harsher on HL-60 cells

After finding that Lipofectamine and FuGENE 6 transfection reagents were unproductive in the transfection of plasmids into PLB-985 cells, we then attempted electroporation, which is a mechanical, as opposed to chemical transfection method. Using the Neon Transfection System, we transfected the px458 plasmid into both PLB 985 and HL-60 cells. In the case of HL-60 cells, we found that the electroporation process was harsh on the cells, with only 3.37% of cells remaining viable two days after electroporation (Fig. S1a). Of this small population of viable cells, 18.3% were determined to be expressing the GFP gene, two days after the electroporation process, showing that electroporation is productive (Fig. S1b). We also used the Neon Transfection System on PLB 985 cells using the same px458 plasmid. We found that Neon electroporation is productive in PLB 985 cells, as 51.9% of electroporated cells were viable two days after electroporation (Fig. 2c). Of these live cells, 22% showed GFP expression, indicating that the PLB 985 cells were transfected successfully with the px458 plasmid (Fig. 2d). Due to the higher percentage of viable cells, we determined that PLB 985 cells were more amenable to transfection and therefore used them for all future experiments.

A heterogenous cell population co ntaining CD11c knockouts was generated

Upon determining that electroporation of PLB 985 cells was an optimal model to test our hypothesis, we conducted an electroporation experiment with the px459 plasmid that contained our CD11c guide RNA template insert. Upon puromycin treatment, a large number of the cells that survived the electroporation process did not survive (Fig. S2). Once the cell viability of the PLB 985 cells that were electroporated eached 5% or lower, they were switched from puromycincontaining RPMI media to normal complete RPMI media (without puromycin). Once the PLB 985 cells had been grown up and cultured for roughly 25 days, we removed some potentially transfected PLB 985 cells for CD11c antibody staining. We used two different Alexa Fluor 488 anti-human antibodies (Clone 3.9 and Clone Bu15). We showed that although some PLB 985 cells did stain for CD11c in both clones, there were cell populations that resembled those that were stained with the isotype control, indicating that some cells did not have CD11c present on their surfaces, as no anti-CD11c antibodies attached to them (Fig. 3). This result indicates that a heterogenous cell population containing both CD11c knockouts and CD11c-containing cells was generated.

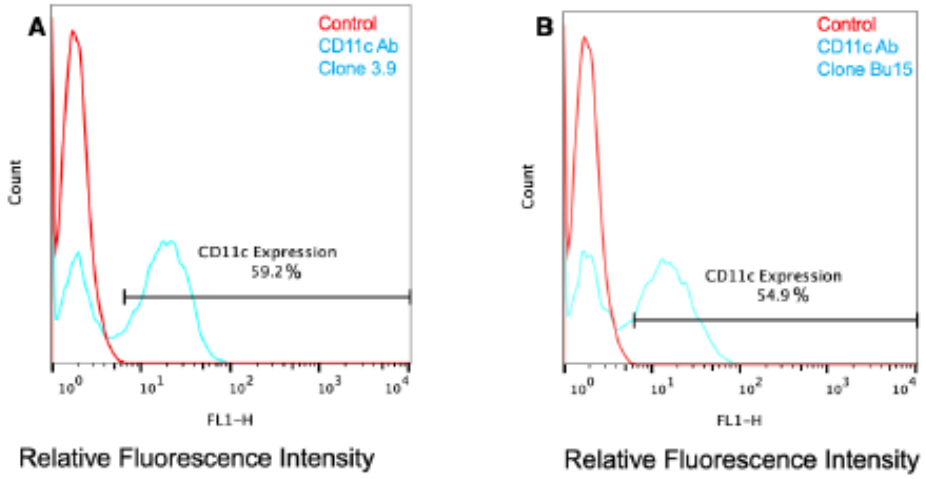

Figure 3. A heterogenous cell population containing CD11c knockouts was generated. PLB-985 cells that had previously been were transfected with the Neon Electroporation System were differentiated into neutrophil-like cells using dimethyl sulfoxide (DMSO) and granulocyte colony stimulating factor (GCSF) and then stained with anti-CD11c antibodies. Flow cytometry results of antibody-staining with Alexa Fluor 488 anti-human CD11c antibody (A) Clone 3.9 (Biolegend) and (B) Clone Bu15 (Biolegend) is shown. Control was conducted with Alexa Fluor 488 mouse IgGI, k isotype. There was (A) 59.2% and (B) 54.9% CD11c expression in the differentiated cell population that was antibody-stained with anti-CD11c Clone 3.9 and Clone Bu15, respectively.

Discussion

Trichomoniasis is the most common non-viral sexually transmitted infection (STI) both in the United States and globally, annually affecting 3.7 million and almost 300 million people, respectively (Miller 2005, Kissinger 2015). Tv, which causes trichomoniasis, is cleared by neutrophils, the most abundant immune cells in the blood, via a novel killing mechanism called trogocytosis, in which the neutrophils "nibble" on the Tv parasite until the parasite's membrane is breached (Mercer 2018). This trogocytic killing is contact-dependent and occurs only in the presence of human serum, which is rich in complement proteins (Mercer 2018). Therefore, we hypothesize that complement proteins such as iC3b are the crosslink between complement receptors on neutrophils and Tv parasites that get coated with complement proteins. One complement receptor (CR) that is known to bind iC3b is CR4 (Noris 2013, Dustin 2016). We therefore hypothesized that CR4 plays a role in the trogocytic killing of Tv. We predict that in the absence of CD11c, a subunit of CR4 with an i-domain, the ability of the neutrophil to kill Tv will be inhibited.

We expect to see diminished or complete cessation of trogocytic activity of neutrophil-like cells lacking CR4 and thus better survival of Tv when they are cocultured together. As neutrophils are short-lived and are not easily manipulated without accidental activation, promyelocytic cell lines such as HL-60 and PLB 985 cells are often used as a neutrophil model, since they are longer lived and less sensitive than primary neutrophils (Boulven 2006, Rincon 2018). Once these promyelocytic cells are genetically manipulated, they can be differentiated into neutrophil-like cells, which are known to perform neutrophil effector functions such as phagocytosis, degranulation, NETosis, and trogocytosis.

In this study, we sought to use the CRISPR/Cas9 gene-editing technique to create CD11cknockout cells. We first determined that both CD18 and CD11c, subunits of CR4, are present on NLCs (Fig. 1). We then designed three oligonucleotides that encoded for the guide RNA of the DNA-cleaving Cas9 protein, and successfully cloned them into a Cas9 expression vector. However, we found that Lipofectamine and FuGENE 6 transfection reagents were not productive for introducing these constructs into either HL-60 or PLB 985 cells (Fig 2.). Upon switching away from chemical transfection methods and towards a more mechanical method, we next tested whether using the Neon Transfection System, which uses electroporation, would be productive in our promyelocytic cell lines. We showed that while productive in both HL-60 and PLB 985 cells, PLB 985 cells were more viable upon being electroporated (Fig. 2c, Fig. S1a). This showed that while used interchangeably, HL-60 and PLB 985 cells are actually phenotypically different. Due to the difference in cell viability post-electroporation, we elected to proceed with only the PLB 985 cells. After electroporating the PLB 985 cells with the px459 plasmid with a CD11c guide RNA insert, we showed that a heterogenous cell population containing both normal NLCs and CD11c-lacking NLCs was generated.

The interchangeable use of HL-60 and PLB 985 cells in neutrophil studies is recently becoming complex as their phenotypic differences are further explored. The HL-60 cell line was created by obtaining cells from an acute myeloid leukemia patient in 1977 (Collins 1978). HL-60 cells were shown to be able to undergo neutrophilic differentiation, becoming a model cell line to study neutrophilic behaviors such as phagocytosis and chemotaxis (Hauert 2002, Fleck 2005). In 1985, the PLB 985 cell line was created from what was later shown to be the same patient that originated the HL-60 cell line, who had an acute myeloid leukemia relapse (Tucker 1987). However, the PLB 985 cell line was later shown to be a subline of the HL-60 cell line, indicating that the PLB 985 cell line are a smaller subgroup of the original HL-60 cell line and are not in fact two distinct cell lines (Drexler 2003). Interestingly, PLB 985 cells display slightly different properties from the HL-60 cells. PLB985 cells generate higher reactive oxygen species (ROS) and can be used in chemotaxis studies as they more closely resemble the behaviors of primary neutrophils (Servant 1999, Ashkenazi 2009). Although both PLB 985 cells and HL-60 cells serve as good model systems for neutrophilic studies, neither fully expresses all behaviors seen in primary neutrophils (Gupta 2014). It has been shown that the antimicrobial activities of NLCs derived from HL-60 cells are less than primary neutrophils, including impaired NET formation and ROS production (Yaseen 2017). This evidence, along with the differences in cell viability between PLB 985 cells (Fig. 2c) and HL-60 cells (Fig. S1a) following electroporation, indicate that electroporation exacerbates the differences among these two promyelocytic cell lines. Therefore, for future neutrophilic studies, the differences between these two cell-line models should be considered.

Future studies will determine the role of CD11c in the trogocytic killing of Trichomonas vaginalis by neutrophils. First, we will generate a homogenous clonal CD11c-knockout cell population through successful single cell dilutions. Once this is observed via antibody staining, we will also confirm the knockout with genetic sequencing. However, there has been some progress made in using commercially available Cas9 proteins, as opposed to our current approach that used plasmids containing Cas9. Future work on this project may therefore transition into an approach that uses Cas9 protein instead of plasmid.

In fact, we hypothesize that perhaps the actual plasmid might have been be activating the promyelocytic cells and thus causing them to die during the recovery period following electroporation, resulting in the low viability we saw following transfection of our constructs (cite figure). Host cells are known to have DNA and RNA sensors in their cytosols (Abe 2019, Maelfait 2020). When nucleic acids are found in the cytosol, it can be a sign that there is an intracellular pathogen or that something is going wrong in the cell, disturbing cellular homeostasis (Roers 2016, Maelfait 2020). These nucleic acid sensors are known to induce programmed cellular death such as necroptosis, pyroptosis and apoptosis (Maelfait 2020). It has been shown that human neutrophils express many DNA sensors in their cytosol constitutively (Xia 2015, Tamassia 2012). These programmed cell death pathways will stop the infection from spreading or will kill the aberrant cell (Maelfait 2020). It has been reported that some of these DNA sensors, like Rig-I-like receptors (RLRs), can be triggered in experiments in which synthetic RNA is delivered cytosolically (Abe 2019, Maelfait 2020). Synthetic RNA can also induce apoptosis if transfected into the cytosol (Maelfait 2020). It is plausible that some of the cells that were successfully transfected triggered these DNA sensors, and this phenomenon could also explain the difference in how PLB 985 and HL-60 cells responded to electroporation if they express different DNA sensors (Fig. 2 and Fig S1a). It may be more reasonable to approach electroporation by using a ribonucleoprotein (RNP) complex, which would circumvent the DNA sensors, as the Cas9 protein will already be created, as opposed to needing to be translated from the plasmid. This would eliminate the experimental variable of the role of DNA sensors in survival of transfectants, though there might be a cell process that identifies exogenous and synthetic proteins.

Regardless of the knockout approach, the next step will be to test whether the CD11c knockout cells can kill Tv parasites to determine if there is a reduction in trogocytic killing by neutrophils. If there is a change in activity, future research could use a lentiviral approach to add back a nonmutated version of CD11c to see if the phenotype is rescued. Future research should also determine the role of the other CR4 subunit, CD18, in trogocytic activity. Once the knockout approach is finalized for CD11c, it would be feasible to also generate a CD18 knockout and a CD18/CD11c double knockout to completely knockout out CR4. Interestingly, complement receptor 3 is very similar to CR4, as they both contain CD18, but CR3 has CD11b as the other subunit, not CD11c.

The potential redundant functions of CR3 and CR4 have been theorized due to their structural homology and beta-2 integrin familial identification, their ability to bind the same ligand and their parallel expression on immune cells (Lukacsi 2017, Vorup-Jensen 2018). Though both complement receptors are known to bind iC3b, they do not bind iC3b in the same structural site (Xu 2017). This may be biologically significant for more efficient opsonization of pathogens (Xu 2017 and Lukacsi 2020). These differences also allow for

diversity such that if a pathogen uses one of the complement receptors to enter a cell via protein mimicry, it won't affect all homologous complement receptors (Xu 2017). While CR3 and CR4 share structural homology, they are not identical in their functions at all times.

Complement receptor 3 is known to participate in phagocytosis, reactive oxygen and nitricoxide species synthesis, and cell migration (Foley 2015, Lukacsi 2020). Complement receptor 4 is involved in phagocytosis and migration as well but is uniquely involved in adherence (Foley 2015, Lukacsi 2020). It was originally reported that of the C3 receptor molecules, CR4 was the most abundant suggesting its role in clearing pathogens that were opsonized by C3 and C3derived molecules (Myones 1988). The differences in their effector function may also lie in their behavior on the cell surface. It has been reported that CR3 is more mobile than CR4, as CR3 was shown to congregate via an actin-based mechanism, while CR4 remained distributed uniformly on cell surfaces (Ross 1992). It has also been shown that CR3 and CR4 may have different signaling pathways once they are activated, though this has not been completely explored (Lukacsi 2017).

According to the literature, CR3 seems to bind iC3b better (Lukacsi 2017, Ross 1992). As trogocytosis is perhaps the most closely related neutrophilic killing mechanism to phagocytosis, it is likely that CR3 is also involved in trogocytosis. In order to determine the role of CR4, the generation of a CD11b knockout would be important in determining if CR3 is involved in trogocytosis. CD18 would need to remain, as knocking this gene out would also affect the function of CR4. This would serve as the positive control for creating a triple knockout (CD11c/CD18-/CD11b-) to test for the combined roles of both complement receptors in trogocytosis. By doing this, we would already be eliminating the compensatory role of CR3 if it is involved in trogocytosis. The negative control would be PLB 985 cells that were electroporated with an empty px459 vector, which would serve for the base trogocytic activity. This is necessary to parse out the contributary and compensatory action CR3 has in the trogocytic killing mechanism. Through a lentiviral approach, both CR3 and CR4 could be added back into the genome of the neutrophils to determine if the phenotype can be rescued, which would indicate that the loss of the CRs was responsible and not the manipulation alone.

In summation, this work and future studies will be important in understanding the role of complement receptor 4 in the trogocytic killing of Tv by neutrophils via the neutrophil-like cell model. By confirming that CR4 is involved, it will be possible to further explore a potential signaling pathway that is initiated by CR4 activation that could lead to the nibbling action of the neutrophil. If the role of CR3 is also elucidated, it would be possible to see how or if either of their signaling pathways interact and exploring the role of complement proteins in Tv clearance. The role of antibodies in trogocytosis is possible as well, as it is known that Tv is able to cause reinfections in those previously afflicted with the parasite. This indicates that there could be an insufficiency in in creating memory cells or in the function of antibodies to prevent a secondary infection. Understanding how the body clears Tv may provide information in the selection of adjuvants that could be added in a Tv-specific therapy that might increase the presence of iC3b or increase the presence of CR3 and CR4 on the surface of responding neutrophils at the sight of infection. This might not be useful for the more virulent strains, as they are able to persist even in an environment in which complement proteins and neutrophils are aplenty. Determining the molecular players in

this host-pathogen interface could be paramount in the future development of preventative treatments against Tv that are desperately needed.

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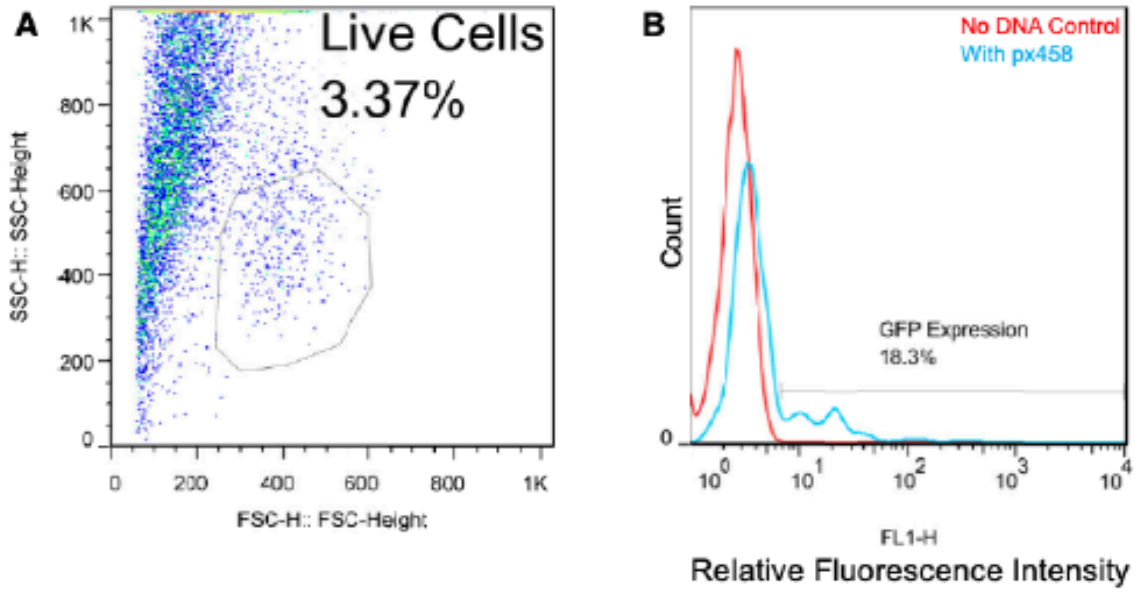
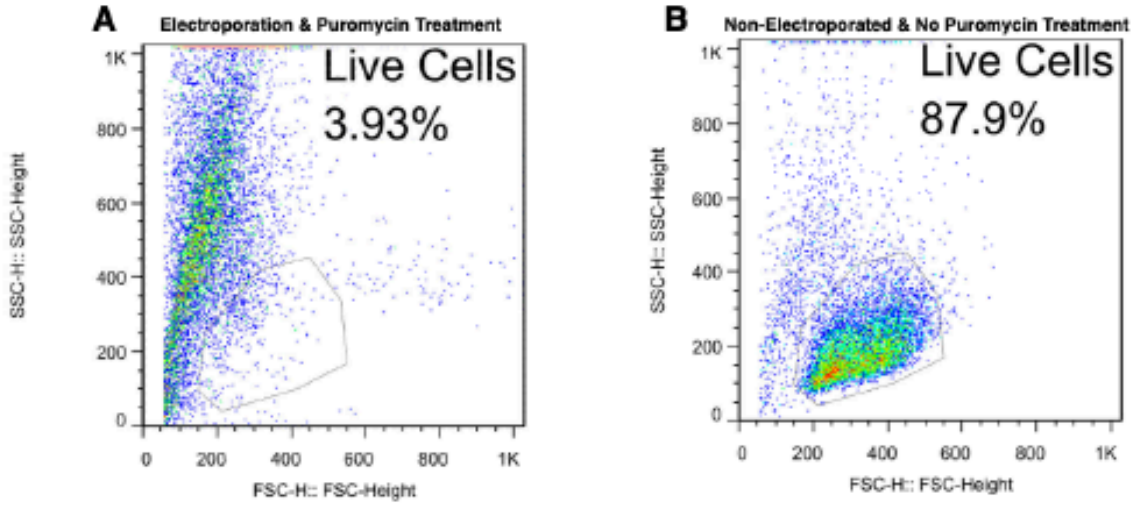
Supplemental Figures



Supplemental Figure 1. Neon Electroporation is harsh, but productive in HL-60 cells. HL-60 cells were transfected with the Neon Electroporation System with px458, a plasmid containing a GFP-reporter gene cassette. Flow cytometry results indicate (A) 3.37% cell viability, of which (B) 18.3% are expressing GFP two days after electroporation.



Supplemental Figure 2. Puromycin treatment is harsh on electroporated PLB 985 cells. PLB 985 cells were electroporated with an empty px459 vector using the Neon Electroporation System. After two days of recovery from electroporation, the electroporated PLB985 cells were treated with 1.5 ug/mL of puromycin. Within 24 hours, cell viability was (A) below 5% at 3.93%. (B) Non-electroporated and without puromycin treatment PLB 985 control population was 87.9% viable (for comparison).

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Organic Synthesis to Combat Leishmaniasis

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Abstract

Leishmaniasis is a parasitic disease that affects many areas in the underdeveloped parts of the world. The current treatments available for leishmaniasis are losing their effectiveness and have a large number of side effects. The family of Bisbenzylisoquinoline (BBIQ) natural products may provide a good starting point for antileishmanial drugs, but methods for their synthesis are limited. The BBIQs are macrocyclic compounds that contain two benzyl or phenylethyl substituted tetrahydroisoquinoline rings which are connected though diarylether linkages. Many approaches have been taken; however, no systematic studies have been performed to determine how these molecules function as antileishmanial compounds. The aim of this study is to use a double Piclet-Spengler reaction in order to provide the BBIQ core of the natural product Tetrandrine. Therefore, this study has the potential provide compounds that are useful in the long-term goal to find new treatments for leishmaniasis.

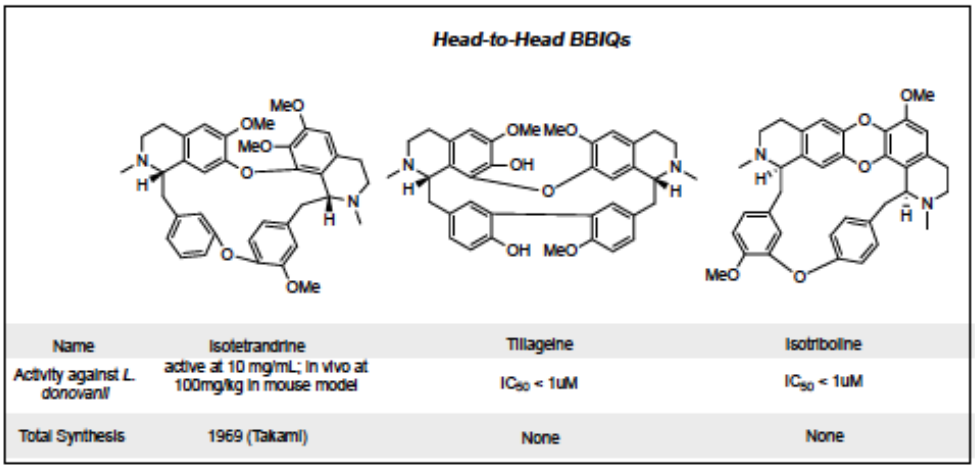
Background

Leishmaniasis is a worldwide parasitic disease, which infects hosts such as humans, dogs, and rats, and affects parts of the skin, internal organs of the body and mucous membranes. Leishmaniasis is transmitted through a bite from an infected sand-fly and is considered a neglected tropical disease because it lacks a dramatic outbreak and is commonly seen more in the underdeveloped parts of the world such as regions in America, Africa, Eastern Mediterranean, Europe, and South-East Asia.1 Leishmaniasis can be categorized into three forms: mucocutaneous leishmaniasis (MCL), cutaneous leishmaniasis (CL) and visceral leishmaniasis (VL). The estimated mortality rate of leishmaniasis is approximately 60,000 per year. MCL leads to the destruction of the typical skin and mucous membranes and is estimated that 12 million people are currently suffering with the disease and 305 million people have the risk of contracting the disease. CL is the most common form of leishmaniasis in humans affecting the skin. The number of cases that arise each year from this certain form of leishmaniasis is estimated to be 1.5 million per year. VL the most severe form of leishmaniasis and is responsible for thousands of deaths each year. The number of cases that arise each year from this certain form is said to be approximately 500,000.2

Currently, effective treatments for leishmaniasis include the use of toxic heavy metals such as pentavalent antimonials, antimonate, sodium stibogluconate, meglumine pentamidine, amphotericin B, miltefosine, paromomycin, and sitamaquine.2 Some of these treatments were discovered over sixty years ago and cause a great number of side effects. Unfortunately, leishmaniasis parasites have developed resistance to these drugs over the years causing about 5 to 70% of the affected individuals to not respond to the current treatments. Researchers have made it a priority to find a safe and effective anti-leishmania drug, including over 300 natural products and over 400 synthetic molecules that have been shown to produce antileishmanial activities in the past decade alone.1 Based on the literature precedent the ability to develop and make use of the modern methods within organic synthesis could potentially create a positive effect by developing new molecules with

antileishmanial activity and exploring their function. The Bisbenzylisoquinoline (BBIQ) class of natural products consists of over 300 members that exhibit many biological activities, including antileishmanial activities.3,4 However, no systematic studies have been performed to determine how these molecules work as antileishmanial compounds.

BBIQ are characterized with two benzyl or phenylethyl substituted tetrahydroisoquinoline rings connected though diarylether linkages as shown in Figure 1.



Name	Isotetrandrine	Tiliageine	Isotriboline
Activity against *L. donovani*	active at 10 mg/mL; in vivo at 100mg/kg in mouse model	IC_{50} < 1uM	IC_{50} < 1uM
Total Synthesis	1969 (Takami)	None	None

Figure 1. Characterization of Bisbenzylisoquinoline. These macrocyclic molecules show a rich diversity in their structural components

Discussion/Analysis:

The goal of this experiment is to synthesize and evaluate new and existing BBIQs that will provide a good starting point for antileishmanial drugs.

Current work: Shown in Figure 2 is the first step in this experiment to formulate a multiple synthesis reaction starting with a process known as Fischer esterification. Sulfuric acid reacts with methanol in order to esterify the compounds 4-bromophenyl acetic acid 1 and 3-hydroxyphenyl acetic acid 3 which will form a methyl ester yielding methyl 4-bromophenyl acetate 2 and methyl 3-hydroxyphenyl acetate 4, respectively.

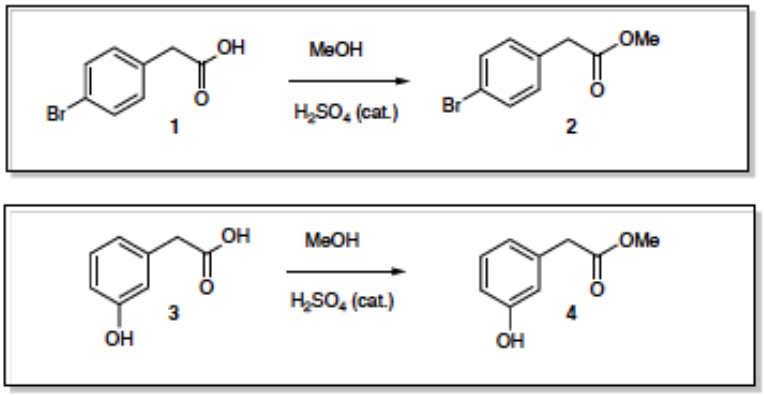


Figure 2. Represents the reactions that were already ran. 4-bromophenyl acetic acid 1 yielding 4-bromophenyl acetate **2** which gave a yield, while 3-hydroxyphenyl acetic acid **3** yielding methyl 3- hydroxyphenyl acetate **4** due to impurities by the starting material wasn't able to obtain a yield.

So far currently obtained is the 4-bromophenyl acetic acid 1 yielding methyl 4-bromophenyl acetate 2 and 3-hydroxyphenyl acetic acid 3 yielding methyl 3-hydroxyphenyl acetate 4. By using TLC analysis on the starting material and product a clear separation is indicated as shown in Figure 3. However, as indicated in Figure 4 which is data collected when obtaining 3hydroxyphenyl acetic acid to yield methyl 3-hydroxyphenyl acetate there wasn't a clear separation of the molecules.

Figure 3. Represents a TLC plate of the starting material labeled "S" (4-bromophenyl acetic acid) and the product labeled "P" (4-bromophenyl acetate). The big gap in between indicated that this reaction successfully separated through the use of the techniques of apparatus of reflux and rotary evaporation.

Figure 4. Represents a TLC plate of the starting material labeled "S" (3-hydroxyphenyl acetic acid) and the product labeled "P" (methyl 3- hydroxyphenyl acetate). The overlapping in the dots showed there was impurities within the sample there no yield was able to be obtained.

To determine and identify that the product in which a clear separation was indicated from the use of TLC plates with the certain characteristics searched for within this experiment an IR (Figure 5) and NMR (Figure 6 and Figure7) were conducted.

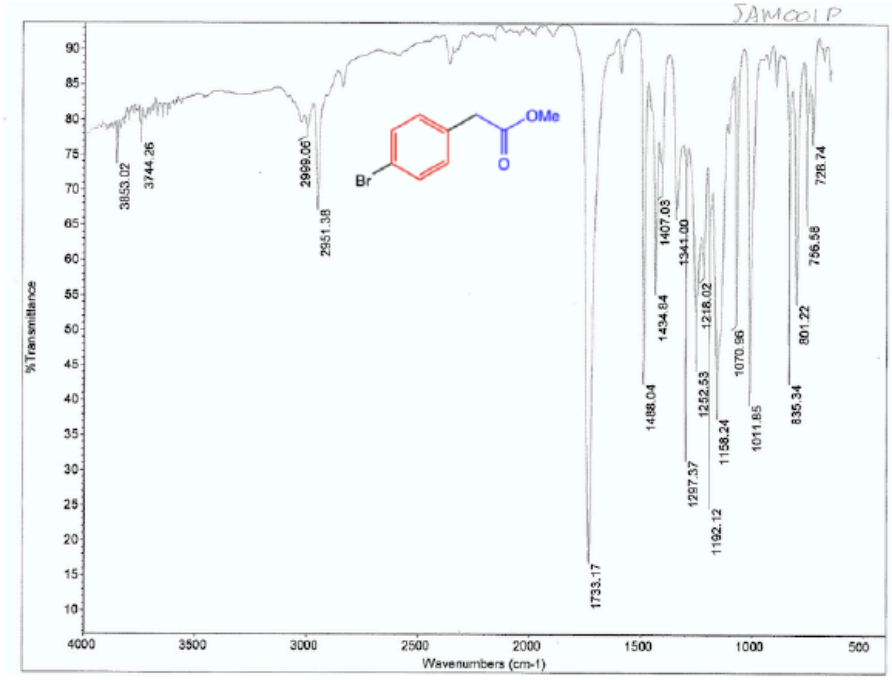


Figure 5. One functional group that this diagram represents is that of an ester running on the peak of the 1733 mark (Highlighted in Blue). The peaks just below the 3000 mark represent C(sp^3)-H bonds; the CH_2 and CH_3 bonds on this molecule. The peaks from 1000-1300 mark represent C-O bond.

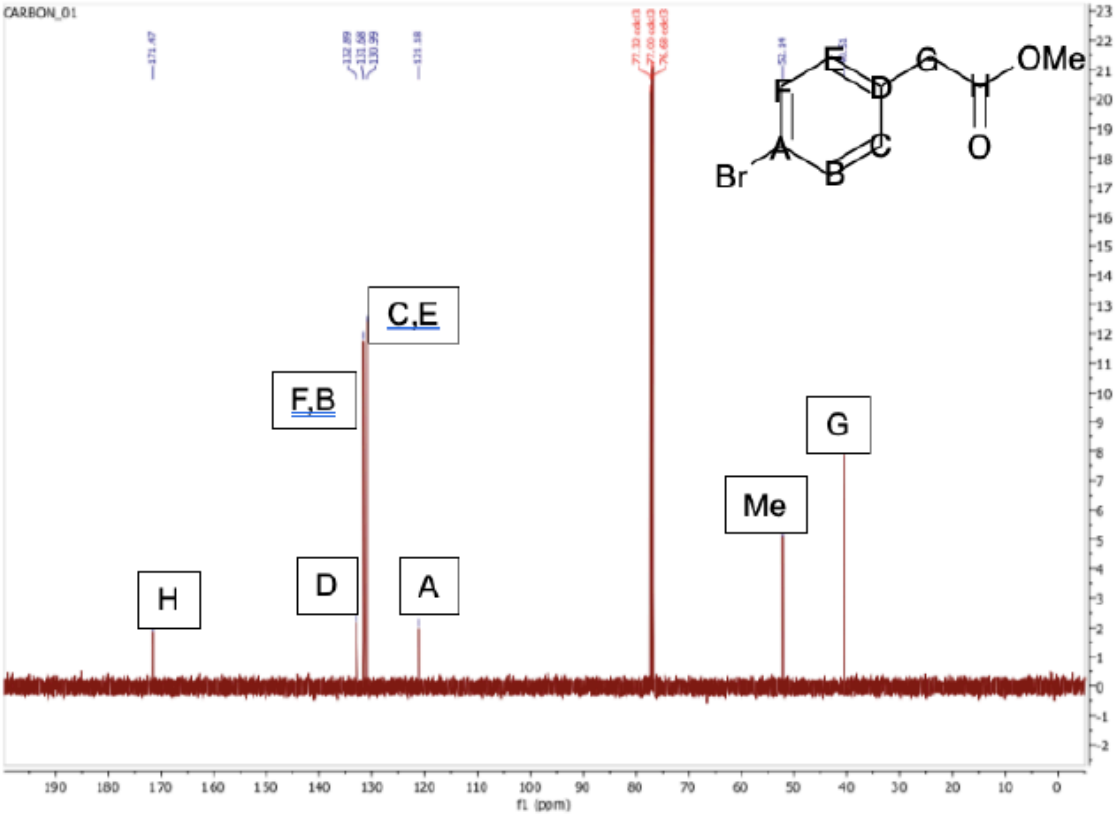


Figure 6. One functional group that this diagram represents is that of an ester running on the peaks about 1700 (double bond) and about 1200 and 1100 (two C-O stretches).

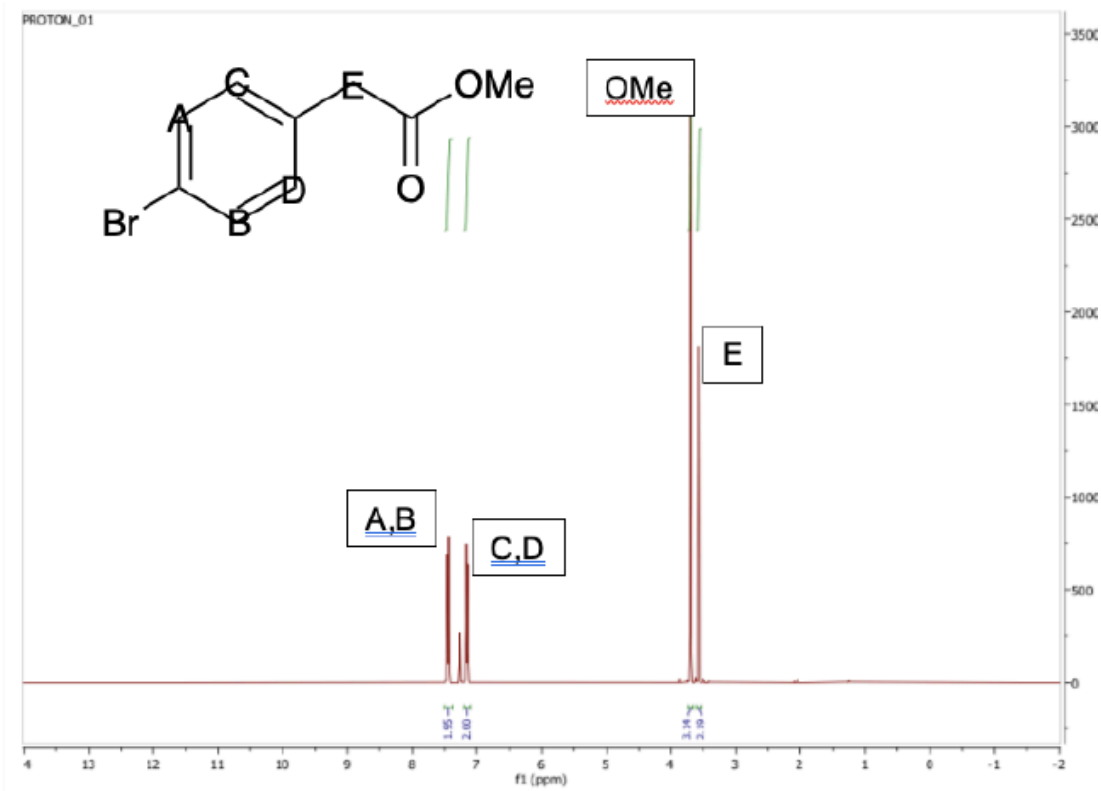


Figure 7. One functional group that this diagram represents is that of an ester running on the peaks 3.5-5.5

Future work: Once the starting materials are obtained the next step in this experiment form a diaryl ether using Ullman coupling in which an aryl halide (2) and phenol (4) are coupled together with the help of a copper catalyst to make diaryl ether product 5. Following this an ester reduction will take place by reaction of reducing reagent Diisobutylaluminium hydride (DIBAL-H) with compound 5 furnishing a dialdehyde molecule 6. Reductive amination on 6 will convert each carbonyl group to an amine creating diamine 7. Finally, a double Piclet-Spengler reaction takes place with the combination of 6 and 7 and the help of an acid catalyst to provide Tetrandrine Core (BBIQ), the final product as shown in Figure 8. Using computer modeling techniques an investigation will be made in order to see the potential in other BBIQs, including the tetrandrine core we are trying to make, as anti SARS-Cov-2 molecules. The Cepharanthine which is natural product falls into the BBIQ family that has had multiple studies done on it before due to its ability to act as an antiviral agent including the one everyone knows as of right now the coronaviruses.

Cepharanthine could be one of the initial compounds in which limit SARS-CoV-2's (Covid-19) virus host interactions, which will disrupt host viral interactions.5

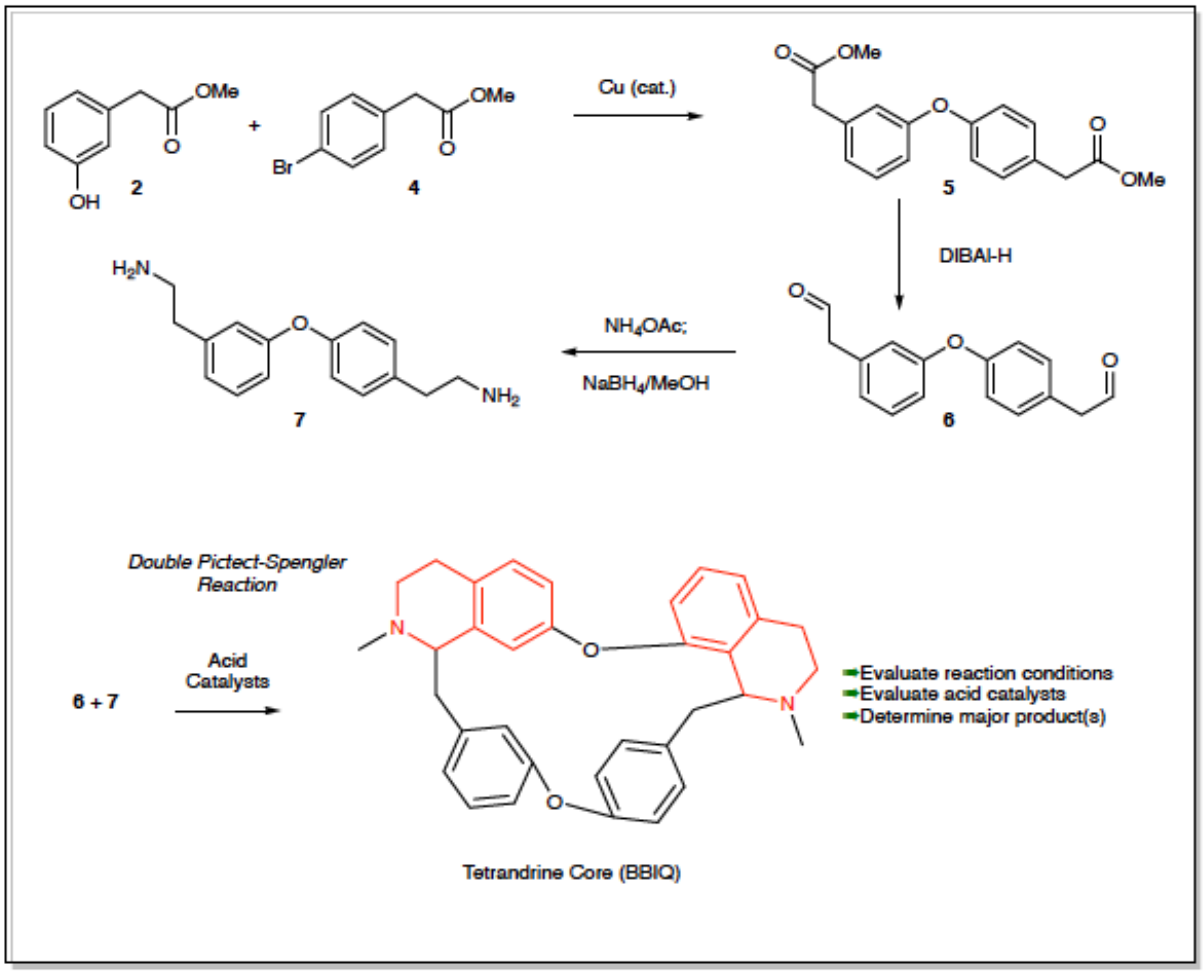


Figure 8. Future work to finish the synthesis of the tetrandrine core.

Conclusion

The family of Bisbenzylisoquinoline (BBIQ) natural products are a family of unique and spectacular molecules which have high potential as therapeutic molecules. Due to its substituted tetrahydroisoquinoline rings which are connected though diarylether linkages they are able toproduce properties of being anti-inflammatory and immunosuppressive. By understanding the use and synthesis of these natural products the use of their abilities would create a significant effect to pharmaceutical companies in producing a safe and effective drug for the human body.

Experimental Section.

Apparatus: 4 cm x 10 cm, silica gel TLC, TLC chamber, UV lamp, round-bottom flasks, separatory funnel, apparatus for heating under oil reflux condenser and magnetic stirring,

Setting up: Add about 1g of 4-bromophenyl acetic acid (4.65 mmol, 1.0 equiv.) and 20 mL of methanol in a round-bottom flask equipped with a stirbar. and swirl. Add a couple of drops of sulfuric acid at room temperature. Attach the reflux condenser and set up the apparatus for heating under reflux with oil base. Heat the mixture for 1 h under gentle reflux. Allow the mixture to cool to room temperature and stir overnight.

Reaction analysis. Preparing & Setting up TLC plate: Cut a strip of silica gel chromatogram sheet about 4 cm x 10 cm. Place a pencil line horizontally 1 cm from with end of the strip. Within the horizontal line place 2 dots about 1 cm apart indicting the starting material and the product. Using a capillary pipet apply a spot of either the starting material or the product (from reflux) on each dot by applying the tip of the pipet to the surface of the plate. Perform this spotting process a couple of times allowing the solvent before putting another drop to evaporate each time. To check and see if enough materials were obtained on the plate in their corresponding spot run under a UV lamp. If appearance occurs then it is done correctly, however if slightly/none are there go back to the spotting process and continue to add more spots in the indicated dots. When each spot is dried and contains enough material place the strip in a chamber containing the solvent (50% ethyl acetate and 50% hexane); make sure not to splash so solvent doesn't get onto the plate. The horizontal line, containing the spots, has to be above the solvent level when placed in the chamber. Allow, the solvent to run up the strip to about .5 cm from the top of the strip then remove. Mark the position with a pencil to where the solvent was stop and allow for plate to air dry.

Analysis: Run the plate under a UV light and a good separation indicates a clear separation of colored spots. Mark the spots where UV light indicated material and calculate Rf values for each of the developing spots.

Purification, Isolation and Work up: Remove methanol by using the technique of rotary evaporation. Dissolve any remains with ethyl acetate. Transfer the reaction from the rotary evaporator to a separatory funnel and add deionized water in order to be washed. Repeat this process twice. Allows layer to separate. Extract aqueous layer to an Erlenmeyer flask labeled "Aqueous." Extract organic layer to an Erlenmeyer flask labeled "Dry Organic" and dry the solution by adding several spatula-tips full of anhydrous sodium sulfate and let it stand for 1 h. After drying is completed separate the "Dry Organic" from the drying reagent

by decantation into a round-bottom flask. Use the rotary evaporator in order to remove the solvent to yield a pure product.

Analysis: Weigh the purified product and determine yield. Obtain NMR and IR spectra of starting material and product. This procedure yielded 4-bromophenyl acetic acid methyl ester 2 (0.9556gg, 4.44 mmol, 90%). The NMR and IR data (below) were consistent with the literature.vi Repeating the same procedures with methyl 3-hydroxyphenyl acetate (3) yielded a crude mixture of multiple products including 4 that we have been unable to purify so far. Analysis of the starting materials revealed we received a tainted batch of 3.

1 Weekly epidemiological record, Ed. Postigo. J. World Health Organization 2017, 38, 557-572.
2 Hussain, H.; Al-Harrasi, A.; Al-Rawahi, A.; Green, I.; and Gibbons, S. Chem. Rev., 2014, 114, 1036910428.
3 Schiff, Jr., P. L. J. Nat. Prod., 1991, 54, 645-749.
4 Schiff, Jr., P. L. J. Nat. Prod., 1997, 60, 934-953.
5 Smith, J; Smith, M. Repurposing Therapeutics for COVID-19: Supercomputer-Based Docking to the SARS-CoV-2 Viral Spike Protein and Viral Spike Protein-Human ACE2 Interface., 2020 https://doi.org/10.26434/chemrxiv.11871402.v3
6 Akamanchi, K.; Deshmukh,S,; and Huddar S. Arkivoc, 2011 (v) 67-75.

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The Stimulation Process

In common language, we typically refer to the phenomena of sensation, perception, and judgment as if there were a single cognitive state. That is, we use the terms interchangeably. Doing so makes it difficult to discuss theoretical topics in cognitive science because it creates confusion and facilitates misinterpretation. Therefore, I am proposing that we should consider sensation, perception, and judgment as separate processes that occur in that respective, serial order. Experimental psychologists, philosophers, and cognitive scientists alike need to practice care to distinguish these three cognitive states.

The chronological sequence of sensation, perception, and judgment is a three-step iteration that repeats indefinitely as the mind processes information in an effort to make sense of (understand) sensory stimulation; let us call this overall iterative process "stimulation." When in place, it will become important to emphasize that previous iterations of sensational and judgmental states can influence a current perceptual state. In essence, this finite sequence of processes repeats because of neurobiological actions and consequent cognitive activity to produce psychological phenomena. Note that in the context of this paper, we will think of cognitive states as composing a cognitive process. This distinction will make it easier to distinguish a parent process composed of child states or subprocesses. Also, when developing this framework, think of the sequence as links of a chain so that it can accommodate refinements and additional stages.

We will take a scientific approach in this argument. Here are our assumptions. (1) There exists at least one mental state with existing correlated biological and physical states. (2) The unconscious mind is a necessary factor in this argument. Essentially, we will proceed withassumption that the unconscious mind exists and that psychological phenomena require unconscious information processing; however, we will neglect to isolate integral functions. (3) Metacognition is linguistically accessible. That is, all metacognitive activity can be expressed in terms of language. (4) People have marginally varied (theoretically comparable) sensational and perceptual states to the same stimulus; that is, different people who perceive the same objects will have similar experience. Even though neurologically there are vast differences between individuals, there is still a natural language in terms of how sensations are encoded electrochemically. Therefore, we will assume that there must be some underlying organic framework at large. A note about Assumption (4): when we say that people have marginally varied sensational and perceptual states to the same stimulus that are theoretically comparable, what we mean here is that if we examine just the human species, we are making the assumption that there exists a theoretical model that can accurately and informatively describe any human psyche. This theoretical model would fundamentally be mathematical. Now that we have our framework in place, let us assign some formal definitions.

Sensation is the unconscious cognitive mechanism that refers to the bio-physical reception of a stimulus. This includes the translation and transmission of the physical reception of stimuli in the form of encoded electrochemical impulses. Note that we

also refer to sensory abilities as the senses, that of which are made possible by the use of an evolved anatomical structure; for example, vision is possible because we have eyes which allow for the collection of visual information via photoreceptors. Thus, visual sensations refer to the biophysical reception of light by the photoreceptors in the eye and the sending of visually recorded information to the brain via anatomic pathways.

Perception is a cognitive product that equates to the mental registration of information and subjective psychological experience of a stimulus. The perceptual experience equates to sequences of ineffable qualia or the what-it-is-likeness to experience something like, for example, the experience of seeing yellow banana or smelling a flower. Percepts are instantiations of phenomenal knowledge. Perception is intimately related to judgment, the next denotation and our concept of interest.

Judgment is an abstract and inferential process that is linguistic in nature. Judgment is a prior-oriented top-down process and is comprised of a postdictive analysis that is preceded by a consciously inaccessible predictive analysis. It is understood that Type I processing occurs naturally without conscious input or intervention, while Type II processing involves the escalation of cognitive resources to include conscious and critical thought patterns. We will soon see how a single perceptual state is indeterminate such that it is possible for a single perceptual state to result in multiple consequential interpretations (or judgmental states). A change in judgmental states is equivalent to a Gestalt switch because it relates to the conscious shift in awareness from one interpretation of a stimulus to another. Lastly, limitations in phenomenology, language, and the pre-judgment process are the cause of restriction in terms of what can be judgmentally formulated.

In short, sensation is the reception of stimuli, perception is the subjective experience of stimuli, and judgment is the interpretation of stimuli. As previously mentioned, past iterations of the stimulation process can influence a contemporary iteration of said process. More specifically, previous sensational and judgmental states can influence a current perceptual state. This implies that previous exposure to a stimulus may change the way it is experienced the next time. On their own, these processes can be difficult to differentiate due to current limitations of language. For example, the phrase of someone have a burning sensation is a vague notion because it can be
used to describe the experience of a multitude of things such as putting your hand on a hot stove, hovering your arm over steam, or your tongue in contact with chili peppers. All of these are subject to their own sensational, perceptual, and judgmental states, but in everyday matters we typically do not feel the need to distinguish them. We will proceed to demonstrate why it is necessary to formalize the chronology of cognitive subprocesses active during sensory stimulation. The best approach to elucidate this is to provide examples to illustrate the point.[1]

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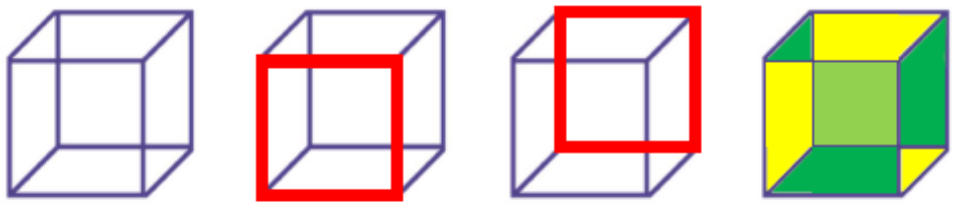
[1] It should be pointed out that there is a consciously inaccessible intermediary process that occurs after perception and before judgment. This intermediary state would extend our three-step process into a four-step process. As it will eventually become clear, it would make sense to designate this as the conception process (conceptual state).

The famous Necker Cube (Macpherson, 2017)[2] is an ambiguous graphic that, as shown in Figure 1, does not have a single correct interpretation such that the image can be interpreted in at least one of three ways: a 3-dimensional cube that is visible from a top angle, a 3-dimensional cube that is visible from a bottom angle, or a connected set of polygons with no apparent depth at all. At first glance, the mind will attempt to understand the graphic being observed and develop a hypothetical judgment about graphic. Subsequently, the first instantiated judgmental state will become part of a previous iteration of stimulation and effectively act as a prior. Therefore, the very first judgmental state that occurs will inadvertently affect the way future judgmental states are constructed, implying that (previous) judgmental states affect attention. For example, judgments can trigger the weapon effect, a phenomenon in which an initial recognition (a judgment of identification) of a weapon in sight will draw resources from the attention span in an effort to maintain knowledge or awareness of the current location and state of said weapon. Thus, the weapon effect comes as a result of witnessing a weapon. Another such example is confirmation bias, which refers to the propensity of an individual to interpret and accept information that is in accordance with their beliefs as well as a tendency to reject or dismiss information that goes against their beliefs. Hence, the weapon effect and confirmation bias are instantiations of past judgmental states influencing a current perceptual state.

Figure 1



The first figure is the original Necker Cube. The second and third figures each highlight a possible frame of reference and aid the illusion of a 3-dimensional cube. The last figure has added colors to help distract from the dimensionality of the figure and is an attempt to present a depthless figure.

Practically speaking, we can safely account for a Gestalt Switch when a person can affirmatively express when they have witnessed something different. The judgmental state, though, is the consequence of subjectively experiencing a stimulus and occurs after the unconscious mind has already decided what to make of it. What a person reports that they see at first exposure to the Necker Cube is a choice (for example, they can choose to lie); however, the true initial judgement about the Cube is not a choice. This unconscious decision of how to interpret a stimulus highlights the fact that there is some sort of unconscious conception that happens before being able to make a judgment about it.

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[2] Donaldson, J. and Macpherson, F. (July 2017), "Necker Cube" in F. Macpherson (ed.), The Illusions Index. Retrieved from https://www.illusionsindex.org/ir/necker-cube.

If we observe Japanese web designer Nobuyuki Kayahara's spinning dancer Silhouette Illusion, we find a GIF that is effective at providing an illusion of ambiguous rotation because of "the lack of visual cues for depth" (Wikipedia, 2003)[3]. When viewing the image, there are at least two salient ways to judge the behavior of the graphic: the dancer can be spinning clockwise (C) or counterclockwise (CC). The multiple salient interpretations of the graphic are illusive of the indeterminate property of perceptual states. The implication here is that there can be situations in which two people can perceive the same stimulus but judge it differently. Alternatively, it is completely plausible that there are individuals who can view this graphic but only see depthless silhouettes of moving shapes and are unable to identify a spinning dancer in the figure at all. The indeterminate property of perceptual states emphatically suggests the theoretical need to discuss the cause of variation in resulting judgmental states.

Suppose that we have found someone who reports that upon viewing the graphic, they interpret it as the silhouette of a spinning dancer (either (C) or (CC)). The judged direction of spin is not exactly a choice, and neither is it a choice to judge the dancer as having changed its direction of spin. Instead, it comes rather incidentally after refocusing attention on the graphic. One can desire and concentrate on mentally trying to interpret a change in behavior, but this does not mean that doing so causes a Gestalt switch. We know that the GIF is a graphic that loops, so it is a fact that sensation of viewing the spinning dancer never changes. The perception is the raw image that appears in "the mind's eye." In theory, this also never changes such that the greyscale colors remain constant and the stimulus is a continuous display of the same sequence of images in rapid succession. It is unknown, however, what exact cognitive mechanisms cause our hypothetical person to interpret (C) or (CC) upon viewing the graphic, nor is it known if the cause of a Gestalt switch is attributable to the same mechanisms. Currently, a change in judgmental states can only safely be accounted for when a person can report that they have witnessed the graphic switch from (C) to (CC) or from (CC) to (C). Unfortunately, this is a severely limited ability to monitor Gestalt switches because it relies on a person's willingness and ability to punctually report when they have experienced a change of states. Take the opportunity to recognize that it is very tempting to say that what is occurring here is a change in perceptual states. In terms of colloquial vernaculars, this will likely suffice to get the point across. But if we wish to become rigorous in discussing cognition, it is important for us to be pedantic and recognize that is what is actually happening is not a perceptual switch but rather a change in judgmental states.

The stimulation process being described is being developed to investigate the mechanics of psychological registrations of stimuli, but first it might be helpful to understand the distinction between a cognitive product and a cognitive mechanism. Cecilia Heyes is a cultural evolutionary psychologist that investigates the core aspects of human cognition in her publication Cognitive Gadgets (2018)[4]. Heyes introduces new invaluable technical vocabulary: grist and mills. "Grist" refers to cognitive products such as memories, whereas "mills" refer to cognitive mechanisms such as logic that give rise to cognitive products

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[3] "Spinning Dancer." Wikipedia, Wikimedia Foundation, 30 Dec. 2019, en.wikipedia.org/wiki/Spinning_Dancer.

[4] Heyes, Cecilia. Cognitive Gadgets. The Cultural Evolution of Thinking. Belknap, 2018.

(Heyes, 3). From a biological perspective, sensation (mills) gives rise to perception (grist); but from a psychological perspective, it is unknown exactly what cognitive mechanisms (mills) produce judgment (grist). It appears that there is a black box problem presented to us because our minds somehow extrapolate information from perceptual states without our conscious input to produce judgments. How this is done is not yet clear, but by creating finer divisions in information processing, we are formalizing the chronology of cognitive states to hopefully make them possible to study scientifically.

The stimulation process applies more than to just visual information processing. Think about what it means for a food item to be an acquired taste. Generally speaking, a food item being an acquired taste means that a person has to have a specific palette of taste to enjoy that particular food item. Suppose we are considering a hypothetical spicy salsa. It is assumed that the sensations produced by consuming this particular salsa are more or less the same for everyone and that the resulting perceptions will be marginally different. The consequential reaction to (judgment of) the taste, however, may vary significantly from person to person. Somebody who typically dislikes spicy food is predisposed to not enjoy the spicy salsa. This aversion may come as a result of natural preferences or a traumatic experience with spicy food, but in any case, the opinion of the flavor (not the flavor of the actual food) will depend on priors. On the other hand, someone who enjoys spicy food is more likely to enjoy the spicy salsa because it aligns more with their preferred tastes. As such, it is easy to see how preexisting priors play a role in constructing judgmental and opinionated states.

As further support of the stimulation process, William James in 1890 proposed the novel idea in Principles of Psychology that in terms of the serial order of biological events, bodily expression precedes emotion (Stanford, 2017)[5]. In other words, James is saying that the body reacts before the mind responds. For example, the emotional experience of rage is a reaction of stress and must be preceded by the release of adrenaline into the bloodstream leading to the onset of a raise in body temperature, increase in heartrate, and bodily shaking. As such, judgment is a metacognitive analysis that naturally comes as a consequence of psychological perception. In accordance to James' proposition, judgmental states describe interpretations of perceived stimuli.

Consider how the mind understands social context and how autism influences consequential interpretation. Social cues correspond to judgmental states and are evaluations of social situations and norms which contribute to intuitions on how one ought to act in those situations. People with Autism Spectrum Disorder have a condition in which they judge social contextual information differently than someone without autism. In particular, autistic individuals are predominantly predisposed to not detect instantiated social cues and have altered conceptions of emotional intelligence. Suppose Person 1 is a person that does not have autism and Person 2 has severe autism. In particular, autistic individuals are predominantly predisposed to not detect instantiated social cues and have altered conceptions of emotional intelligence.

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[5] Goodman, Russell. "William James." Stanford Encyclopedia of Philosophy, Stanford University, 20 Oct. 2017, plato.standford.edu/entries/james/.

Suppose Person 1 is a person that does not have autism and Person 2 has severe autism. In a conversation between the two individuals, Person 1 and Person 2 should have significantly similar perceptions of what is being said in the course of their interaction. However, the two are very likely to walk away with significantly different interpretations of the conversation. Person 2 is much less inclined to have picked up on relevant social contextual information and this would effectively misconstrue certain aspects of the conversation with Person 1. Hence, an important detail here is that social constructions are higher order judgmental states such that they are not something that can be directly perceived.

Autism is one of the topics that Andy Clark touches on in his book Surfing Uncertainty: Prediction, Action, and the Embodied Mind (2015)[6]. Clark proposes the Predictive Processing (PP) model which, in summary, theoretically explains that the mind is always in a constant state of attempting to predict its environment and make sense of stimuli presented to it. There are historically two traditional views that have been used to theoretically explain the mind: bottom-up and top-down processing. Bottom-up processing asserts that psychological phenomena arise solely out of biological constructions of all pertinent stimuli and does not rely on preexisting mental states. Alternatively, top-down processing asserts that the mind constructs perceptual experiences strictly out of preexisting mental states and expectations. Clark's proposal asserts that both processes are integral to the structure of the PP framework and claims that attention is the intersection between bottom-up residual errors and top-down predictions. The PP model is elegant in its simplicity and flexibility with the built-in ability to accommodate multiple philosophical interpretations of cognition. Though the PP model does not have a particularly great practical utility, it does help to ascertain cognition from philosophical perspectives. Hence, the PP model may not have significant predictive power, but it does have the intended effect of delivering a systematic approach to reason through the production of psychological phenomena.

The PP model is compatible with this proposal because the processes have a correspondence to sensation, perception, and judgment. Sensations are analogous to bottom-up residual errors, whereas previous judgments are analogous to top-down predictions. Therefore, perception is the continuously updating cognitive state, in this case being identical to conscious attention, and meets at the intersection of bottom-up and top-down processing. Hence, the model is in accordance with the PP model and does not violate Clark's proposal.

Hallucinations are a topic of interest because most (if not all) cases cannot be induced by one's own volition; that is, it is not known for people to have the mental faculty to willingly self-induce hallucinations. If we follow Clark's assertion that hallucinations are instantiations of "uncontrolled perception" (196), then logically speaking, this idea of hallucination makes sense at face value. However, this denotation is not particularly useful in relation to the stimulation process because sensation is an unconscious process that determines perception. This would imply we are always hallucinating. Clearly, this is not what we are trying to convey. By adopting the stimulation process consistent of the serialized subprocesses sensation, perception, and judgment, we can introduce a refined

[6] Clark, Andy. Surfing Uncertainty: Prediction, Action, and the Embodied Mind. Oxford University Press, 2019.

denotation of hallucination that is logically consistent with our framework.

At first, it might seem that hallucinations are problematic to the framework of the stimulation process, but providing a refined formal definition makes it clear that the framework itself is robust. We can choose to identify that a hallucination occurs if a person's perception or consequential judgement does not match their true sensation. For example, a person that heavily abuses hallucinogenic drugs is prone to hallucinating, that is, perceptually experiencing things that did not or cannot actually happen. In such a case, our framework does not break down, but rather, the stimulation process tells us that the true stimulation has gone awry. Functionally speaking, if there is something that is breaking the logical progression of the stimulation process from sensation to perception, then we know that the person is hallucinating and is indicative of a foreign substance or of abnormal psychological phenomena.

We will now consider additional applications of stimulation and address some outstanding questions. Related to hallucinations, synesthesia is a condition in which a person will experience additional perceptions in addition to the normal perceptions that come with sensory exposure. For example, this condition is what allows for individuals to see music or taste colors. Clearly, there is an extra layer of perceptual experience that needs to be explained here. It is not clear, however, where the added perception fits in this framework. Is it the case that multiple perceptual states constitute the perceptual process? Is it the case that multiple instantiations of stimulation run in parallel leading to multiple percepts? Or is it the case that instantiations of stimulation are fast enough to run serially so much that individuals cannot identify which percept comes first? All of these options are reasonable, but it is not clear which is correct, if any of these. In continuation of this process, one should investigate the neurological structures that are active during moments of synesthesia and try to parse local neural activity to determine how stimulation can accommodate psychological synesthesia.

Concretely defining the stimulation process may be useful in studying artificial intelligence because it will allow us to develop an analogous process to separate distinct processes that are taking place. We know that AI's can make predictions (judgments) that surpass our own; for example, Google's AlphaZero can outcompete world class chess players (Lincoln, 2018)[7]. These kinds of judgmental states already exist in inanimate technology. The sensations are analogous to physical inputs to interact with it; in AlphaZero's case, moves made against it in the game of chess are sensational interactions. What now needs to be determined is what kind of cognitive process occurs when it learns to beat human players. If it is deemed not suitable to say that computers can never experience a perceptual state, that is one way to say that a computer will never be conscious. Therefore, this argument claims that if a computer becomes perceptive, it becomes conscious.

Can you describe the differences and relationships between the descriptors active, animate, cognitive, sentient, conscious, and self-aware? Briefly, here is a denotation of each. Being active means that something has a duration of activity, but this is distinct from being animate which means to behave (or act) idiosyncratically. For example, obviously a cat is active, but I argue that a battery (that is not fully discharged) is too. Clearly, a cat is also animate, but it is absurd to say that a battery is animate. This is yet another instance of where common language muddles the necessary rigor of cognitive science. To continue, cognition refers to having cognitive states (technically, at least one). I argue that single-celled organisms are technically cognitive because it requires organized and systematic functions to survive (cells are both active and animate). Moreover, in terms of cognition, I would even argue that this could extend to viruses as well because they also operate in organized and systematic methods, but that is another discussion on its own. "Sentience refers to the ability to have positive and negative experiences caused by external affectations to [the] body or to sensations within [the] body" (Animal Ethics)[8]. This would imply that sentience requires cognition since sensation is a cognitive state. Being conscious, I argue, is the same as being perceptive, that is, subjectively experiencing qualia. Finally, I argue that self-awareness equates to metacognition, an even higher order cognitive task, and is something that requires consciousness. This argument suggests that self-awareness is a stronger, that is, more restrictive, requirement than consciousness. The result of this argument is that cognition is required for consciousness, which is required for metacognition.

Now we can proceed to address a problem that arises out of functionalism. If we are to describe any hypothetical AI, what does it mean for an AI to be conscious? How would we determine if we gave consciousness to an AI on accident? What would it need to make it be considered conscious or more impressively, self-aware? Say we just care about designing an AI that is conscious; that is, we do not really care about making it self-aware. One problem that we will have is that we are not sure how to identify percepts without it being self-aware. It seems that we need a conscious entity to communicate to us that it is conscious, but the problem is it has to be self-aware to be able to communicate that with us. Thus, the problem of finding the boundary between consciousness and self-awareness needs to be addressed to determine what is necessary to detect consciousness in animate entities.

Consider the droid, R2-D2, from the famous Star Wars franchise. How would you classify R2-D2? I would argue that R2-D2 is active, animate, cognitive, sentient, conscious, and even self-aware. For some to be familiar the reference, it would require them to do homework and watch a few Star Wars films, but for the majority of people that are familiar it, think about what you would classify R2-D2 and why.

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[8] Animal Ethics. The Problem of Consciousness, www.animal-ethics.org/sentiencesection/introduction-to-sentience/problemconsciousness/#:~:text=To%20be%20conscious%20is%20to,experience%20or%20awareness%2 0of%20something.&text=The%20word%20%E2%80%9Csentience%E2%80%9D%20is%20so metimes,to%20sensations%20within%20our%20body.

Anyone can say that, clearly, R2-D2 is a preprogrammed robot and more relevantly, is a fictional character. But consider if such a droid was real. Then, would you say that it is conscious or self-aware? Try to formalize your reasoning and determine exactly what qualities or actions make R2-D2 fit into the categories you put him into (yes, R2-D2's pronoun are he/him/his)[9] The bottom line is despite the fact that R2-D2 is not real, R2-D2 is socially relevant in the film and was adopted into social circles such that he acquired pronouns. What makes this bot so special?

Figure 2

R2-D2 is Famous Star Wars character that is a widely known concept of an artificially intelligent robot.

Hopefully asking these questions made the task of identifying and evaluating consciousness in artificial intelligence less abstract. This is my advanced version of Turing's Imitation Game (Turing, 1950)[10] and I urge the reader to consider the technical requirements for recognizing consciousness in conscious entities that lack metacognitive ability. We will now conclude this paper by discussing what comes next.

In the future, there is much that cognitive scientists can do to expand on the theoretical stimulation process. Referring to the black box problem we described previously, the gap to explain judgmental construction requires investigation of what cognitive mechanisms decide how metacognition relates to the perceptual experience. That is, more attention needs to be given to the cognitive mechanism that precedes judgment and is subsequent to perception. This theoretical process would entail conceptual operations with respect to priors including but not limited to logic, emotions, instincts, beliefs, and motivations. These are suitable components that play a key role in judgmental construction because they are essentially what make an intelligent specimen. Advancements in game theory, technology, and neuroscience should hopefully move this process forward. Unfortunately, our efforts are further hindered by our current inability to safely and ethically study psychological phenomena. What we are left with is the use of simple but provocative thought experiments that argue concepts of theoretical progressions of cognitive states. I hypothesize that studying this in tandem with the simulation process will elucidate frailties in our current understandings of cognition.

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[9] "R2-D2." Wikipedia, Wikimedia Foundation, 23 May 2020, en.wikipedia.org/wiki/R2-D2.
[10] A. M. Turing, I.—Computing Machinery And Intelligence, Mind, Volume LIX, Issue 236, October 1950, Pages 433–460, https://doi.org/10.1093/mind/LIX.236.433.

When defining cognitive states, there may be a need to refine our process to include unconscious instances of cognitive states. For example, people with Hemispatial Neglect Syndrome are able to detect items without consciously being aware of it (TED-Ed, 2019)[11]. Studies of P.S. suggest that his decisions are intentional rather than coincidental in avoiding averse situations because they were unconsciously deemed avoidable and unconsciously guided. Thus, there is a need to define new unconscious perceptual and judgmental states. Either or both may need to exist to accommodate the description of cognitive states of subjects with Hemispatial Neglect Syndrome. Therefore, cognitive scientists should try to apply the stimulation process to cases of abnormal psychology to try a new approach to explain psychological phenomena.

There are clear distinctions between sensational, perceptual, and judgmental states. Cognition is difficult to study because of inherent limitations of phenomenology, but hopefully using the stimulation process framework will help to refine our currently limited conceptions of sensation and perception. Most times in psychology, scientists will study grist and avoid getting into the murky territory of mills. It is understandable why scientists resist getting involved in resolving that complicated mess, but that is the direction we are headed toward if we are to develop better insights of cognition.

[11] Graziano, Michael. “What Is Consciousness? -Michael S. A. Graziano.” YouTube, YouTube, 11 Feb. 2019, www.youtube.com/watch?v=MASBIB7zPo4.

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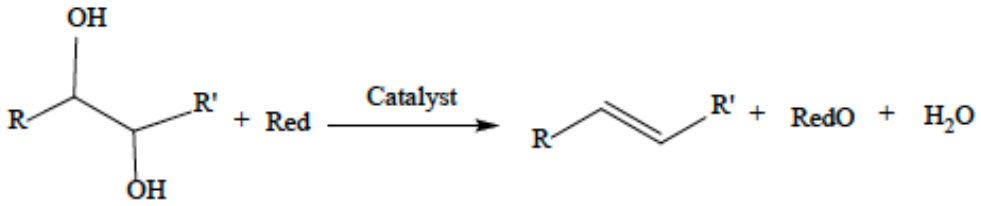
Research report: Synthesis of asymmetrical ligand for Deoxydehydration catalyst

Introduction

Biomass, the organic material made by plants and animals, is useful as one of the sustainable alternative resources to replace fossil resource because of their similarity in chemical structrure. However, due to its highly oxygenated nature, methods to reduce oxygen content in biomass are required to be able to convert biomass to sustainable platform chemicals. One of these methods is the deoxydehydration (DODH) reaction. Deoxydehydration is the synthesis of an alkene from a vicinal diol by removal of one H2O and ½ O2 using a reducing agent (Scheme 1). Biomass, the organic material made by plants and animals, is useful as one of the sustainable alternative resources to replace fossil resource because of their similarity in chemical structrure. However, due to its highly oxygenated nature, methods to reduce oxygen content in biomass are required to be able to convert biomass to sustainable platform chemicals. One of these methods is the deoxydehydration (DODH) reaction.

Deoxydehydration is the synthesis of an alkene from a vicinal diol by removal of one H2O and ½ O2 using a reducing agent (Scheme 1).



Scheme 1: General Scheme for Deoxydehydration of a Vicinal Diol. R, R': alkyl, aryl, or H, Red: Reductant, RedO: Oxidized reductant.

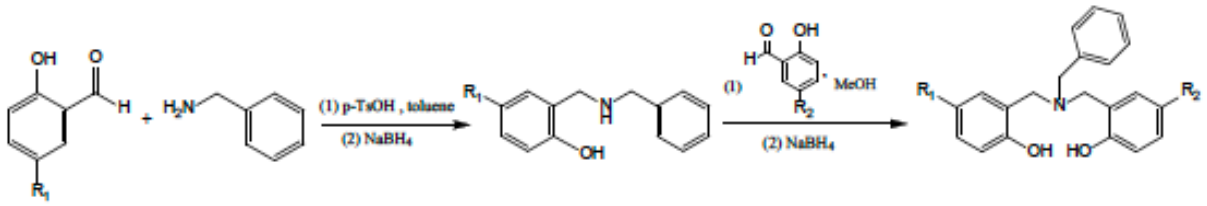
Many studies had been done on the substrate to expand it from to not only focus on biobased sugar alcohol such as pentitols and hexitols, but also sugar acids, their esters and sugars (Stalpaert and Dirk, 2018). In the catalyst scope, there are three metal-based catalysts that give positive result for DODH reaction: Rhenium, Vanadium and Molybdenum (Dethlefsen et al., 2015; Chapman and Nicholas, 2013). Among those, Rhenium-based homogeneous catalysts exhibit the best performance.

However, because of its rarity, the use of Rhenium-based catalysts is expensive. Therefore, cheaper alternatives such as Molybdenum-based catalyst are being investigated to replace Rhenium-based catalysts. However, the activity of Mo-catalyzed DODH reaction is relatively low compared to Rhenium counterparts. Different ways to increase the yield have been examined and one of them is the use of ligands.

Studies on effect of homogeneous symmetric ligand on the yield of DODH reaction show that both steric and electronic effect from the ligand affect the yield of DODH reaction. Specifically, reactions that uses catalyst with bulkier ligand (e.g. 2,2,6,6-tetramethylheptane-3,5-dionate) give higher yield of DODH product than those use catalyst with less bulky ligand (e.g. 1,1,1,5,5,5-hexafloroacetyl-acetonate).

Beside, ligand with stronger electron donating strength (e.g. 2,2,6,6-tetramethylheptane-3,5-dionate) also give a higher DODH product yield than ligand with weaker electron donating strength (e.g. dibenzoylmethanate). Among the two effects, steric effect appears to be more prominent than electronic effect (Stalpaert and Dirk, 2018).

However, these studies only involve homogeneous symmetric ligands. Little study has been done on the effect of asymmetrical ligand on DODH reaction. Therefore, our research focuses on synthesizing asymmetrical ligands to be able to use them in DODH reactions. Specifically, we synthesized an asymmetric ligand using two different salicyaldehydes and benzylamine (Scheme 1).



Scheme 1: Synthesis of Asymmetric Ligand.

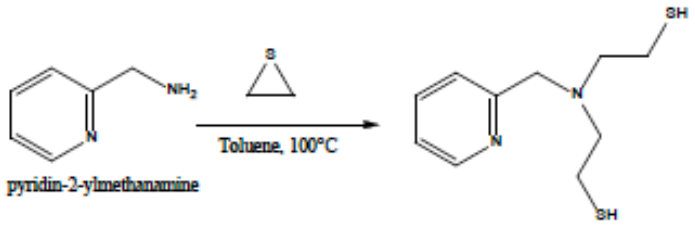
II/ Experimental

Benzylamine, salicyaldehyde and p-toluenesulfonic acid were taken into toluene and stir at room temperature. The collected solution was concentrated to dryness result in solid crystals. The compound was then reduced with NaBH4 in methanol at room temperature until the solution became clear. The solution was then worked up and concentrated to dryness.

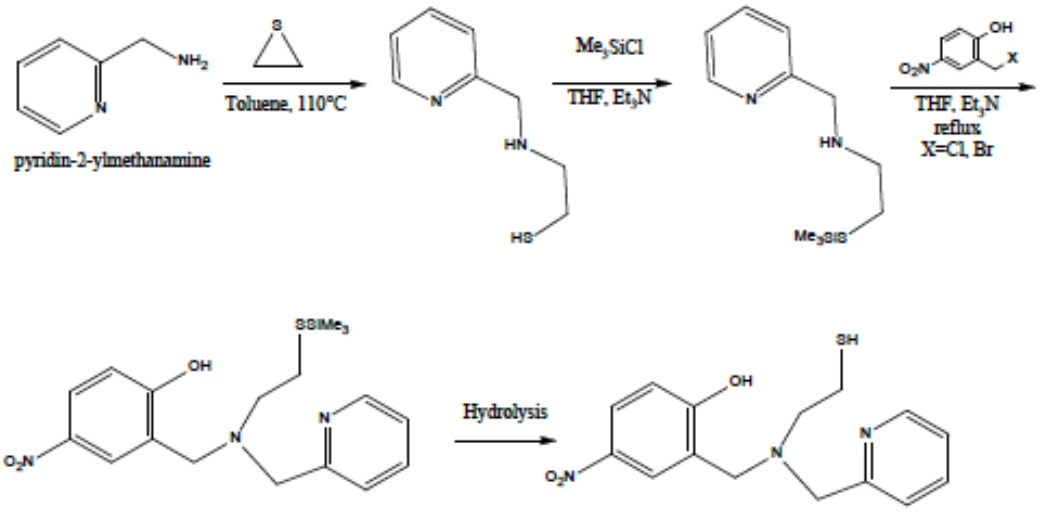
The secondary amine was added into a round bottom flask with another salicyaldehyde species, methanol and were refluxed. The resulting solution was cooled, reduced with NaBH4, and concentrated until crystal was seen with little solution remained.

III/ Future work

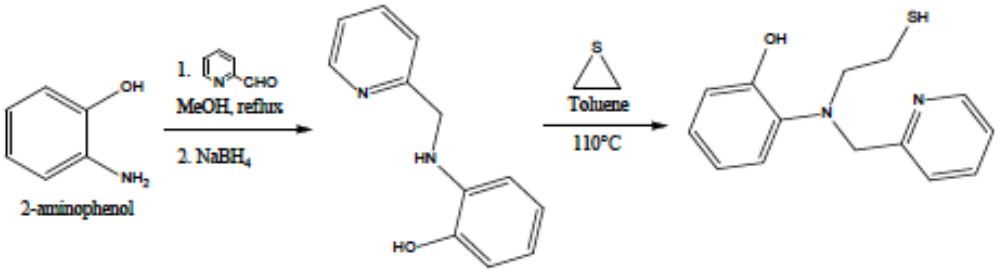
For future, more asymmetrical ligands that are different in bulkiness and electron donating strength would be synthesized. Suggested ligands include 2-[Bis(2-sulfanylethyl) amino]-4-tert-butylphenol (Scheme 2), 2-[N-(2-hydroxy-5-nitrobenzyl)-N-(2-mercaptoethyl)] aminomethyl-pyridine (Scheme 3), 2-[N-(2-mercaptoethyl)-N-(2- pyridylmethyl)]aminophenol (Scheme 4), and N,N-bis(2-mercaptoethyl)benzylamine (Scheme 5) (Wong et al., 2003). These ligands will then be used to synthesize Molybdenym-based catalysts and tested for catalyst reactivity in deoxidehydration reaction.



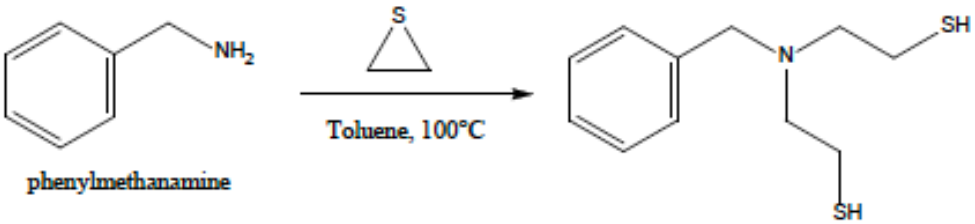
Scheme 2: Synthesis of 2-[Bis(2-sulfanylethyl)amino]-4-tert-butylphenol.



Scheme 3: Synthesis of 2-[N-(2-hydroxy-5-nitrobenzyl)-N-(2-mercaptoethyl)]aminomethyl-pyridine.



Scheme 4: Synthesis of 2-[N-(2-mercaptoethyl)-N-(2-pyridylmethyl)]aminophenol.



Scheme 5: Synthesis of N,N-bis(2-mercaptoethyl)benzylamine.

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Encapsulation of Fiber Optic Biosensors within Microfluidic Channels

Abstract

Biosensor is an emerging area that has been attracting scientists for its applications in various fields such as food safety, detection of pathogenic bacterial strains, biomedical research, etc. Fiber optic biosensor developed in the lab utilizes U-shaped biconically tapered optical fiber with the core diameter of approximately 10 µm. To retain sensitivity of the sensitive region of the fiber for long-term usage, the suitable environment for a biosensor is to situate the tapered fiber in an enclosed place with the integration of fluidic channels. For the encapsulation of biosensors, rectangular compartment was designed and built by utilizing polydimethylsiloxane, or PDMS. Plasma adhesive bonding technique was employed for secure adhesion of glass slide to the PDMS surface. The compartment consists two holes in which the tubing system was integrated to inject desired amount of solution. The sensitivity and variability of measurements of encapsulated biosensor were compared against the control biosensors without the compartments.

Major objective(s)

The project consists of three objectives; 1) to encapsulate the sensitive region of the fiber optic biosensor with PDMS compartment, 2) to take and compare measurements of encapsulated sensor versus unencapsulated sensor to check differences in the reading, and 3) to apply the biosensor with biological components such as antibodies, aptamers, bacterial DNA, etc.

Background research with analysis and summary of literature review

Biosensor is an analytical device that is used in a various field ranging from food safety, environmental control and monitoring, medical diagnosis and monitoring, and to pathogen detection. The term "biosensor" itself is an umbrella term for sensors that utilize transducers and biological elements to detect a specific molecule of interest, and sensor transduction types can vary from optical biosensor, electrochemical biosensor, piezoelectric biosensor, to magnetoelectric biosensor, etc. It is an emerging field of study, and IUPAC has recognized this type of sensors just over two decades ago. Due to its convenience, high sensitivity technology, and low-cost production, a lot of attentions have been aimed to the development of fiber optic biosensing technology. This paper will discuss overall structures and advances that fiber optic biosensor has made in last two decades in popular fields such as water treatment and monitoring, pathogen detection, and medical diagnosis and monitoring. The paper will not examine different kinds of biorecognition molecules and potential biomarkers for particular molecules.

Optical fiber is a material that allows laser to pass through its core without penetrating or losing its signals, though varying distance and conditions can have impact on the strength of signals. Compare to conventional material such as copper wire, optical fibers are more flexible in that it provides larger bandwidths and transmit data at a much higher rate.
Fiber optic biosensor consists of three important components; transducer, biorecognition elements, and the sensor interrogation system. The fundamental mechanism of fiber optic biosensor is based on the principles of total internal reflection that occurs in two different mediums; the high refractive index of fiber glass and low refractive index of air.

One external coating known as cladding as a protective coating was introduced to optical fibers. Cladding possesses low refractive index glass compared to the core, and this will overcome the issue of coating the fiber without ceasing the total internal reflection phenomenon (Kumar & Deen, 2014). A magnetic field, called evanescent field is created few hundreds micrometer outside the cladding and surrounds the core. The change, through the binding of antigen to antibodies, enzymatic activities, aptamer binding to its ligand, and any other biorecognition processes that produce readable signals, in the evanescent field is what is detected by the sensor (Marazuela & Moreno-Bondi, 2002).

One of the popular areas in which biosensor has been introduced to the replacement of conventional machineries for water treatments such as high-performance liquid chromatography atomic absorption spectroscopy, and ultraviolet–visible spectroscopy (Ejeian et al., 2018). A handful of small portable biosensors have been commercialized despite its short existence since the discovery. Evanescent wave excitation biosensor, or EWE biosensor, is a well-studied field of optical sensor typically applied in wastewater monitoring, its flexibility in the overall design has long been favored within the optical sensor systems (Xiao-hong et al., 2015). The main principle of EWE biosensor is the reaction between flurophore-tagged antibodies and antigen. Laser diode light is coupled into the edge of the biochip and propagates along the sensitive area of the biochip by total internal reflection, or TIR. In the TIR point, the evanescent wave field interacts with the fluorescence-labeled biomolecules that have been immobilized on the surface of the sensor, causing the excitation of fluorophores. The emitted fluorescence light is collected by polymer fibers and is filtered to reject any lost and scattered laser light, and then the light signal is detected by the photodiodes through a lock-in amplifier (Xiao-hong et al. 2014). The method proposes viable results for the commercialization of a potential biosensor, yet there still is a need for the field to assess common problems of EWE biosensors such as interferences and cross linking of antibody-antigen specificity.

Ejeian et al. examined the use of optical biosensor for detection of organic materials in wastewater. Fluorescent antibodies are commonly used technique to visually display the presence of target analytes. The study evaluated the potential of transformed bacterial cells containing plasmid with fluorescent label. This technique is used in recognition and quantitation of various compounds at the presence of low solute concentrations ranging from estrogenic derived hormone such as estriol and esterone, and to pesticides and organic compounds found in groundwater (Tschmelak et al. 2005). The analysis shows a promising potential for the biosensor as a substitution of immobile, laboratory-intensive machineries.

The current method of medical diagnosis and patient monitoring yield an accurate, reliable results at a high cost. Biosensors such as glucose monitoring in diabetes patients and pathogen detections are some of the commercialized point of care biosensors used in medical field. POC analyzers provide a same accurate result for patients in non-clinical settings. The aim can even extend to application of POC product in a resource-limited third country settings for a greater context of global health monitoring and managing. The current detection methods for serious infections such as tuberculosis and HIV in third world countries are not as accurate but are inaccessible for a large population and take few days for the results to come out. To address this technological gap, Lifson et al. analyzed the advancement of optical-based biosensor in pathogen detection and emphasized on its

capability to interact with a whole-cell of bacteria for a better result. For a further advancement of biosensing system, numerous kinds of technologies can be integrated suchas microfluidic platforms, smart materials along with smartphones will change the way POC platforms work in resource-limited settings. In the more current advances in technologies of microfluidics, nanotechnology, polymers, and smartphones have directed to creating proficient POC diagnostic devices. The performance of POC platforms were enriched by the improvements in convenient biosensing approaches using such surface plasmon resonance, fluorescence, colorimetry, electrochemical detection and 3D printing. 3D printing specifically has an exceptional addition to enhancing the POC system performance which are established on "low-cost, one-step fabrication, and equipment-free capabilities". The improvements in 3D printing can change the way POC diagnostics work for instance it can be transformed into a robotic program for proficient and fast DNA/ RNA extraction along with nucleic acid amplification (Zarei, 2017).

The sensor interrogation system is complex, and commercialization of the sensor requires an interdisciplinary approach due to different components of biosensor that plays a role in measurements. Biosensors have advanced rapidly with the collective efforts of scientific community to develop a device that provides attractive features for doctors, marketers, academic institution, etc. Despite its potential to be a substitute for conventional laboratory machines, it still requires years of experimentation and evaluation for such technology to be used by general public. Future research should replicate those findings to enhance fundamental elements of biosensor such as sensitivity, specificity, and affinity.

Methods (Experimental procedure/design):

Tapers were fabricated by pulling an optical fiber axially while heating. After drawing the desired length to fit into the chamber, about 1 inch, the tapers were bent into a U-shaped and secured to glass slides with tape.

The procedure for the encapsulation of the biosensor using PDMS starts with the make of PDMS mixture. Using metal cast that is 1-inch by 1-inch by 0.5-inch and the 1:1 PDMS to curing agent ratio, 3 g of PDMS was mixed with 0.3 g of curing agent, and the mixture was stirred for at least 5 minutes to fully combine two chemical solutions. The solution was poured into the cast and was sat for 60 to 90 minutes until all the air bubbles that were made during the mixing phase gone from the mixture. PDMS was cured in an oven set at 70 °C for 60 minutes. The mold was cooled for 40 minutes before it was taken out of the cast. The fiber was immobilized on the opening surface of the PDMS using epoxy glue, and the surface opening of the mold was enclosed with glass slide by utilizing Plasma adhesive bonding technique. In order to prevent the fiber from bending at an extreme angle and breaking, about 2 cm of heating shrink tube was incorporated on the fiber that was exposed from the compartment as a protective coating for the fiber. Biosensors were then tested for signals and compared against the control sensors in which sensors were not encapsulated with PDMS.

After PDMS has been embedded in the fluidic channel, the sensitivity of the sensors was measured. 3 mL of room temperature water was injected into the channel, and every 30 minutes, water was taken out and reinjected. We also repeated the same protocol but with 15 minutes interval of water refillment. In this way, we can test the sensitivity of the sensor to temperature change as well as observing the relationships of the peak shift and the

temperature change. Data analysis was carried out in a software, Igor Pro.

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):

The project started with figuring out the best method for the material of the compartment. We were able to narrow down it to using PDMS after proposing methods such as sol-gel, aerogel, etc. Few designs were created for the metal cast, the first one being 3-inches by 1-inch, the second one is 2-inches by 1-inch, and the most current one is 1-inch by 1-inch by 0.5-inches. The final dimension was developed, because we came to realize that the sensitive region of the sensor is only about 1 cm in length. The extra space in the compartment and the small movement of the solution can cause the sensor to shift and wiggle in solution, which can lead to interference in the reading. The compartment also needs efficient space for about 1-3 mL solution can be injected and ejected and the sensor to be localized without touching the surface of the compartment. The 1-inch by 1-inch cast is still in the making process and it has not been used in the lab at this moment. However, we expect that the final dimension would be the most suitable with the condition considering the second version contains a lot of free space. that does not have positive contributions to the sensor system. The mold can be made by mixing a 10:1 PDMS to curing agent ratio. The second cast required 6 g of PDMS and 0.6 g of curing agent, and the mixture was poured into the metal cast. The cast with PDMS is left for 60 to 90 minutes to remove all the bubbles. PDMS then is cured in the oven set at 70 °C for one hour. The mold can be handled after it completely cools down to the room temperature, which takes about 40 to 60 minutes. The sensor was immobilized using epoxy glue, and, again, only the sensitive region of the sensor was inserted into the compartment. The open surface of the mold is sealed with a glass slide by utilizing plasma adhesion technique. The opening at the sensor was also sealed using additional epoxy gel to prevent the leakage of the solution. In order to protect the fiber region that doesn't have polymer coating, 2-3 cm of the heating shrink tube was also used at the beginning of the fiber coming out of the compartment to prevent the sensor from breaking off at the stem. This is the complete protocol for the encapsulation of the fiber optic biosensor. The current objective of the project is to take the signals and readings need to be taken from the encapsulated sensor and compare the measurements to the unencapsulated sensor to see if there is any difference among the two types of the sensor.

We have demonstrated the encapsulation of a tapered fiber optic sensor in a PDMS fluidic channel. This process prevents the breakage of a tapered optic fiber sensor due to external forces. The sensor within the fluidic channel gave functional peaks. Temperature vs. wavelength plot leads to a conclusion that the sensor peak shift is inversely proportional to the temperature change, as expected from theory. Our preliminary data suggests that the encapsulation of the sensor retains the sensitivity and the amplitude of the power before and after the injection of the water.

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?

One of the most problematic issues that I faced during the encapsulation of the sensor is the breakage of the sensor. Fiber, when polymer coating is removed, is very fragile and breakable, and my mishandling ended in breakages of few sensors. In order to practice the protocol as well as preventing such a wasteful action, I used raw fiber that does not have polymer coating. Unstretched fiber is less prone to physical stress, but it enabled me to learn how to properly handle such a delicate object.

There still are issues with the protocol of encapsulation using epoxy glue and continue use of sensors performing the protocol with water. It is an ongoing process to assess whether the fluidic channel and the sensors immobilized to the compartment by just utilizing glue can maintain its shape and form. Although careful precaution is being taken when handling embedded sensors and injecting water, it is possible that such frequent rates of fluid filling might have alter the location of immobilized sensors. Pressure is another major problem with creating a sealed environment for sensors. With every surface tightly sealed with glue and plasma adhesion process, the compartment becomes highly under pressured, and another hole is needed to depressurize the system in order to pump in water. There still is a number of problems that need to be analyzed through trials and errors.

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The facilitation of mindfulness: Meditation influence on well-being at a continuation school

Intro

One of the main issues facing inner-city youth in the State of California is educational attainment. According to the National Center for Education Statistics (2019), inner-city youth, have the lowest graduation rates compared to their suburban and rural counterparts. More specifically, Latino/a/x students, who make up 52% of all grade school and secondary school students in California (Pew Research Center, 2014), and African American students have some of the highest high school dropout rates and lowest college enrollment rates compared to their White peers (California Department of Education, 2018). Previous studies have found that ethnic minority students are disproportionately subjugated to zero-tolerance policies that leads to high rates of suspensions, expulsions, and arrests which derails their academic trajectory (Kennedy-Lewis, 2012; Noguera, 2003; Rios, 2011; Vigil, 1999). As a result of these policies, many Californian students are funneled through alternative schools with hopes of providing these student adequate education but fail to address the nonacademic barriers that interfere with their progress towards graduation and college enrollment (Kennedy-Lewis, 2012; Velasco, Austin, Dixon, Johnson, McLaughlin, and Perez, 2008; Perez and Johnson, 2008). Administration, teachers, and staff of alternative schools have voiced the challenges they encounter due to the lack of support and training when working with students who attend alternative schools (Kennedy-Lewis, 2012; Perez and Johnson, 2008). Students have echoed similar sentiments by highlighting the limited or non-genuine support from the teachers, staff, and administration which impacts their learning experience (Hernandez, 2017; Kennedy-Lewis, 2012; Rios, 2011; Valenzuela, 1999). Studies that have examined characteristics of effective alternative schools have found that partnerships with community entities like local community colleges and community-based organizations have led to effectiveness by providing additional critical support (Bush, 2012; Perez and Johnson, 2008; Velasco et.al., 2008).

The purpose of this study is to examine the effects of an intervention provided by a community-based organization (CBO) to students at an alternative school in an inner city of California. The intervention is a curriculum that addresses topics of social-emotional well-being utilizing positive psychology exercises and meditation. In the following sections, the literature on continuation schools, community-based organizations (CBOs), positive psychology and meditation will be reviewed.

Alternative Education—Continuation Schools

Alternative schools are school programs with ambiguous goals operating outside the realm of traditional K-12 school system (Aron, 2006). It serves as a solution to provide different means of achieving grade-level standards and achieving the needs of disadvantaged students (California Department of Education, 2017). In California, three main types of alternative schools exist—continuation schools, community day schools, and county-run community schools (Ed Source, 2008). Table 1 describes in depth the functionality of the three programs. For the purpose of this study, we will be focusing on continuation high schools given that it is the most used option of alternative education (Perez and Johnson, 2008).

Table 1. Alternative Education Programs in California, 2005-2006.

Type of School	Students Served	Operating Agencies	Number of Schools	Official Enrollment (based on October data)	Enrollment Based on Accountability Data
Continuation High Schools	For students who are at least 16 years old and generally "undercredited" relative to their age group	School District	519	68,371	116,551
Community Day Schools	For students in grades K-12 who have been expelled from comprehensive schools for disciplinary reasons or are on probation and referred from the juvenile justice system	School District or County Office of Education	294	6,959 in district-run schools; 3,232 in county-run schools	18,455 in district-run schools; 11,857 in county-run schools
Community Schools	Serve same students as community day schools but can also provide independent study	County Office of Education	56	18,055	46,889

Adapted from *Alternative Education Options in California: A View from Counties and Districts.*

Continuation high schools have evolved since its inception in 1917. What started as a program to provide part-time schooling to young workers, has later evolved to provide vocational education to now serve as a course credit recovery program (Williamson, 2008). The ambiguity in the state's mission statement for continuation high schools have provided administration with excessive discretion to operate their schools based on their perceived needs (Bush, 2012; Perez and Johnson, 2008). Because of this discretion, many continuation schools across the state of California have opted to serve as a drop-out prevention strategy (Velasco et.al., 2008; Williamson, 2008). An in-depth examination, however, has unveiled that continuation schools are now being used a "dumping grounds" for students exhibiting emotional and behavioral problems which administration at normative high schools refuse to address (Hernandez, 2017; Perez and Johnson, 2008).

An examination of 37 California's continuation schools unveiled that majority of their students are characterized by their chronic absences, gang affiliations, high levels of substance use, and disengagement from school and/or lacking motivation to pursue their studies (Perez and Johnson, 2008; Velasco et.al., 2008). More specifically, continuation high school students have twice the rates of regular and heavy alcohol and drug use than comprehensive school students leading to dependency problems. When asked if they had ever attended school under the influence of a substance, one-fifth of continuation students answered they had been drunk or high at school. That is three times more than comprehensive high school students. Aside from their regular and heavy use, one-fifth continuation students reported been drunk or high at school on seven or more occasions. This is more than three times the reported rate among 11th graders.

The study also demonstrated the prevalence of violence in continuation schools. Continuation students were three times more likely to have been in four or more physical fights in the past 12 months and carried a gun to school. The violence that occurs can be attributed to the street socialization that inner-city youth experience (Hernandez, 2017; Vigil, 1999). Vigil (1990) makes the argument that the Latino students from the inner cities internalize norms and values derived from survival strategies that they have developed to cope from the chaotic and dangerous environment they live in. This results in students developing habits and emotional characteristics that negatively affect their learning and behavior in the educational setting. It is inevitable for these students to come to school stress free as they come from severely strained homes. As Vigil (1990) points out, these students come to school every day with sense of hopelessness, lack of self-worth and discipline, and emotionally and physically hurt.

As mentioned before, administration, teachers, staff, and students share similar sentiments that alternative schools, like continuation schools, fail or lack the support to address the socio-emotional needs of students placed in alternative schools (Hernandez, 2017; Kennedy-Lewis, 2012; Perez and Johnson, 2008; Rios, 2011; Valenzuela, 1999). In examining effective continuation schools, studies have shown that partnerships between CBOs and continuation schools can be critical in providing support to address the nonacademic learning barriers that continuation students face (Bush, 2012; Perez and Johnson, 2008; Velasco et.al., 2008).

Community-Based Organizations (CBOs)

Community-based organizations serve a multitude of purposes. One common purpose, however, is to provide academic assistance to K-12 students in their communities. While academic tutoring is a primary source of assistance, CBOs can also assist by addressing social factors that interfere with student's educational trajectory and achievement (Adger and Locke, 2000). One reason why CBOs are successful with addressing youth's needs is because of the character and culture they create which attracts inner-city youth to engage with CBOs (Heath and McLaughlin, 1994). Additionally, CBOs are comprised of staff with similar backgrounds and shared language which allow for students to relate with the staff unlike the administration and teachers of their respective continuation high school.

CBOs have demonstrated to have great success with inner-city youth. For example, McLaughlin (2000) found that inner-city youth that have participated with CBOs have presented to be more academically and civically engaged compared to non-participating youth despite living in deteriorating neighborhoods. Students also self-reported to experience higher levels of self-efficacy and sense of worthiness. Additionally, CBOs have been instrumental in providing alternative paths for gang affiliated youth which is a salient characteristic of students attending continuation high schools.

Continuation high school's administration, staff, and teachers pay little to no attention to the socioemotional needs that inner-city youth lack. It may be because of the negative attitudes school personnel hold and express towards these students or because of the lack of training teacher have with at-risk students which may be compounded by the lack of support and funding. Because of the cultural and character components that CBOs have to offer, we wanted to examine the effectiveness of an existing partnership between a continuation high school in the city of Pomona, California and a CBO, Just Us 4 Youth,

which serves the community of Pomona by providing mentorship to the inner-city youth through in-school and outside-school programing.

Just Us 4 Youth

Just Us Youth (JU4Y) is a community-based organization that has served the community of Pomona, CA for the past twelve years (Vazquez, 2019). As of 2018, they began to serve the community of Apple Valley, CA expanding their services to a total of thirteen schools, both middle school and high school campuses. The staff is composed of a team of fifteen staff members including Licensed Clinical Social Workers, Master of Social Work, certified clinical trauma professionals, and college graduates, and community members. One of the programs that the staff delivers across the campuses is the On-Point Program. On-Point is a restorative program that emphasizes on students' socio-emotional needs and development of healthy relationships, character, and leadership. The On-Point program is a curriculum comprised of four components: the arts, interactive questioning, journaling and application. See index for an example of the curriculum.

Positive Psychology and Meditation

Research has conveyed positive psychology intervention using positive affirmation as successful at deterring negative attributions and stereotype threat. Facilitating affirmation exercises for disadvantaged ethnic minority middle school students showed significant success in increasing grade point averages (Yeager and Walton, 2011; Cohen et al., 2009). Cohen et al. (2009) findings yielded a 40% reduction in the academic achievement gap compared to Whites. Moreover, positive psychology interventions utilizing positive feedback to reinforce positive traits and skills has been shown to actualize satisfaction with life, gratitude, and hope in prisoners of Washington Corrections Center (Huynh, Hall, Hurst, and Bikos, 2015). Similarly, mindful meditation exercises has been used to improve sense of well-being in adult child abuse survivors (Kimbrough, Magyari, Langenburg, Chesney & Berman, 2010). Over an eight-week intervention, symptoms of anxiety, depression, and posttraumatic stress significantly decreased and plateaued after 12 weeks after the intervention. Within school settings, meditation exercises have been shown to have an exceptional influence on overall well-being, attentiveness, and cognitive functions in elementary students with low executive function (Routhier-Martin, Roberts and Blanch, 2017). Twice a day transcendental mindfulness exercises in disadvantaged middle school students of a large urban, primarily low income, neighborhood in California resulted in a significant increase in both English and math test scores on the California Standardized test (Nidich, Mjasiri, Nidich, Rainforth, Grant, Valosek, Chang, & Zigler, 2015). Participants of the experimental group surpassed their pre-intervention test scores and outscored the control group (Nidich, Mjasiri, Nidich, Rainforth, Grant, Valosek, Chang, and Zigler, 2015). Nevertheless, while this study aspires to replicate the findings of positive psychology and mindfulness interventions, tempering mental stressors and academic insecurity, this study will also analyze if the employment of both positive psychology and mindful meditation can improve self-efficacy in academic performance and confidence in pursuing individual ambitions in disadvantaged students.

Purpose

The purpose of this study is to examine the effectiveness of an intervention that consists of a curriculum with positive psychology exercises and meditation delivered by a CBO at a continuation high school by measuring their perceived stress, life satisfaction, and general self-efficacy.

We are interested in the following research question: What are the effects of receiving the intervention on perceived stress, life satisfaction, and general self-efficacy?

Hypotheses

1. H0: Perceived stress will not significantly decrease after receiving the intervention.
   HA: Perceived stress will significantly decrease after receiving the intervention.
2. H0: Life stress will not significantly increase after receiving the intervention.
   HA: Life stress will significantly increase after receiving the intervention.
3. H0: General self-efficacy will not significantly increase after receiving the intervention.
   HA: General self-efficacy will significantly increase after receiving the intervention.

Methods

Participants

Participants (N=4) were high school students in a continuation high school in the state of California. Participants were assigned to this intervention through their affiliation with a local non-profit organization, Just Us 4 Youth (JU4Y), who was a primary partner in facilitating this intervention. All of the participants identified as male. Three of them identified as Hispanic/Latino and one identified as Filipino/White. Two of the participants indicated living with their biological parents and the two other participants indicated not living with their biological parents. Three of the participants identified as Seniors in high school, one identified as Junior standing. Three participants indicated they were 17 years of age, and one chose not to disclose.

Table 1. *Demographics of Participants.*

	Participant 1	Participant 2	Participant 3	Participant 4
Grade level	Senior	Junior	Senior	Senior
GPA	1.something	2.5	2.0	1.30
Race/Ethnicity	Filipino/White	Latino	Latino	Latino
Live w/ Biological Parents	No	No	Yes	Yes
Foster Youth or Ward of State?	No	No	-	-
Siblings	Yes	No	Yes	Yes
How many	2		2	7
Employed?	No	No	No	No
Commute to school?	Walk/Bike	-	-	Parent/Guardian

Measures

Perceived Stress Scale (PSS). Cohen's (1988) Perceived Stress Scale (PSS) is a 10 item self-reported scale measuring participants' perceptions of personal stress. Responses are rated on a 5 point likert scale where, 0 = Never, 1 = Almost Never, 2 = Sometimes, 3 = Fairly Often, 4 = Very Often. The PSS has been shown to have strong face validity (0.88), a Cronbach Alpha of 0.72, and strong internal consistency (0.93), (Khalili, Sirati, Ebadi, Tavallai, & Habibi, 2017).

Student Life Satisfaction Scale (SLSS). Heubner's (1991) Student Life Satisfaction Scale is a 7 item self-report scale measuring students' perceived satisfaction with their life circumstances. Participant responses are rated on a 6-point likert scale from "Strongly Disagree" to "Strongly Agree". The SLSS has been found to have strong internal consistency

(α = .86:), (Heubner, 1991); and has been widely employed throughout various analyses of individual wellbeing.

General Self-Efficacy Scale (GSE). Schwarzer & Jerusalem's (1992) General Self-Efficacy Scale is a 10 item self-report scale measuring adaptive ability, such as coping with stressful tasks. Participants report individual scores of self-efficacy on a 4-point likert scale of 1 = Not at All, 2 = Hardly True, 3 = Moderately True, 4 = Exactly True. Previous analysis of the internal reliability and validity of the GSE range from a Cronbach Alpha of α = 0.76 to 0.90.

Procedure

An intervention that consisted of mindful meditation exercises and positive psychology attribute, followed by JU4Y's curriculum was implemented once a week for fourteen weeks, in the second semester of a continuation high schools' academic year. Participants were recruited through their involvement in JU4Y. Participants were summoned once a week from a specific class period to be part of the intervention. In the first week of the intervention, a pre-test was administered that consisted of a demographic questionnaire, PSS, SLSS, and GSE. After that, each session would start with a five-minute mindful meditation exercise, followed by a prompt gratitude or affirmation exercise. The director of the program and the researchers then gave the participants the opportunity to discuss their experience with these exercises. Following that discussion, JU4Y's curriculum was implemented. The curriculum consisted of positive psychological attributes and topics. At the end of the semester, on the fourteenth week, a post-test was given to the participants that consisted of a demographic survey, PSS, SLSS, and GSE.

Compensation

There were three waves of compensation throughout this study. On week one, when participants were asked to fill out the pre-test, they each received a ten-dollar In-N-Out gift card. On week five, participants received pizza at the school site. Finally, on week fourteen, when participants were asked to fill out the post-test, they each received another ten-dollar In-N-Out gift card.

Results

Table 2. *Descriptive statistics of Perceived Stress, Student Life Satisfaction, and General Self-Efficacy.*

Measures	Pre-Test	Post-Test
PSS	19.00 (8.37)	22.00 (9.63)
SLS	27.25 (6.90)	27.50 (7.42)
GSE	30.5 (4.65)	27.25 (7.04)

Table 2. *Descriptive statistics of Perceived Stress, Student Life Satisfaction, and General Self-Efficacy by Participant.*

Measures	Participant 1		Participant 2		Participant 3		Participant 4	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
PSS	12.00	10.00	15.00	20.00	18.00	25.00	31.00	33.00
SLS	17.00	17.00	30.00	28.00	30.00	31.00	32.00	34.00
GSE	26.00	17.00	27.00	29.00	30.00	34.00	35.00	33.00

Perceived Stress. Contrary to our belief, the participants, as a group (N=4), self-reported an increase of self-reported stress (M= 22.00; SD= 9.63) by the end of the intervention compared to the beginning (M= 19.00; SD= 8.37). To test the significance, a sample paired t-test was performed. There was not a significant increase of self-reported stress after receiving the intervention (M= 22.00; SD= 9.63) than before receiving the intervention (M= 19.00; SD= 8.37); t(3)= -.586, p = .599.

Student Life Satisfaction. There was not a significant increase in the student's life satisfaction scores after receiving the intervention (M=27.25, SD=3.44) than before the intervention (M=27.50, SD=3.70); t(3)= -.293, p = .789.

General Self-Efficacy. The participants, as a group (N=4), self-reported perceiving lower self-efficacy (M= 27.25; SD= 7.04) after receiving the intervention compared to prior receiving the intervention (M= 30.50; SD= 4.65). To test the significance, a sample paired t-test was performed. There was not a significant decrease in self-efficacy after receiving the intervention ((M= 27.25; SD= 7.04) than before receiving the intervention (M= 30.50; SD= 4.65); t(3)= 1.42, p = .250.

Discussion

The purpose of this study was to examine if an intervention created and delivered by a local CBO that works with at-promised students, specifically students at continuation schools, would decrease student's perceived stress while increasing their life satisfaction and general self-efficacy. Although the results did not support our hypotheses, it is important to consider the study's limitations and the challenges presented when working with students from a continuation high school.

The intention of the study was to originally sample 18 students from the continuation school for the intervention. However, our sample significantly dropped to four participants over the course of the semester making it a significant limitation to our study since t-tests with a sample of n<5 are considered extremely small and not recommended. Consistent with the literature on California continuation schools (Perez & Johnson, 2008; Velasco et.al., 2008), our sample decreased due to participants chronic absences, dropping out of school, moving out of town, and being incarcerated.

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Gay Men & Self-Perception Based on Grindr Use

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Abstract

Although social networking applications are on the rise, there has been limited research on how social media affects our mental health, especially in sexual minority populations. Gay men often turn to these applications to form relationships with other members of the queer community. Commonly, gay men face stigmatization and discrimination while trying to find a connection in virtual spaces, using digital spaces specifically designated to reduce prejudice against sexual minorities. However, queer digital spaces like Grindr are often subjected to toxic behaviors and stigma coming from within. This paper aims to understand the relationship between toxicity experienced online and user's emotional self-perception. Twitter tweets using Grindr are used to identify keywords that connect to toxicity, self-esteem, and emotional well-being. The findings show that most users experience higher rates of negative self-feelings from using Grindr. Most tweets acknowledge that toxic behavior is prevalent on Grindr, and use it to find personal validation. The data pointed to users comparing themselves to other profiles, trying to fit the expectations of a desirable user (indicators can include conventionally traffic, athletically fit) to receive positive reinforcement in the form of increased profile traffic (number of views, messages). Users who received positive reinforcement experienced positive self-feelings, while users who experienced negative reinforcement (i.e., rejection, prejudice, low levels of profile traffic) more likely experienced negative self-feelings. Suggestions for future research about social media platforms associated with sexual minority populations are provided.

Introduction

Grindr is a dating application for gay men seeking intimacy and connection online. This study examines the relationship between Grindr use and gay men's mental health. Gay men and other sexual minorities often face prejudice and discrimination at home, the workplace, and numerous other public spaces (Connor 2018). Using social networks like Grindr allows gay men to connect with others safely in a private online space online. Although Grindr intends to provide gay men with the opportunity to connect with other gay men, the pressure of traditional masculine roles often curates a toxic environment that enables racism, sexism, and prejudice over non-ideal body types (Shensa, Sidani, Dew, Escobar-Viera, and Primack 2018, Pantic 2014).

This study focuses on the toxicity found on Grindr and its effect on users' self-perception, potentially consequential to gay men's wellbeing. Using a popular social media website like Twitter, keywords in tweets were used to analyze the relationship between toxicity and self-feelings. A content analysis of tweets was conducted, creating several codes by clustering tweets into categories that acknowledge toxic behavior and track positive or negative feelings. The research question addressed in this study asks: To what extent does using Grindr affect gay men's mental health? Research on Grindr and gay men's mental wellbeing, specifically among minority populations like the LGBTQ+ community, is still understudied (Connor 2018, Miller 2018). Thus, it is essential to study these associations because it could facilitate reducing the toxicity of online communities and provide insight into the development of "safer" social networking applications in the future.

These social media sites are tools queer people can use to reduce societal stigmas when trying to meet other queer people in physical spaces. Gay men and other queer people are often subjected to higher levels of minority stress because of their gender and sexual identity, making social media applications a critical part of building support systems and forging relationships with community members (Luk, Gilman, Haynie, and Simons-Morton 2018). Online communities can become susceptible to toxicity if regulations are not put in place to check toxic behaviors, hence the rationale for conducting this study.

Background

Online Activity & Mental Health

A possible link between social media usage and mental health shows that social media usage affects a person's self-esteem, which can further lead to depression and anxiety (Shensa, Sidani, Dew, Escobar-Viera, and Primack 2018). Shensa and colleagues (2018) used an online survey and measured participant's experience of symptoms of anxiety and depression based on their online connectivity habits. The 'Wired' and 'Connected' categories (those who connected to social media more often) showed an increase in the likelihood of depressive and anxious symptoms (Shensa et al. 2018).

Research by Pantic (2014) goes into further detail by examining social media sites (SNS) linked to mental health from the past ten years. This study primarily focused on Facebook activities connected to individual's self-esteem, finding a strong correlation between SNS use and mental health (Pantic 2014). One of the theoretical approaches used to explain how social networking affects mental health is objective self-awareness theory. Objective self-awareness theory states that when people are stimulated by the objectification of their own person, self-esteem, and impression of oneself that people most likely will change. Results show that these aspects generally decrease the longer one objectifies themself (Pantic 2014).

Bergagna and Tartaglia (2018) conducted a study of university student Facebook users through self-reported surveys, examining the relationship between self-impression and increased Facebook use, drawing on social comparison as a model for an explanation. Social comparison theory explains that comparing oneself to others is an essential human need, which allows one to collect information on themselves, and social media networks is a convenient way to do this, thus increasing Facebook use (Bergagna and Tartaglia 2018). Although much of this research based on social media is primarily negative concerning self-perception, some researchers investigated potential positive effects of social media use. For example, Clark and colleagues (2017) found positive views that social media was used to maintain connections that, in turn, promote intimacy and acceptance of one's needs.

LGBTQ+ and Mental Health

Research provides evidence that sexual minorities, such as most queer adolescents, experience increased rates of cyberbullying and victimization (Luk et al. 2018). Luk and colleagues (2018) used data from the NEXT Generation Study and applied latent growth models to examine depressive symptoms in sexual orientation disparities of 17 to 21-year-old adolescents. The results reveal that sexual minorities experience higher rates of low family satisfaction and cyberbullying victimization, associated with an increase in depressive symptoms. Luk et al. (2018) propose that minority stress theory explains the higher risk

of mental health problems among LGBTQ+ youth because they face higher rates of societal stigmatization and prejudice. Luk and colleagues (2018) findings support the assumptions of the minority stress theory, which argues that in addition to generalized life stressors (e.g., economic, familial, or state of health), minorities (including sexual orientation) experience higher rates of stigmatization, which can lead to adverse mental health outcomes during adolescence that may continue to affect youth as they grow into adulthood (Meyer 2003).

Moreover, studies have shown that the online experience is essential to queer people, especially sexual minorities, who use social media to manage self-identity and disclosure (McConnell, Neray, Hogan, Korpak, Clifford, and Birkett 2018). Observed online patterns of self- identifying queer people, and interviews that focused on individuals' social media habits, the authors found that LGBTQ+ clustered in High Overall Outness had the most connectivity among online networks such as Facebook and Twitter (McConnell et al. 2018). These findings further promote the idea that queer individuals obtain social capital and emotional investment through social media networks (Cseri and Talmud 2015).

Gay Men, Grindr, & Mental Health

Research on gay men using the app Grindr provides evidence that Grindr negatively affects users' self-esteem and mental health (Conner 2018). One of the most common types of toxic behavior found on Grindr is the presentation of users online in the form of hegemonic masculinity. Hegemonic masculinity refers to traditionally performed masculinity with an emphasis on domination while deprecating femininity (Miller 2018). User identity is a huge aspect of Grindr as users want to optimize their profiles to best fit in with a socially acceptable image that will generate the most traffic. By self-performing their identity online, users are often stating explicitly racist and discriminatory profile descriptions to filter traffic that may be undesirable (Jaspal 2017). Thus, understanding the relationship between gay men using Grindr and mental health is important because research in this area remains understudied (Connor 2018).

Current Study

This current study aims to empirically examine the use of Grindr and its effects on gay men's mental wellbeing. The main research question asks: To what extent does the daily use of Grindr affects symptoms of anxiety and depression among gay men?

According to recent studies, we propose that most gay men who frequently use Grindr will show depressive symptoms, similar to social media sites like Facebook and Twitter (Connor 2018). In line with recent studies, we assume that Grindr use leads to a change in self-perception, producing mostly negative self-feelings. Using objective self-awareness theory and the social comparison approach (Pantic 2016, Bergagna and Tartaglia 2018), we expect that gay men who unsuccessfully self-perform (and do not attract profile traffic) are at a higher risk of depressive symptoms and overall poor mental health (Conner 2019).

Methods

Method & Sample Data

To study the relationship between the use of Grindr and wellbeing, we use a content analysis approach to examine the twitter responses and communication among users. Specifically, social media

posts were categorized into various types of self-reflecting behavior. One advantage of applying a content analysis is the non-invasive nature of the approach, compared to online questionnaires. Based on the current study's explorative nature, we opted for a content analysis to answer our research question. Table 1 and the Appendix provide information about the coding matrix and final coding choices applied in this study.

Using Twitter as the primary source of data, 50 social media posts (tweets) were recorded through Twitter's search engine using keywords Grindr and toxic. Also, a sub-sample of 25 tweets was recorded using the words Grindr and self-esteem. Tweets are not confined to one single category, and they may include multiple codes. For example, a tweet from a user can express that they acknowledge toxic behavior but also acknowledge negative self-feelings due to Grindr use. Therefore, that tweet would be coded as acknowledging toxic behavior (code: ATB) and acknowledging negative feelings (code: ANF). However, sample 2 tweets were only recorded using the ANF code and the APF code (acknowledging positive feelings).

Using the data of samples 1 & 2, the aim was to measure negative self-feelings and toxicity compared to positive self-feelings (see also Appendix for code sheets 1 & 2, including the twitter responses and codes used in the analysis).

Measures

For this study, the key measures are toxic behavior and self-feelings. Toxic behavior is defined as engaging in social behaviors on Grindr that produce negative outcomes for oneself and/or others (i.e., verbal abuse, discrimination, self-harm, low-self- esteem, etc.).

The measure of self-feelings reflects a person's emotions on a spectrum, ranging from positive to negative self-feelings. In this study, negative self-feelings are defined as personal feelings that diminish one's self-worth and self-esteem, leading to depressive symptoms, anxiety, sadness, and anger stemming from the use of Grindr. In comparison, positive self- feelings will show users expressing confidence, empowerment, and high self-esteem through Grindr use.

Results

In the data we collected, we focus on establishing a connection between self-feelings (positive or negative) and toxic behavior. Each tweet recorded was clustered into one or a combination of five different categories (see Table 1 adapted from Luk et al. 2018, Shensa 2014).

Five categories have been established to examine the relationship between user's self-feelings and toxic behavior. The categories are as follows: (1) Acknowledging Toxic Behavior (ATB) - The social media post acknowledges that toxic behavior is a current problem on Grindr, gathered from their own experiences and/or observations; (2) Self-Performing Toxicity (SPT) - The social media posts show the user expresses active participation in toxic behavior on Grindr; (3) Acknowledging Positive Self-Feelings (APF) - The social media post by the user acknowledges they have experienced or are currently experiencing positive self-feelings based on their activity on Grindr; 4) Acknowledging Negative Self-Feelings (ANF) - The social media post by the user acknowledges they have experienced or are currently experiencing negative self-feelings based on their activity on

Grindr; and (5) ***Neutral (N)*** - The social media post shows the user has a neutral opinion on Grindr.

Table 1 summarizes the five developed codes applied in the analysis.

TABLE 1. Summary of Coding Scheme

Description	Code
Acknowledging Toxic Behavior	ATB
Self-Performing Toxicity	SPT
Acknowledging Negative Self Feelings	ANF
Acknowledging Positive Self Feelings	APF
Neutral	N

Note: Coding Scheme adapted from Luk et al. (2018).

TABLE 2. Tweet Sample #1 Using *Grindr* and *Toxic* Keyword Search

Description	Code	Total N observed	Total %
Acknowledging Toxic Behavior	ATB	22	44.0
Self-Performing Toxicity	SPT	0	.00
Acknowledging Positive Self Feelings	APF	0	.00
Acknowledging Negative Self Feelings	ANF	0	.00
Neutral	N	1	.02
Interactions			
Acknowledging Toxic Behavior + Self-Performing Toxicity	ATB + SPT	17	34.0
Acknowledging Toxic Behavior + Acknowledging Negative Self Feelings	ATB + ANF	9	18.0
Self-Performing Toxicity + Acknowledging Negative Self Feelings	SPT + ANF	0	.00
Acknowledging Toxic Behavior + Self-Performing Toxicity + Acknowledging Negative Self Feelings	ATB + SPT + ANF	1	.02
Total		**50**	**100.0%**

Note: Coding Scheme adapted from Luk et al. (2018).

Of the 50 tweets in Sample 1, 96.2% of all tweets were ATB (see Table 2). 34% of users acknowledged toxic behavior while expressing their desire or encouragement to participate in toxic behavior on Grindr. A lower 18% of ATB tweets also expressed negative feelings (i.e., low self-worth, low self-esteem, negative body image). Most tweets (other than the ATB cluster) were assigned a combination of codes, with a low percentage in tweets being assigned a unique code. The majority of tweets had a negative perspective, many of them citing specific toxic behaviors such as ignorance towards HIV status, sexual racism, hypermasculinity, and negative stimulus towards body expectations. Many tweets also expressed deleting Grindr because of the toxic culture it curates. There was a higher percentage of ATB tweets that also expressed SPT (34%) than users of ANF (18%). Based on these results, we propose that 44% of users who solely acknowledged toxic behavior (ATB) have also experienced negative self-feelings from using Grindr. These findings raise a new question for future research, if users know and understand that Grindr curates a toxic environment, then why do people actively contribute to it with their own toxic behavior? We could deduce that this behavior is learned through chronic use of Grindr, implying that negative self-feelings push people to acclimate to Grindr's toxic environment to better a user's chances of increased profile traffic (which in turn will produce positive self-feelings).

TABLE 3. Tweet Sample #2 Using *Grindr* and *Self Esteem* Keyword Search

	Total N observed	Total %
Acknowledging Negative Feelings (ANF)	14	56.0
Acknowledging Positive Feelings (APF)	11	44.0
TOTAL	25	100.0

Sub-sample 2, consisting of 25 tweets (see Table 3), was solely scored on whether the tweets showed users experiencing positive or negative self-feelings from Grindr use. The results do not show much of a difference as there was nearly an equal number of users who expressed positive and negative self-feelings. Slightly more users (56%) experienced negative self-feelings compared to 44% of users who reported positive self-feelings. Many APF tweets shared that they use Grindr to seek physical validation, attention, and a boost of self-esteem. Users who expressed that they have received many personal messages from other users had positive self-feelings towards using Grindr. We can deduce this is because users objectify themselves to mostly positive reinforcement in the form of compliment and increased profile traffic (Pantic 2014). ANF tweets mostly felt that way because other users harshly rejected them.

There were some users, who albeit feeling low self-esteem and low self-worth from Grindr interactions, openly did not comprehend why they continued using Grindr; both APF and ANF tweets were found to seek physical validation on Grindr.

Based on the sample 2 data, we propose that profile traffic on Grindr is based on physical appearance. The goal for users is to receive positive reinforcement from attention and compliments from other users to boost self-esteem and self-worth. This can be explained by a combination of objective self-awareness theory and social comparison (Pantic, 2014; Bergagna and Tartaglia, 2018). For example, self-awareness theory suggests that users always evaluate their self-image, displayed in posting photos of themselves on Grindr in hopes of profile traffic.

At the same time, these users are comparing their photos to other user profiles. Not only is the user objectifying themselves, but they are also trying to anticipate how other users will objectify them, and act accordingly. When a user is rejected by other users (or receives little to no personal messages), it can produce negative self-feelings. Users who receive messages produce positive feelings and an increase in self-esteem and self-worth.

Comparing samples 1 and 2, the results confirm that toxic behavior is rampant in Grindr's community among users who initially use the application to enhance positive self-feeling. However, harsh rejections based on body type, racism, and demeaning sexual interactions between users have created a sense of normality among Grindr's users and hence a toxic environment. Users who do not fit Grindr's community expectations of a desirable user are subjected to maltreatment, which typically results in negative feelings of one's self. At the same time, the percentage of users who do fit the Grindr's mold of being a desirable user (conventionally attractive, physically fit, and masculine) reaps the most benefits – generating positive self-feelings from using Grindr.

Conclusion

The main aim of this study was to examine the relationship between Grindr use and mental health. We found that there is a consensus among the social media community that Grindr curates a toxic environment. Although users acknowledged toxic behavior occurring, most expressed continuing using Grindr to seek physical validation, regardless of potential adverse effects on self-perception. There was a slightly higher percentage of users experiencing negative self-feelings than users who experienced positive self-feelings. We presume that users objectify themselves while socially comparing their online presence to others in an attempt to gather information (Pantic 2014, Bergagna and Tartaglia 2018). Users utilize this information in order to self-perform online to increase profile traffic (Connor 2018). Users who do not receive validation experienced negative self-feelings when subjected to harsh rejections, discrimination, or prejudice. We propose that these negative self-feelings are reinforced by users socially comparing themselves to others. Once they realize that they do not meet Grindr's expectations of being desirable users, negative self-feelings intensify.

There are a couple of limitations that should be acknowledged. First, this research aimed to specifically focus on the population of gay men. All tweets recorded on Twitter were assumed to be by gay men. Although Grindr is marketed as a dating app for gay men, it is a free app that anyone can use. Second, for this study, we observed Grindr's public perceptions through tweets on Twitter; we were only able to record what users self-reported online. There was only a small percentage of users (18%) with ATB tweets that also acknowledged negative self-feelings. We assume that users might not express negative self-feelings stemming from Grindr for fear of a negative response or backlash from peers -due to a societal expectation of using Grindr in a toxic way.

Despite these limitations, it is important to research further the underlying mechanisms between Grindr and user's mental health. Moreover, examining the relationship between social media networks, other minority groups and mental wellbeing will not only further the collection of empirical data but also allow us to better understand how social media shape our social functioning.

In the case of sexual minorities, it is especially important to investigate how social networks allow sexual minorities to express themselves and connect with others online. This research could pave the way for future studies to examine apps like Grindr so that a new dating app for sexual minorities could be created with safety and mental health at the forefront of its user interface. Because gay men and the queer community are still discriminated against in public spaces, sexual minorities use online spaces in order to connect with others. Using data from this study and studies beyond, we may be able to prevent future queer dating apps from breeding toxicity online.

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APPENDIX

A. Sample 1: Eight Coding Matrix Examples

Single User	Tweet	Supplemental Material	Description	Code
1	the thought of being on grindr past the age of 26 id rather d1e		Acknowledging Toxic Behavior	ATB
2	Grindr is so toxic (unamused face emoji) I'll give it another week (neutral face emoji)		Acknowledging Toxic Behavior, Self-Performing Toxicity	ATB, SPT
3	Grindr is so fucking toxic		Acknowledging Toxic Behavior,	ATB
5	Grindr culture is toxic and honey... I'm also toxic.		Acknowledging Toxic Behavior, Self-Performing Toxicity	ATB, SPT
7	It does sound like it's increasingly toxic. Although me and the husband met on Grindr so (oh well emoji)		Neutral	N
8	@Grindr convo I had just now... Yes, you should know your status, and that also means you should know about #HIV and know the toxic and wrong ways to talk about your status. Regardless of status, people with HIV are NOT dirty. They are beautiful and matter!	picture of grindr conversation	Acknowledging Toxic Behavior	ATB
12	should i process my emotions in a healthy way tonight by writing a poem or should i be toxic & chat up some bottoms on Grindr with no intention to meet up		Acknowledging Toxic Behavior, Self-Performing Toxicity	ATB, SPT
13	I've just seen a tweet about someone sharing their experience of sexual racism on grindr and you have gays commenting saying " this is why I hate Grindr" yes grindr is toxic but Grindr is not the issue because even if grindr wasn't a thing it would still be problem		Acknowledging Toxic Behavior	ATB

B. Sample 2: Eight Coding Matrix Examples

Single User	Tweet	Supplemental Material	Description	Code
1	I talked to a guy on Grindr and went to his house. He said I was better looking in photos and called me an Uber (at least was honest). Goodbye Grindr, scruff & Tindr. Time to heal and rebuild my long gone self-esteem.		Acknowledging Negative Self Feelings	ANF
3	Remembering my grindr days and how I never want my self-esteem to be that low ever again		Acknowledging Negative Self Feelings	ANF
4	this dude told me i look worse than my grindr pic... self esteem -100		Acknowledging Negative Self Feelings	ANF
5	I joined Grindr for the compliments to boost my self esteem. I stayed for the head.		Acknowledging Positive Self Feelings	APF
6	good morning ladies and gents, woke up with 60 messages on grindr and my self esteem is thru the roof (happy face emojix2)		Acknowledging Positive Self Feelings	APF
11	A man wasted my time so if you see me on grindr this week know that I am suffering from low self esteem		Acknowledging Negative Self Feelings	ANF
12	getting grindr is really good for your self esteem as a trans guy, just saying (oh well emoji)		Acknowledging Positive Self Feelings	APF
15	Grindr is so bad for my self esteem lmao why do I still have it		Acknowledging Negative Self Feelings	ANF

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Efficacy of Aerosol AmBisome for treating Murine Pulmonary Aspergillosis

Background Information

Aspergillus spp. is a medically and industrially important fungal genus. This genus exists in many environments ranging from the soil and air of the outdoors to inanimate surfaces, food, water, air, and organic matter in the indoors (Paulussen et al., 2016). The genus produces asexual conidia, commonly referred to as spores. These spores are very tolerant of stressful environmental conditions such as desiccation and mechanical trauma (Stevenson et al., 2015), and when the environment is more stable, they can also reproduce by forming sexual ascospores (Wyatt et al., 2015).

Within the Aspergillus genus there are hundreds of species, though only a few are responsible for having harmful effects on human and animal health. Among these are Aspergillus fumigatus, Aspergillus flavus, Aspergillus niger, Aspergillus terreus, and Aspergillus nidulans (Baddley et al., 2001; Perfect et al., 2001; Enoch et al., 2006; Gupta et al., 2015). A. fumigatus is responsible for nearly 90% of the infections, including invasive pulmonary aspergillosis (IPA), followed in frequency by A. flavus and A. niger (Lass-Flörl et al., 2005; Balajee et al., 2009a,b).

IPA is most prevalent in immunocompromised individuals, with a 50-90% mortality rate without treatment and a 50% mortality rate even with present treatment, indicating the need for improved therapy (Dagenais et al. 2009; Shaunak et al., 2015). Even more concerning, the rates of IPA have increased dramatically in recent years with the expanding use of immunosuppressive agents used for transplantation and cancer chemotherapy (Paulussen et al, 2016). The present treatment options include intravenous amphotericin B based formulations. Such polyene classes of antifungal therapy provide effective performance as a broad-spectrum option with concentration-dependent and dose-dependent pharmacodynamics in a variety of animal models, as well as well-documented clinical success (Groll et al, 2019). Among the options is intravenous AmBisome® (AmBi), a potent, antifungal, liposomal formulation of amphotericin B, which is used as first-line therapy for IPA given its significantly reduced toxicity compared to the other amphotericin B formulations (Patterson et al., 2016). AmBi's significantly reduced toxicity has made it more tolerated by the body than other amphotericin B based treatment options (Patterson et al., 2016).

To further reduce any possible systemic toxicities of AmBi, other routes of administration have been investigated. Preclinical studies using AmBi as an aerosol, rather than as an intravenous treatment, have shown its potential for treating IPA in immunosuppressed mice (Dave et al., 2019). When tested in a clinical study, it was found that patients experienced no adverse events due to inhalation of AmBi (Rijinders et al., 2015). It has been hypothesized that aerosol AmBi administration may be more effective than its intravenous administration in treating pulmonary fungal infections as it allows the drug to concentrate in the lungs, at the primary site of the pulmonary infection, and minimize its distribution into the kidneys and liver (Schiller, 2015).

We have recently completed a series of novel studies investigating the use of AmBi as an aerosol compared to intravenous delivery. Our laboratory has reported that aerosol delivery of AmBi achieved antifungal lung drug concentrations effective against IPA in immunosuppressed mice when the causative pathogen was A. fumigatus (ATCC strain #13073) (Dave et al., 2019). After comparing the efficacy of 5 daily IV doses with 5 daily 10 or 20 minute aerosol doses or 5 intermittent aerosol treatments, it was found that lung fungal burden was significantly lower with 20 minute daily aerosol treatments compared to the other treatments. This study also showed that AmBi given intravenously resulted in higher concentrations of drug in the kidneys, liver, spleen, and lungs versus aerosol delivery, and the efficacy of aerosol AmBi based on increased survival and reduction in lung fungal burden was significantly better than when the drug was given by the intravenous route.

Although aerosol AmBi in this mouse model of IPA, using this particular strain of A. fumigatus, is effective, multiple strains of A. fumigatus as well as other species of Aspergillus, need to be tested in this same murine model to determine if it can be used more widely since the strain of fungus that can cause the infection varies greatly from city to city and country to country. Data from the published literature has reported significant differences in virulence of different strains of A. fumigatus and differing responses to anti-fungal drugs by other Aspergillus spp. (Latgé, 1999). The focus of the present studies will be to determine if aerosol AmBi delivery alone, or in combination with IV AmBi, can be used to treat IPA caused by different strains of A. fumigatus and different Aspergillus species.

Research Question

How effective is aerosolized AmBisome, alone or in combination with IV AmBisome, in treating IPA infections caused by Aspergillus fumigatus strains V029 and V080?

Methods

In this study, 8-9 week old Swiss-Webster mice were injected intraperitoneally with the steroidal immunosuppressant, triamcinolone acetonide, and were subsequently inoculated intranasally with 3.2x107 spores in a 30 uL volume of strain V029 or 2.1x107 spores in a 30 uL volume of strain V080 of Aspergillus fumigatus. Mice being tested for each strain were then separated into 5 groups (N=12/group), and received AmBi treatments corresponding to the following Table:

Group/Strain (V029 or V080)	Treatment (IV AmBi 7.5mg/kg/dose and Aerosol AmBi with 1.33mg/mL)
1	Aerosol AmBi 5 daily doses, 20min each, beginning 4h post-challenge
2	Aerosol AmBi 5 daily doses, 20min each, beginning 8h post-challenge
3	Aerosol AmBi 5 daily doses Beginning 8h post-challenge + IV AmBi at 12h, 36h, 60h post-challenge (Combination therapy)
4	IV AmBi at 12h, 36h, 60h post-challenge
5	IV Buffer (PBS) 5 daily doses beginning 4h post-challenge

Table 1

Twenty-four hours after the final treatment, 5 mice from each group were sacrificed by carbon dioxide asphyxiation. The sacrifice group of mice had their blood, lungs, livers, kidneys, spleens and BAL collected for future fungal burden analysis using a quantitative Sabouraud'sagar plating method and future tissue amphotericin B drug concentrations assessed using a bioassay (ug/g of tissue), with Candida albicans as the indicator organism, as described by Olson et al. (2006). The remaining 7 mice in each group were monitored for survival and morbidity for 21days following the fungal challenge.

Preliminary Results

Preliminary results from this study showed that strains V029 and V080 of A. fumigatus differ in their responses to AmBi treatment, though Aero AmBi was effective in significantly reducing the infection regardless of which strain was used. In the experiment with the V029 strain, the combination therapy approach (aerosol AmBisome + intravenous AmBisome) resulted in the highest survival (100%), the fullest weight recovery, and the lowest disease scores than any other treatment option for this strain. In the experiment with the V080 strain, the aerosol monotherapy AmBisome treatment beginning 4 hours post-challenge was the best with 100% survival, the most weight recovery, and the lowest disease scores.

Figure 1a. Survival of Mice Infected with *A. fumigatus* Strain V029

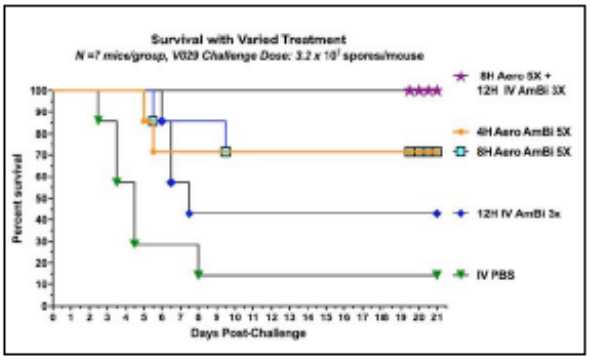


Figure 1b. Survival of Mice Infected with *A. fumigatus* Strain V080

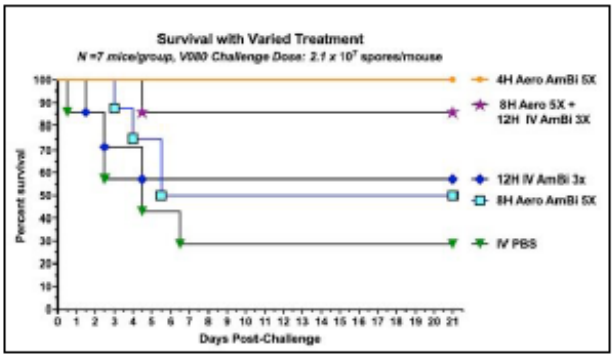


Figure 2a. Weight Loss of Mice Infected with *A. fumigatus* Strain V029

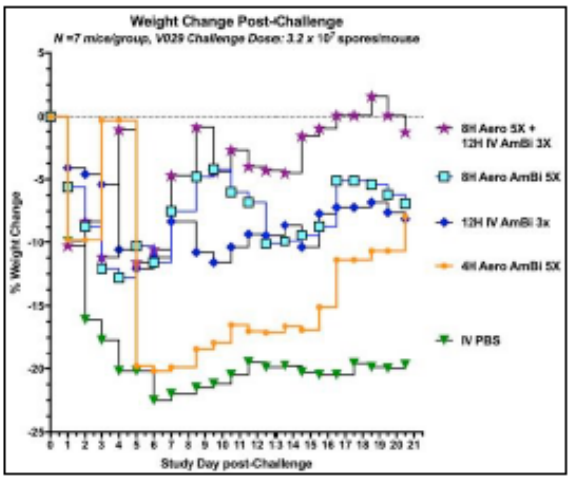


Figure 2b. Weight Loss of Mice Infected with *A. fumigatus* Strain V080

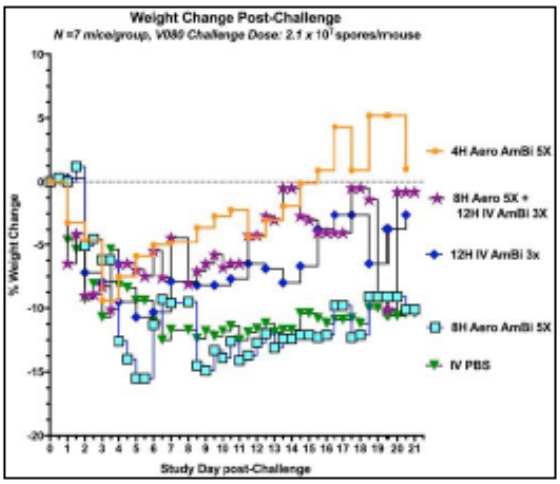


Figure 3a. Disease Scores of Mice Infected with *A. fumigatus* Strain V029

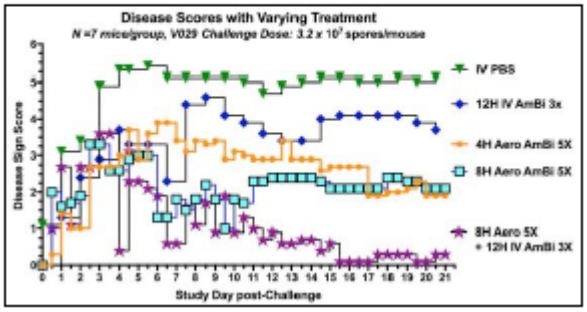
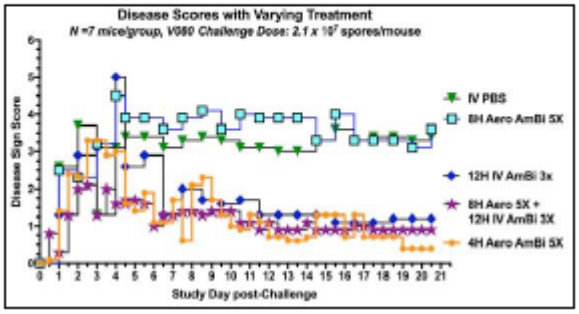


Figure 3b. Disease Scores of Mice Infected with *A. fumigatus* Strain V080



Discussion

The results of these experiments provide additional evidence that there is a difference in virulence, or severity of a disease, between strains of A. fumigatus, as predicted by Latgé in 1999. The results of this study indicate that A. fumigatus strain V029 is more virulent than strain V080 as there was greater mouse mortality with the V029 strain than the V080 strain. In addition, the V080 strain was effectively eradicated with either therapy options, 4H aerosol AmBi monotherapy or Combination therapy, whereas the V029 required the Combination therapy. Since patients can be infected with any strain of A. fumigatus and the particular strain is not identified during clinical diagnosis, having a therapeutic approach that appears to work with different strains, provides an important clinical advantage.

Survival rates of mice in these experiments suggest that the combination therapy (aerosol AmBisome + intravenous AmBisome) was successful for both strains V029 and V080 of A. fumigatus. This approach – which tackles Invasive Pulmonary Aspergillosis (IPA) infection in the lungs (via aerosol AmBi) and systemic IPA (via IV AmBi) – is the most effective treatment in the V029 strain of A. fumigatus, resulting in highest survival (100%). In V080, however, combination therapy is an alternative treatment option to 4H aerosol monotherapy (100% survival), and it also achieves high survival (~85%) in our murine models. This experiment with the V080 strain suggests that if aerosol AmBi monotherapy, beginning 4 hours after infection, is instead delayed an additional 4 hours and also supplemented with an IV injection of AmBi, then survival will remain high. This option is useful because it is difficult to predict when an infection has taken place and how long afterwards treatment is initiated, which is simulated by a delayed treatment option. It is also useful because knowledge of which species or strain caused the IPA infection is often unknown at diagnosis, but if a broad range of IPA-inducing species and strains are effectively eradicated with combination therapy or aerosol monotherapy, then there is an opportunity to revise the way we approach treatment of IPA.

Future Studies

There is still much left to be explored about how AmBisome® can be utilized in improving treatment therapies, including aerosol monotherapy and aerosol-intravenous combination therapy and how effective these treatment options are against Invasive Pulmonary Aspergillosis (IPA) caused by various species and strains of Aspergillus spp. Short-term future studies will include determining both the fungal burden as well as the organ drug concentrations f AmBisome in the hearts, lungs, livers, kidneys, and spleens of mice that we have already infected with A. fumigatus strains V029 and V080. All of these organs will be examined since we know that the drug distributes throughout the body and

the infection can penetrate into many different organs once it gets established.

Immunohistochemistry in which antibodies to the drug are incubated with tissue samples of treated and infected tissue can be used to help determine the localization of the drug within these organs and in which cells they are residing. This will guide us in our understanding of how using different AmBisome treatment options will affect the drug's interaction at the tissue and cell level. Several other studies need to be done to examine how effective these various treatment options will be when the causative agents are from other spp. or strains of Aspergillus since the causative agent of IPA varies throughout the world and is often not known at the time of diagnosis of IPA. By exploring how effective these treatment options are against a broad assortment of species and strains of Aspergillus, the data will help guide the development of clinical trials using these treatments.

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Water Quality of Thompson Creek Watershed (TCW), San Gabriel Mountains, CA.

Introduction

Between the Angeles National Forest and the San Gabriel Mountains, the area of field investigation, Thompson Creek Watershed (TCW), is found cutting through Cobal Canyon in Claremont, California. TCW is located about 12 miles north east from Cal Poly Pomona and about 50 miles east from the Pacific Ocean.

The water that flows through TCW ultimately ends in the Thompson Creek Dam, which received 27.43 inches of rain from October 2018 to August 2019. The water is stored in the Thompson Creek Dam before it percolates and recharges the Canyon Basin. Canyon Basin is a part of a larger aquifer, the Six Basins Aquifer, and the Six Basins Aquifer is responsible for providing drinking water to the local surrounding cities such as Claremont, La Verne, Pomona, Upland, and other surrounding cities (Brethorst, Nicholas). Alongside TCW is a popular 5-mile hiking trail, known as "The Loop," in the Claremont Hills Wilderness Park. This area is known of by locals and travelers alike due to its quick escape from the suburban areas. This trail has become an area of recreation and a meeting point for families, friends, including pets. While there is heavy foot traffic, it is not uncommon to see wildlife along the watershed; deer, snakes, rabbits, squirrels, and coyotes are a few examples that can be seen there on any given day.

Despite this water being consumed by local communities, being a part of a recreational area, and being habitat for wildlife, there is little available public information on the quality of this water.

Geology

When analyzing the quality of water, it is important to take into consideration the types of rock material surrounding the area. Whichever types of rock units the water may come into contact with or interact with in the subsurface may play a role in any source of contamination. TCW predominantly has metamorphic and sedimentary deposits. The San Gabriel Mountains are known for having mineable deposits; however, since the 1980s, there has been a decrease in mining activity due to stricter Environmental Protection Agency (EPA) regulations.

Looking at Figure 2, the rock units found near TCW are msg, gr, and Qoa. The northernmost parts of the stream are composed of msg, which is "mica schist to gneiss, dark grey, fine grained, foliated, composed of biotite mica, quartz, feldspar; includes calc-silicate layers with sillimanite, garnet" (Dibblee and Minch). Intertwined with the msg, gr can be found. The unit gr is "granitic rocks, grey-white to tan-white, hard but brittle, fine to medium grained, massive to rarely gnessoid, composed essentially of sodic plagioclase feldspar, K-spar, and quartz in nearly equal proportions, and minor amounts of biotite mica or minute flakes" (Dibblee and Minch). Intruding into areas of msg, Qoa can be found which is "low remnant of elevated alluvial gravel" (Dibblee and Minch).

The surface sediments in Cobal Canyon are often saturated and remains saturated into the dry season. Given that there are impermeable rock units in TCW, looking at the groundwater depth in Figure 3 we can infer that “infiltrating water apparently accumulates as perched groundwater on the impervious bedrock surface interpreted to exist at shallow depth” (Davis, James F.).

Methods

From February 2019 to July 2019 we collected a total of 24 water samples. In February, we had six different sample locations; in July we had one sample location due to lack of rainfall and temperature increases. We took note of the change in volume of water throughout the stream as we transitioned from wet to dry season to observe any seasonal changes in the concentrations of given elements. We also made note that half of the site locations were collected from spring locations and the remaining half were collected from areas along the stream. We collected three water samples at each site location to be tested for alkalinity, anions, cations, and metals. The samples were analyzed at two different universities: Cal Poly Pomona and University of California, Riverside (UCR). At Cal Poly Pomona, alkalinity and anions were measured by titration and use of the Ion Chromatography (IC) Machine, respectively. At UCR, the samples were measured for cations and metals. We analyzed the samples with these given parameters to understand where the water is coming from, whether it is groundwater or surface water, and to measure and ensure elements are within the Environmental Protection Agency (EPA) Standards.

Measurements

We compared the data from our samples with the EPA primary and secondary drinking water standards to ensure that the quality of the water in TCW is safe enough for human consumption. Primary drinking standards are mandatory and enforced water quality standards that protect the public from contaminants. Secondary drinking standards are not mandatory nor enforceable; however, these standards are recommended for color, odor, and taste of the water.

The elements looked at for the scope of this project are alkalinity, fluoride, iron, pH, nitrate, and sulfate. These elements give a broad sense of what type of water is in the area and how the water is reacting with the rock material. Alkalinity from the samples ranged from 17.5 mg/L to 327.5 mg/L. Fluoride has an EPA primary standard of 4.0 mg/L and the samples ranged from 0.1543mg/L to 2.2762 mg/L, within the mandatory limits. Iron has an EPA secondary standard of 0.3 mg/L however most site locations were above this standard, the highest recorded concentration being 4.745 mg/L. The pH has a secondary standard ranging from 6.5 to 8.5 and the samples collected ranged from 7.04 to 8.28, within the recommended limits. Nitrate has an EPA secondary standard of 45 mg/L and the samples ranged from non-detect to 21.8855 mg/L. Sulfate has an EPA secondary standard of 250 mg/L and the samples ranged from 1.917 mg/L to 503.792.

Discussion

Alkalinity

Measurements of alkalinity are important in regard to water quality assessments because it can give you an idea of where the water is coming from. The longer amount of time water has had to react with the minerals in rocks or the subsurface, typically the water will have a higher alkalinity concentration. Rainwater will typically have a lower alkalinity concentration, less than 50 mg/L, because it has had less time to interact with the rock material.

Looking at Graph 1, most of the values are above 50 mg/L which suggests that the samples collected are predominantly groundwater. As we exited the wet season and entered the dry season, there is a definite linear feature that shows the water increases in alkalinity as temperatures increase. This observation suggests that TCW is a gaining stream and there is groundwater seeping into the channel at various locations. This data is consistent with the data mentioned earlier suggesting that groundwater is perched above the impermeable rock units.

Fluoride

Measurements of fluoride are important to analyze in water quality assessments because not only is it a plausible health concern if the concentrations are above a given value, but also because "fluoride forms strong solute complexes with many cations, and some fairly common mineral species of low solubility contain fluoride" (Hem, John D.).

Looking at Graph 2, the concentrations are within the EPA primary drinking water standards. At this given time, fluoride concentrations are not of concern for the quality of TCW.

Iron and pH

Evaluating iron is important because iron is the second most abundant metallic element in Earth's crust that can alter the quality of water. Two influences on how iron reacts within a system is low pH levels (usually less than a pH of 5) and redox conditions (Hem, John D.).

The graph shows the levels of iron are greatly above the EPA secondary drinking water standard. For the most part, the site locations follow the same trend; however, the site 3 location shows much greater concentrations. When looking at the pH in Graph 4, all of the samples fall within the recommended range, although site 3 is one of the more acidic in relation to the other sites. In absolute terms, site 3 has a pH of about 7.4, so we can infer that the dissolved iron is not affected by the pH but rather another source. As discussed in alkalinity, the water in TCW is predominantly groundwater. Groundwater typically has reducing conditions because dissolved oxygen has been consumed; "If no dissolved oxygen is present, the water is "anoxic", but there are other chemical species—nitrate, manganese, iron, sulfate, and carbon dioxide, in that order—that can accept electrons in oxygen's place" (Rosecrans, C.Z. et al).

Since site 3 is well above the standard in comparison to the other sites, we can assume the contaminant source is nearby. The likely source is the rock material surrounding this specific location, possibly due to the mineable deposits. For this project, various other metals were also analyzed; however, iron was the only metal that resulted in high concentrations, all other metals were either non-detect or below the standard.

Because iron is considered a secondary drinking water standard, these levels do not pose any threat to humans through consumption; however, these values are still to be taken into consideration when reviewing the overall quality of the water in TCW.

Nitrate

Nitrate levels in water are “strongly influenced by the vital importance of the element in plant and animal nutrition” (Hem, John D.). If the results were to show high levels of nitrate, assumptions can be made that human interference could be the source of the contamination. Graph 5 shows that the nitrate levels in TCW are below the secondary drinking water standard and are decreasing as the dry season continues. In comparison to iron levels, looking at the data of site 3 in Graph 5 there are very low concentrations of nitrate. This suggests that the nitrate is being reduced to another form of nitrogen, through a process known as denitrification, that was not analyzed for the scope of this project. The data for nitrate also shows consistency with iron that the concentrations are affected by the reducing conditions.

Sulfate

Sulfur levels are important to take into consideration when looking at a water quality assessment because it is “related strongly to redox properties of aqueous systems” (Hem, John D.). Sulfur in its reduced form becomes very soluble with most metals; a common metal that greatly influences the geochemistry of sulfur is iron (Hem, John D.). Look at Graph 6, almost all site locations are below the secondary drinking water standard. The exception being site 3 and as fore mentioned, site 3 also had the highest levels of iron. When comparing the Graphs 3 and 6, an inverse relationship can be seen. When the sulfate levels are high, the iron levels are lower, and vice versa. The source of the two elements may be from pyrite crystals that are commonly found in sedimentary rocks. Pyrite is “commonly associated with biogenic deposits such as coal, which were formed under strongly reducing conditions” which is consistent with the knowledge of mineable deposits in the area as well as having reducing conditions in the groundwater (Hem, John D.).

Conclusion

The water that flows through TCW is vital for the local communities, is a part of a popular recreational area, and is home to habitat in the foothills of the San Gabriel Mountains. Limited public information was available to understand the quality of this water; thus, this research project was conducted. 24 water samples were collected and sampled for alkalinity, anions, cations, and metals and much information was produced. From the data, we were able to understand that the water in TCW is predominantly groundwater and has reducing conditions that affect certain chemical elements-iron, nitrate and sulfate-that are dissolved in the water. Overall, the quality of the water in TCW is safe for human consumption, the likely sources of contamination in this area are due from the rock material that interacts with the water. Further investigation should be conducted to observe the rock units that attribute to the contamination, as well as ensuring the quality of the water is maintained.

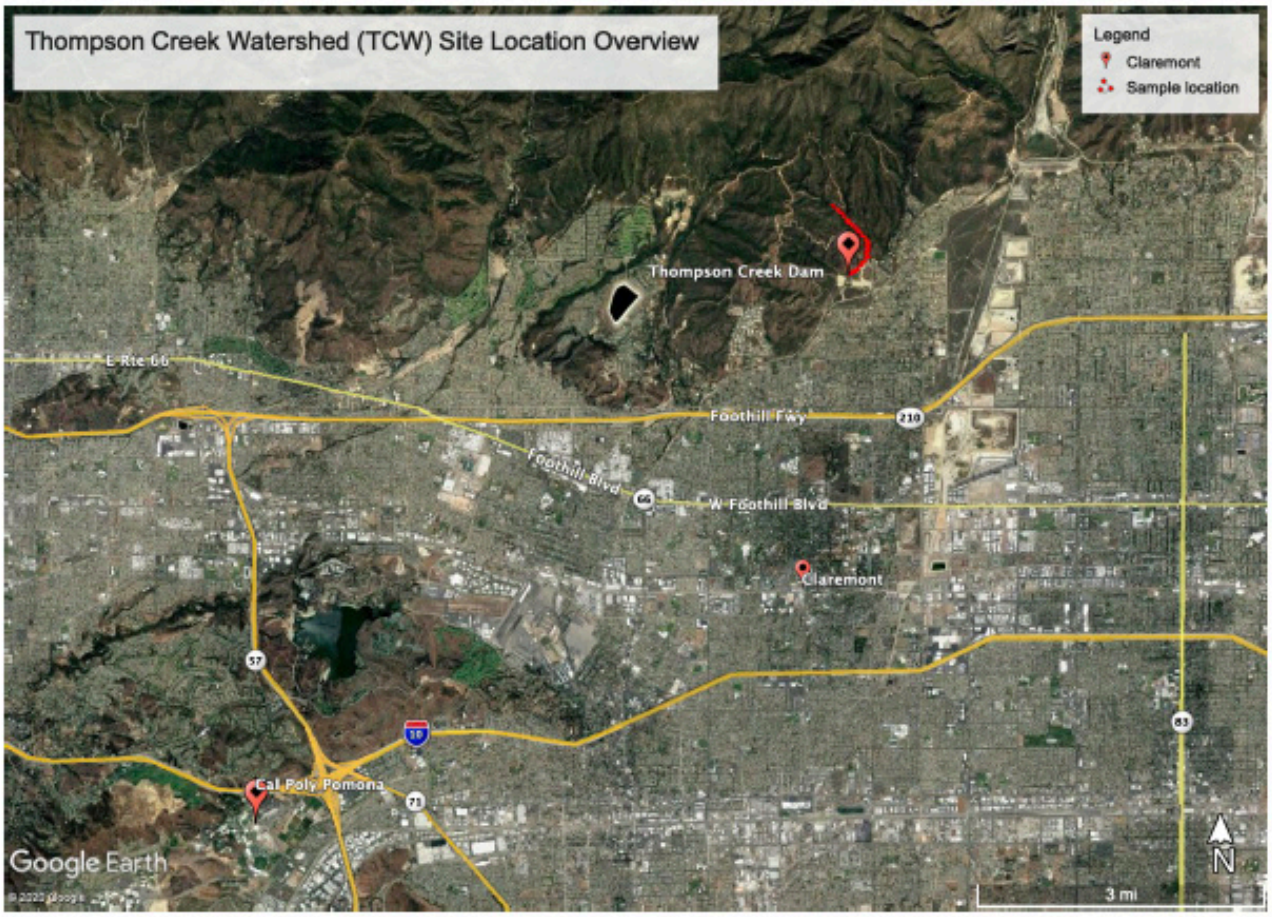


Figure 1: TCW is outlined in red to show relative location in relation to the City of Claremont and Cal Poly Pomona.

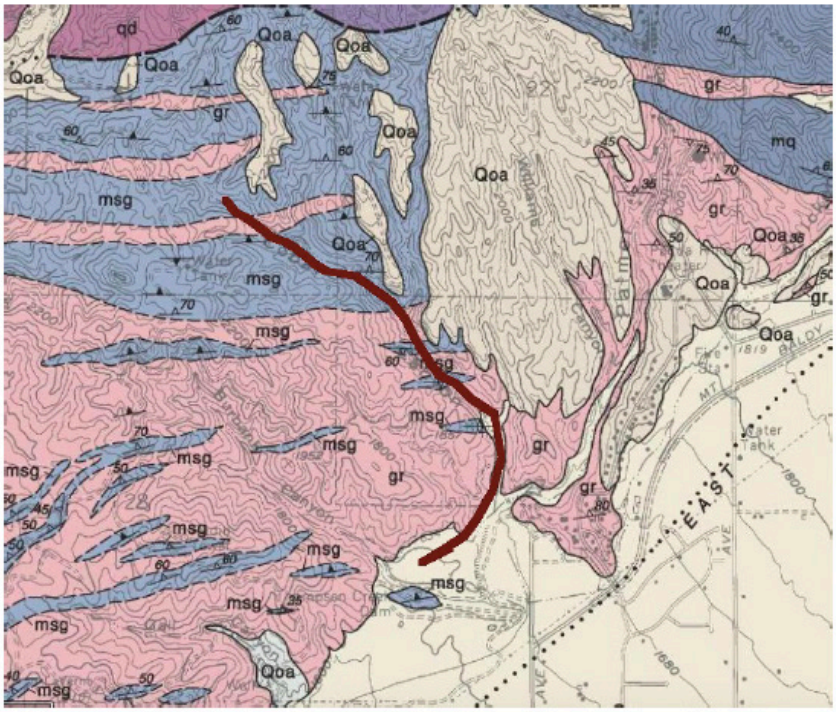


Figure 2: TCW is outlined in red and cuts through rock units msg, gr, and Qo as shown in the map provided by USGS (Dibblee and Minch).

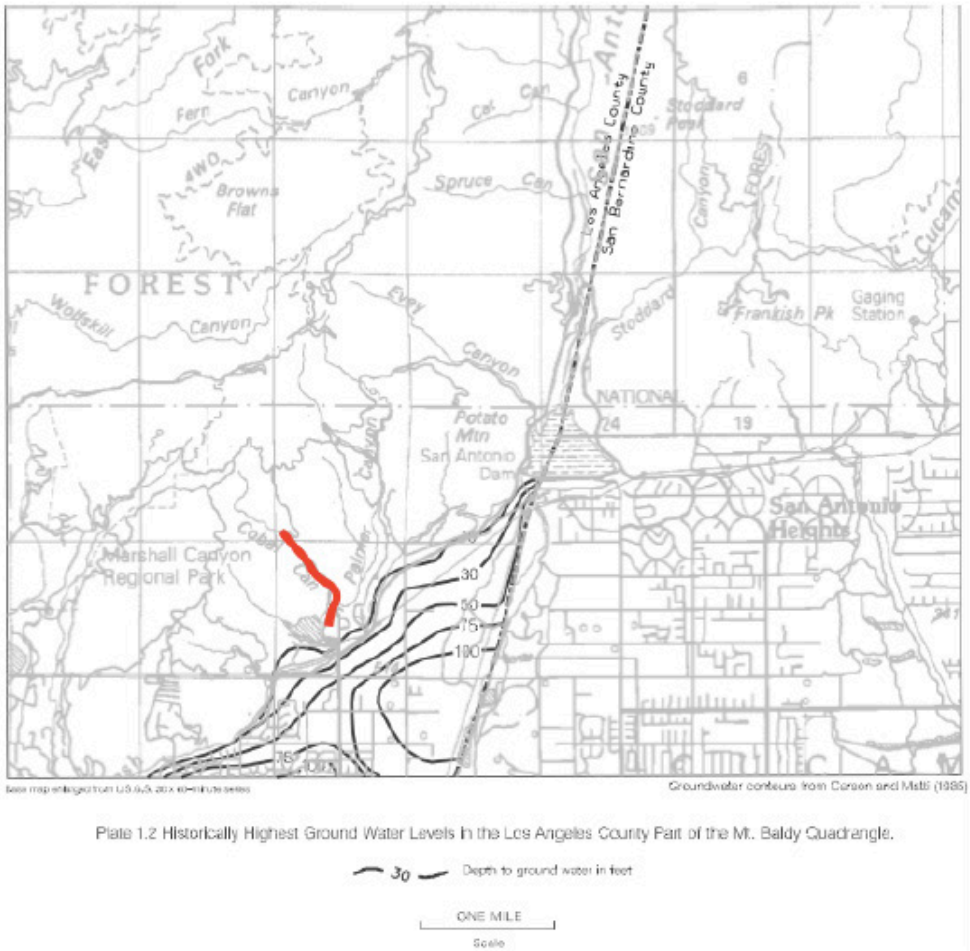
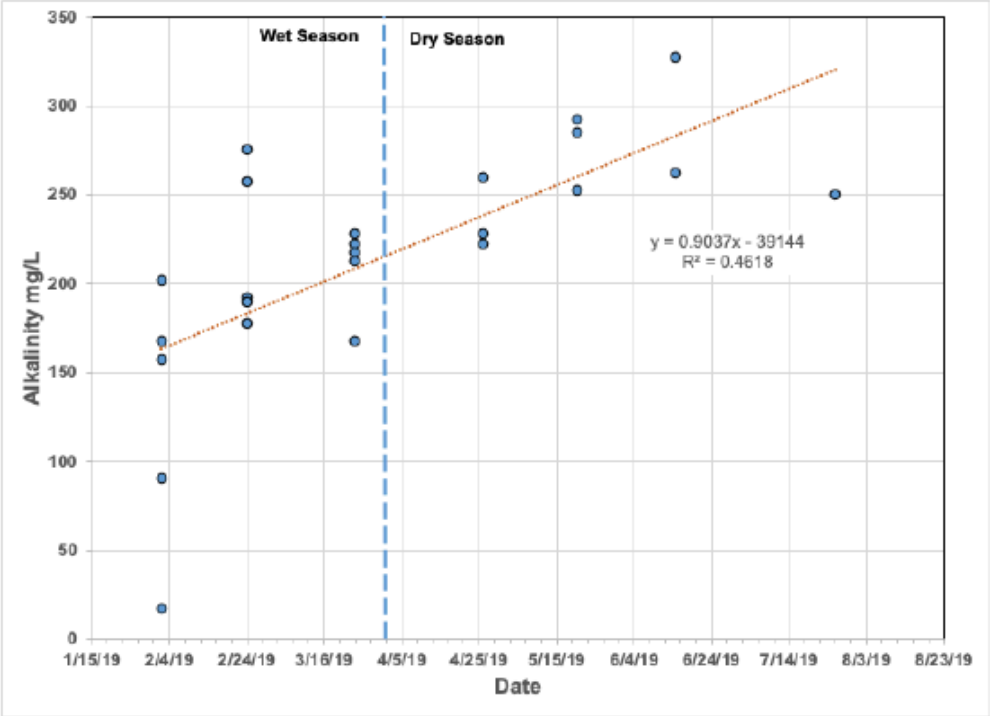
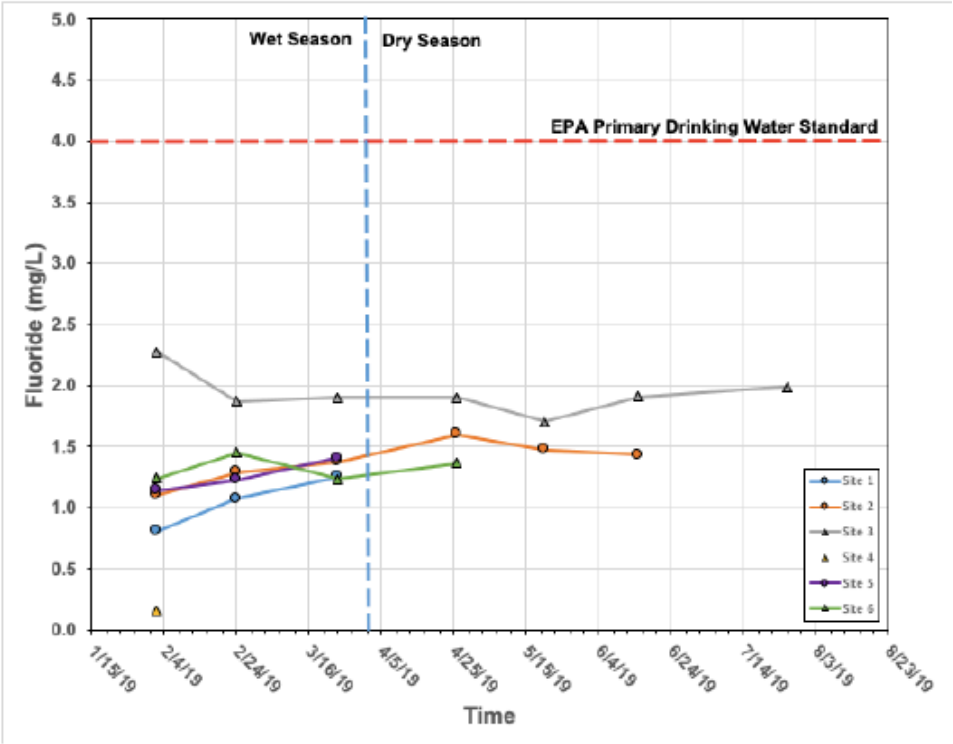


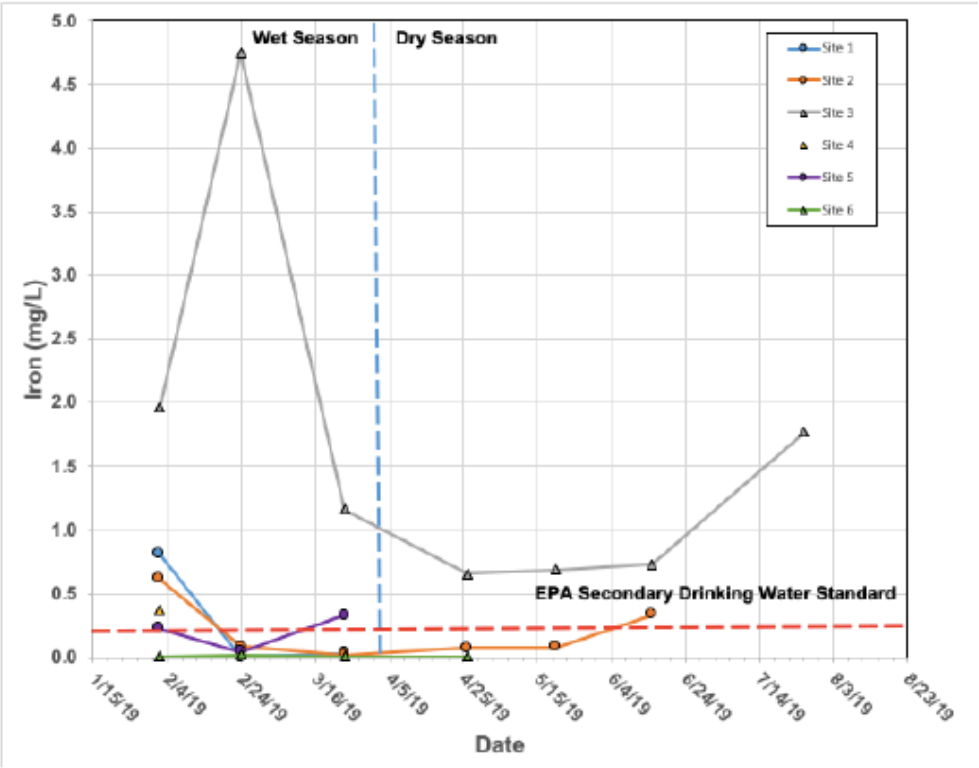
Figure 3: TCW is outlined in red and groundwater contours are shown in black (Carson and Matti).



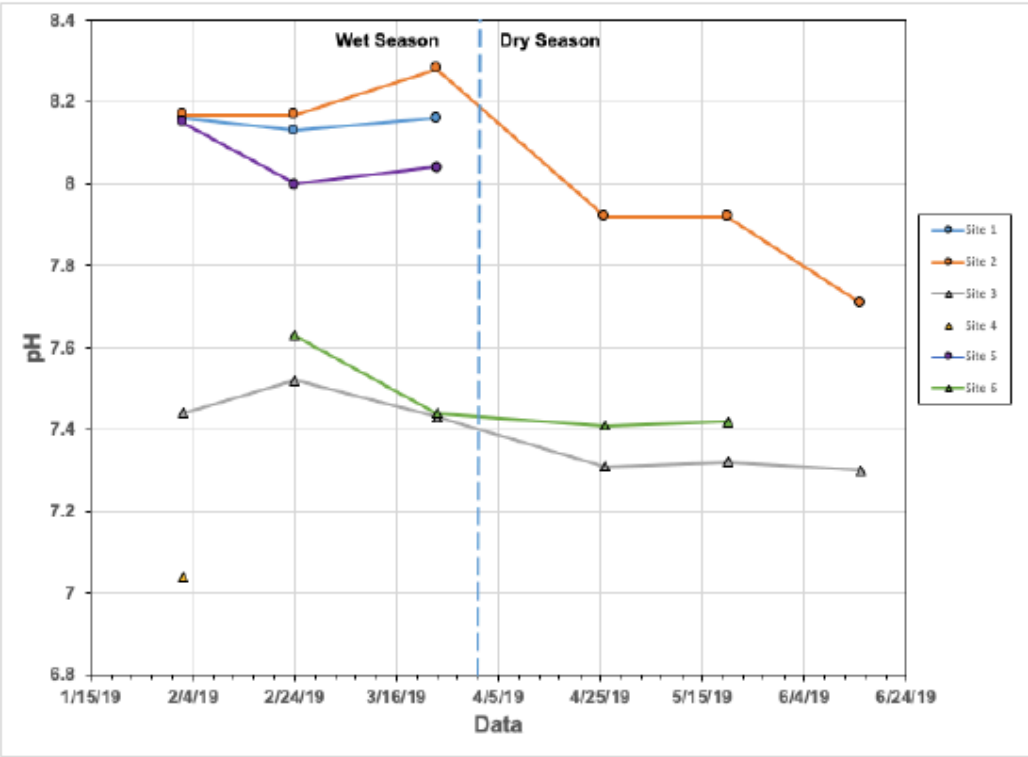
Graph 1: Alkalinity vs Time. The blue line depicts an arbitrary boundary of wet versus dry season based upon looking at precipitation data.



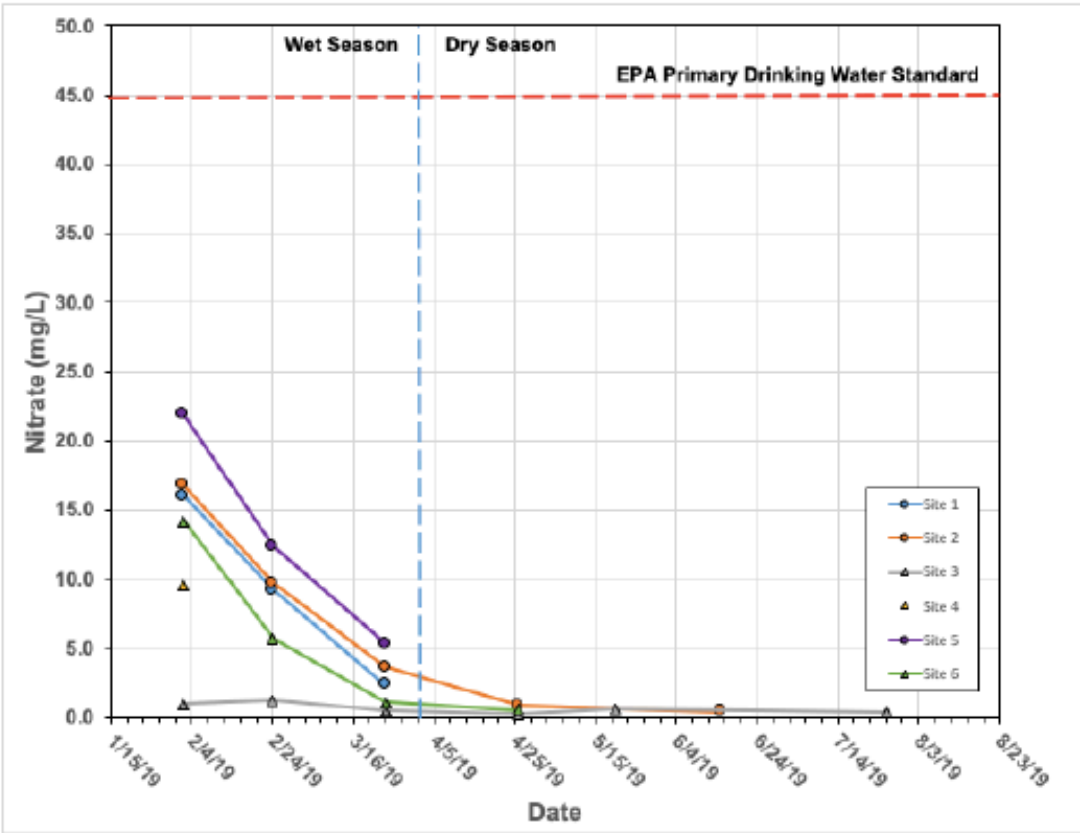
Graph 2: Fluoride vs Time. Graph depicts the wet and dry season boundary as well as the uppermost limit for the EPA Primary Drinking Water Standard.



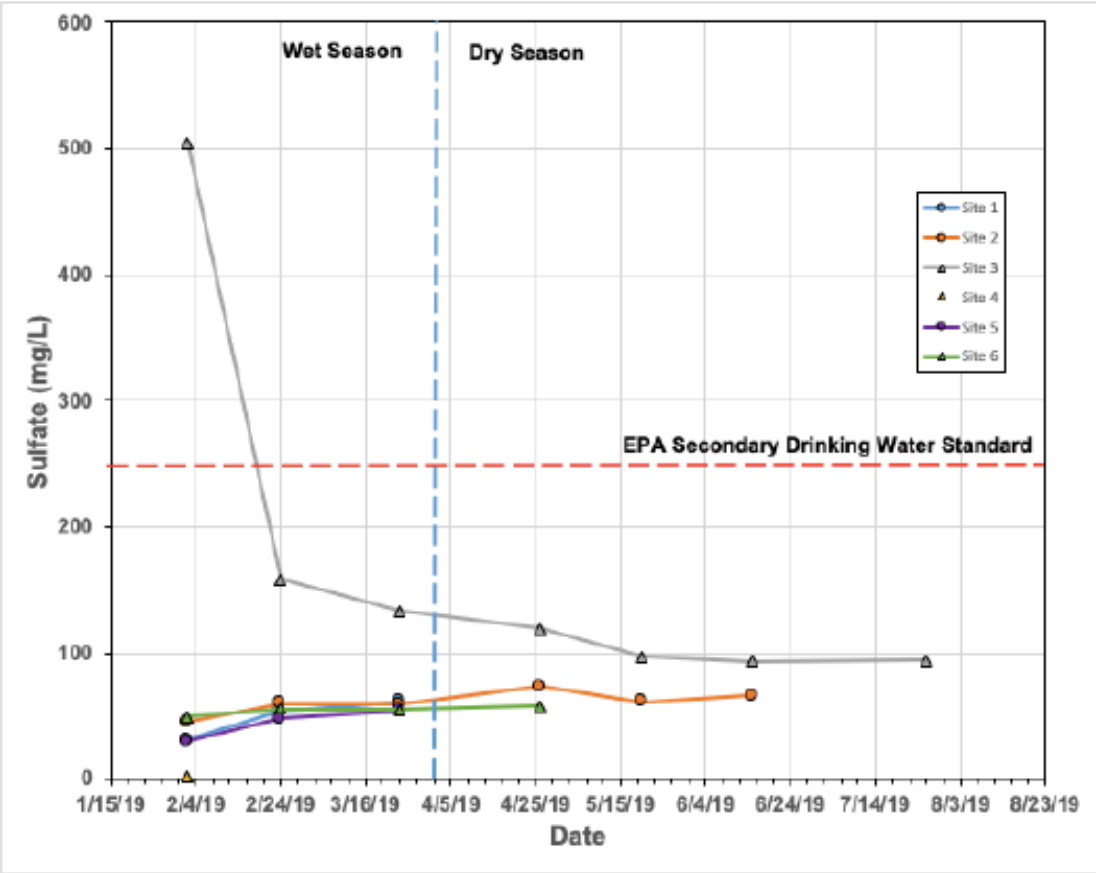
Graph 3: Iron vs Time. All site locations relatively follow the same trend through the transition of wet to dry season. The site 3 location has much greater concentrations than all other sampling sites.



Graph 4: pH vs Time. All samples have a pH value within the recommended range.



Graph 5: Nitrate vs Time. Nitrate levels are decreasing as the dry season continues. This likely results from the reducing conditions of the water in TCW.



Graph 6: Sulfate vs Time. The site 3 location shows consistency in assumption that the water conditions are reducing.

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An Empirical Analysis Based on Studies of Funding Structure of 50 Fintech Companies

Abstract

Crowdfunding is a collaborative process of a group of people who use their money in common to support efforts of business organizations using internet sites and online sources. As a disruptive force of the post-financial crisis banking sectors, the world's leading fintech are increasingly using crowdfunding to cement and enhance their businesses. Some theories suggest the low-interest nature of crowdfunding minimize risks of investment and incentivizes higher returns. In this paper, by statistically analyzing business models of top 50 Fintech companies with biggest revenue amounts, the relationship between fintech companies and funding process will be better identified. Moreover, this paper further examines each Fintech sector for consumers and explores the correlation between targeted consumer groups and Fintech funding models. By using a simple regression analysis, the purpose of this paper is to better clarify the intertwined relationship among Fintech business models, funding sources, and revenues.

Keywords: Fintech, Crowdfunding, Venture Capital, Initial Coin Offerings.

Introduction

The growth of financial technology (fintech) has mainly driven by the 2008 Financial Crisis and technology advancements. In 2008, the Lehman Brother crisis developed a lack of trust in the banking industry. Therefore, many fintech companies began to generate with more regulations in supervision and consumer protections. In addition, series of technologies such as machine learning, artificial intelligence, big data, blockchain, and cloud computing have made people's lives more convenient with online banking and mobile payment services. Many banks are using AI to get better, real-time understands of their markets and operational risks. The unprecedented rise of fintech has made cryptocurrency and P2P lending possible which enabled companies to raise funds through initial coin offering and digital crowdfunding. Since most fintech companies are recent start-ups, little is known about their own funding sources. As a result, this research will classify and investigate various funding sources. By focusing on a list of 50 most innovative Fintech companies from Forbes 2019 and each of their business model and funding source, this paper will present how fintech start-ups raise funds.

Funding Sources

Venture capital funding is usually for start-up companies with little trading history and their key assets are not tangible.[1] An initial investment by a venture capital fund is called a "series A investment" where the fund seeks a minority stake in the company and receives preferred shares in the company, as well as additional protections under an investment agreement.[2] Venture capitalists are most likely to put their money into firms with high potentials. They would then possess a bundle a right to govern the corporation, along with residual claims

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[1]Funding your FinTech. (2016, September). Retrieved from TalorWessing: https://www.taylorwessing.com/download/article-funding-your-fintech.html
[2] See id

on its assets in proportion to the number of shares they own. The company then could charge its customers, pay its employees and distribute the leftovers to its shareholders.

Traditional capital markets require business owners to contractually divest themselves of various rights over their corporation's assets. [3] In contrast, the ICO method can leave economic ownership and legal control unencumbered.[4] Traditional capital-market transactions are heavily mediated by laws, regulations, contracts, and social norms. [5]ICO transactions augment, and perhaps replace, those mediators by embedding controls within the smart contracts through which rules function.[6]

Angel investment, also known as seed funding or angel funding, refer to funding below $1 million. 7 For this reason, seed rounds for high-tech startups usually do not see angel rounds since large VCs (venture capital firms) tend to offer capital well into the millions of dollars to promising high-tech firms. A company will hit the Series A stage when VC funding falls between roughly $2 million to $10 million. [8]

Crowdfunding is a form of fundraising where groups of people make typically small individual contributions through Internet platforms, to support a particular goal. [9] It could be categorized as donation-based, reward-based, lending-based or equity funding. [10]

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[3] See, e.g., Ivo Welch, Corporate Finance 4–5 (4th ed. 2017) (discussing tradeoffs between various contractual methods of financing).
[4] Balaji S. Srinivasan, Thoughts on Tokens, Earn.com (May 27, 2017), https://news.earn.com/thoughts-on-tokens-436109aabcbe
[5] See, e.g., David Singh Grewal, Laws of Capitalism, 128 Harv. L. Rev. 626, 652 (2014) (reviewing Thomas Piketty, Capital in the Twenty-First Century (2014)) ("Capitalism is fundamentally a legal ordering: the bargains at the heart of capitalism are products of law."); Katherina Pistor, A Legal Theory of Finance, 41 J. Comp. Econ. 315, 315 (2013) ("[L]aw and finance are locked into a dynamic process in which the rules that establish the game are continuously challenged by new contractual devices, which in turn seek legal vindication.").
[6] See, e.g., Julie E. Cohen, Pervasively Distributed Copyright Enforcement, 95 Geo. L.J. 1, 2 (2006) (discussing this in the context of copyright enforcement).
[7] What's the Difference Between Angel, Series A and B Rounds of Funding? (n.d.). Retrieved from LawTrades: https://www.lawtrades.com/answers/difference-between-angel-series-funding/
[8] See id.
[9] Schwienbacher A., and Larralde B., 2010. "Crowdfunding of small entrepreneurial ventures" in D.J. Cumming, ed. The Oxford Handbook of Entrepreneurial Finance. Oxford: Oxford University Press
[10] Adhami, Saman and Gianfrate, Gianfranco and Johan, Sofia A., Risks and Returns in Crowdlending (March 3, 2019). https://ssrn.com/abstract=3345874

Historically, crowdfunding has evolved from a way to finance creative projects, which has the potential to dramatically change the venture capital ecosystem. [11] Crowdfunding makes it possible for early-stage start-up companies to raise 'venture capital' from a large group of individuals, sidestepping the traditional fundraising process that includes lengthy due diligence periods and tough negotiations over the pre-money valuation and contractual terms. [12]

Growth equity is somewhere between venture capital and private equity. With a company's revenue range from $5 to $50 million. [13] In the U.S, recent examples of growth equity investment in Fintech include DST Global's lead investment into Chime Bank, Goldman Sachs Principal Strategic Investments' lead investment into Nav Technologies, and Edison Partners' lead investment into YieldStreet.[14]

Funding Sources

This research is based on the Forbes 2019 of 50 most innovative fintech list. We used fintech companies's funding sources as dependent variable. Other factors such as fintech industrial sectors, business revenue, founding years and geographical locations as independent variables. According to the Forbes 50 most inovotive fintech lists, companies are most companies are established after 2008. Due to the different regulations in each state, most companies are located as it is displayed in figure 1.2. Out of six different fintech sectors, figure 1.3 illustates that payment and personal finance sectors funded the most money. Some prestigeous companies in these sectors are Chime, Brexm Plaid and Stripe.

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[1]Funding your FinTech. (2016, September). Retrieved from TalorWessing: https://www.taylorwessing.com/download/article-funding-your-fintech.html

[2] See id

[11] Fenwick, Mark and McCahery, Joseph A. and Vermeulen, Erik P.M., Fintech and the Financing of Entrepreneurs: From Crowdfunding to Marketplace Lending (September 12, 2017). TILEC Discussion Paper No. 2017-25; ECGI - Law Working Paper No. 369/2017; Lex Research Topics in Corporate Law & Economics Working Paper No.20173. http://dx.doi.org/10.2139/ssrn.2967891

[12] See id.

[13] What's the Difference Between Angel, Series A and B Rounds of Funding? (n.d.). Retrieved from LawTrades: https://www.lawtrades.com/answers/difference-between-angel-series-funding/

[14] Cardenas, J. (2019, April 12). Growth Private Equity Investment in the Fintech Sector. Retrieved from American Bar Association: https://businesslawtoday.org/2019/04/growth-private-equity-investment-fintech-sector/#_edn1

Figure 1.1:

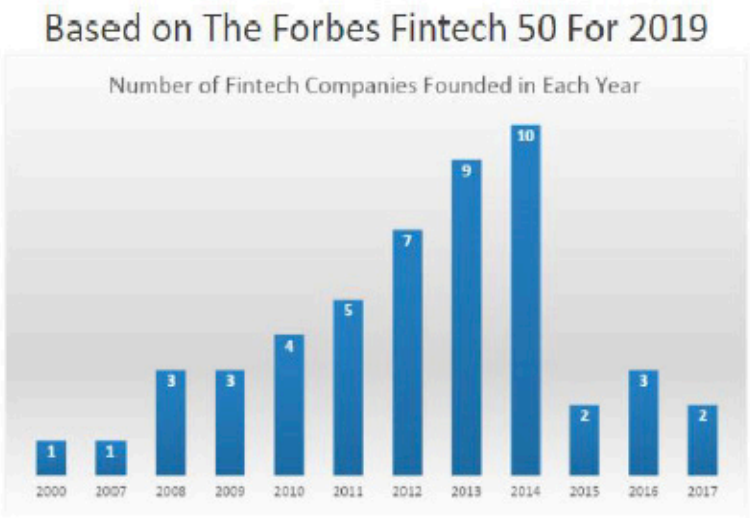
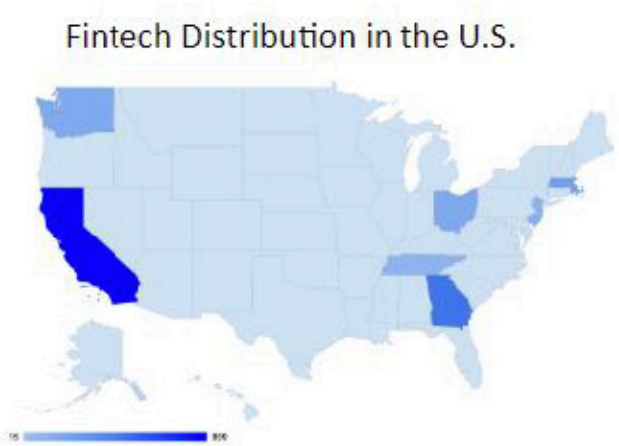


Figure 1.2:



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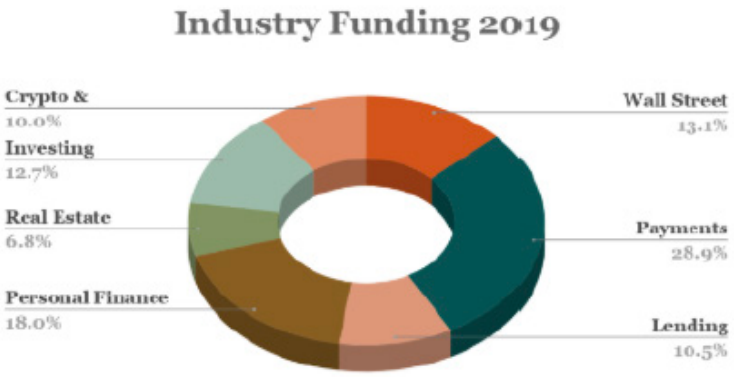

Figure 1.4:

Acorns	257 M	Irvine, CA	PayPal, NBCUniversal, BlackRock **(VC)**
Addepar	240 M	Mountain View, CA	8VC, Valor Equity Partners **(Last stage venture, PE-Secondary Market)**
Affirm	450 M	SF, CA	Founders Fund, GIC, Khosla Ventures, Lightspeed Venture Partners, Spark Capital, Thrive Capital. **(Debt financing, VC)**
Axoni	59 M	NY, NY	Citi, Goldman Sachs, JP Morgan, NYCA, Andreessen Horowitz **(VC)**
Ayasdi	106 M	Menlo Park CA	Kleiner Perkins, Khosla Ventures, Citi Ventures **(VC)**
Behavox	15 M	NY, NY	Index Ventures, Hoxton Ventures, Citigroup **(VC)**
Betterment	275 M	NY, NY	Kinnevik, Bessemer Venture Partners, Menlo Ventures
Bitfury	150 M	Amsterdam, Netherlands	**(VC)**
Blend	160 M	SF, CA	**(VC)**
Bolt	20 M	SF, CA	Founders Fund, Intuit **(VC)**
Brex	315 M	SF, CA	Y Combinator Continuity **(Debt financing)**, Kleiner Perkins **(VC)** DST Global
Cadre	133 M	NY, NY	Silver Lake, CapitalG, Tiger Global Management Andreessen Horowitz **(VC)**, Ford Foundation, Goldman Sachs **(Series C)**
Carta	148 M	Palo Alto, CA	Spark Capital, Tribe Capital, Meritech **(VC)**
Chime	105 M	SF, CA	DST Global **(PE)**, General Atlantic **(PE)**, ICONIQ. **(Series E)**
Circle	246 M	Boston, MA	IDG Capital, Bitmain, Breyer Capital, Goldman Sachs **(VC, Secondary Market)**
Coinbase	525 M	SF, CA	Andreessen Horowitz, Tiger Global Management, Union Square Ventures **(VC, Secondary Market)**
Credit Karma	869 M	SF, CA	Silver Lake, CapitalG **(PE)**, Tiger Global
			Management. **(Secondary Market)**
Cross River	128 M	Fort Lee, NJ	KKR, Andreessen Horowitz, CreditEase, LionTree Partners **(VC)**
Digital Reasoning	110 M	Nashville, Tennessee	Goldman Sachs, BNP, Nasdaq **(VC)**
Earnin	190 M	Palo Alto, CA	Ribbit Capital, Matrix Partners, Andreessen Horowitz, DST Global **(VC)**
Enigma	130 M	NY, NY	New Enterprise Associates, Two Sigma Ventures, American Express **(VC)**
Even	51 M	Oakland, CA	Khosla Ventures, Valar Ventures **(VC)**
Flywire	142 M	Boston, MA	Bain Capital Ventures, Fidelity's F-Prime Capital, Spark Capital **(VC)**
Forter	100 M	NY, NY	Sequoia Capital, Scale Venture Partners, March Capital **(VC)**
Fundrise	59 M	Washington, US	Renren, Guggenheim Partners. **(Equity Crowdfunding)**
Gemini		NY, NY	
Guideline	59 M	San Mateo, CA	Tiger Global Management, Felicis Ventures, Propel Venture Partners and Lerer Hippeau **(VC)**
iCapital Network	80 M	NY, NY	Credit Suisse, BlackRock, Morgan Stanley, UBS, BNY Mellon **(Corporate round) (VC)**
IEX Group	100 M	NY, NY	Franklin Templeton, Spark Capital **(VC)**
Kabbage	489 M	Atlanta, Georgia	SoftBank Vision Fund, BlueRun Ventures, Mohr Davidow Ventures **(Debt Financing, VC)**
Lemonade	180 M	NY, NY	SoftBank, Allianz, Sequoia and Aleph **(Secondary market)**
LendingHome	166 M	SF, CA	Foundation Capital, Ribbit Capital **(VC)**
Marqeta	116 M	Oakland, CA	Visa, 83 North, Coatue Management **(VC)**
Nova Credit	20 M	SF, CA	**(VC)**
Opendoor	1000 M	SF, CA	Khosla Ventures, SoftBank, General Atlantic **(VC)**
Personal Capital	225 M	Redwood City, CA	IGM Financial **(VC)**
Plaid	310 M	SF, CA	Andreessen Horowitz, Kleiner Perkins, NEA **(VC)**
Poynt	132 M	Palo Alto, CA	Matrix partners **(PE)**, Oak HC/FT, GV **(VC), (Secondary Market)**
Remitly	175 M	Seattle, Washington	Naspers' PayU, Bezos Expeditions, Stripes Group **(VC)**
Ripple	94 M	SF, CA	Accenture, Andreessen Horowitz, Google Ventures **(VC)**
Robinhood	539 M	Menlo Park, CA	NEA, Index, Thrive Capital, Sequoia, Kleiner Perkins **(VC)**
Roofstock	75 M	Oakland, CA	Bain Capital Ventures, Lightspeed Venture Partners, SVB Capital **(VC)**
Root Insurance	178 M	Columbus, Ohio	Coatue, DST Global, Tiger Global Management **(VC)**
Stash	117 M	NY, NY	Breyer Capital, Coatue Management, Union Square Ventures **(VC)**
Stripe	685 M	SF, CA	Sequoia Capital, General Catalyst, Visa **(VC)**
Symphony	300 M	NY, NY	**(VC)**
Tala	105 M	Santa Monica, CA	RPS Ventures, IVP, Revolution Growth **(VC)**
Toast	248 M	Boston, MA	CV, Tiger Global Management, Bessemer Venture Partners **(VC)**
Tradeshift	400 M	SF, CA	Goldman Sachs, Public Sector Pension Investment Board, HSBC **(VC)**
TransferWise	397 M	London, United Kingdom	Sir Richard Branson, IVP, Andreessen Horowitz **(VC) (Secondary Market)**

Results

By performing a basic categorization and a basic statistical analysis. Figure 1.4 displays the funding source each fintech company have used. It is clear that most fintech companies choose venture capital as their fund sources. Many have partnered with TigerGlobal, Kleiner Perkins, Khosla Ventures and Goldman Sachs to raise their funds. Out of the Forbes 50 companies; 3 companies used Private Equity, 1 used Secondary Market, 1 used Equity Crowding funding and the rest 45 companies all used Venture Capital (VC). It is quite interesting to see that most of these fintech companies are favoring VC as their funding sources.

Conclusion

This research shows that Fintech companies does not purely depend on Crowdfunding and there is little correlation between the fund raised and the industrial sectors. It suggests that most of these Fintech companies It also implies that Fintech falls into standard start-up type in the eyes of investors. Results in this research give business students and faculties a better understanding on fintech companies’ business models and different funding sources. There is no doubt that technological advances are reshaping financial services. Block-chain, artificial intelligence and machine learning are making people’s lives more convenient.

Appendices

Figure 2.2: Business Model for Avant

Key Partners	Key Activities	Value Proposition	Competition	Customer Segments
August Capital General Atlantic QED Investors RRE Ventures WebBank	Launch new products such as secured lending and deposits.	Focuses on lower the costs and barriers of borrowing for everyday people	Lending Club Prosper	Middle-income borrowers. 18 or older.
	Key Resources: Albert Goldstein Adam Hughes Karolina Andrix Grant Miles James Paris Ryan McLennan Shyama Rose		**Distribution Channels:** Direct-Funding or Balance-Sheet Model WebBank	

Services	Revenue Streams
Personal Loans and Credit Card	Personal Loans product and Credit Card product.

Figure 2.3: Business Model for Affirm

Key Partners	Key Activities	Service	Competition	Customer Segments
Walmart Cross River Bank Shopify Oracle Commerce Celery Miva	Launched mobile app. Accept Apple Pay and Google Pay	Consumers can use Affirm to pay for purchases of any amount up to $15,000 at over 2,000 merchants including well-known brands across retail like home furnishings, travel, personal fitness, electronics, apparel and beauty, and more.	Klarna Earnest	Young people, millenial and Gen Z People who are new to credit. Does not have enough credit line for a purchase.
	Key Resources Max Levchin Christa Quarles Silvija Martincevic Greg Fisher		**Distribution Channels** Point-of-sale financing.	

Value Proposition	Revenue Streams
Transparent, Flexible, Fair	Equity funding and Series G

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A Case for Reforming Structural Linguistic Biases: Gender in English[1]

Abstract

Expressions can carry problematic hidden implications. I argue that the hidden implications that are deeply embedded in language are most problematic because they are frequently used and the harmful effects are not easily recognized. Specifically, by looking at why expressions of gendered language are problematic, as they (i) are difficult to find and address in everyday language, (ii) may act as a vehicle for dog-whistling, (iii) violate the privacy of the person being mentioned by disclosing their gender, and (iv) lead to confusion and exclusion. After discussing the problems, I argue for specific approaches in reforming language that should be applied in structural and individual ways. I further develop arguments for addressing other types of hidden implications embedded in language outside of gender in English. Lastly, I consider the strongest objections to my view, namely, the concern with gender expression through language, and prioritizing other forms of reform.

My name does not clearly indicate my gender, consequently, I have been misgendered many times. What I have noticed about the pattern of how people go about assuming the gender of a person named "Marmar" is heavily based on the social position they believe Marmar to be holding. For example, when I am the supervisor at a job or in a leadership position, or purchasing a car and requesting detailed information on the car, or talking about philosophy, I often get referred to with language that indicates that people think that I am a man. In contrast, when I am asking for a recipe on an online forum, or talking about anger as a pragmatic and important public emotion, (Flanagan and Cherry 2017) the language used to describe me reveals the assumptions that I am a woman.

The effects of language on structural oppression may not be as readily observable as some other aspects of oppression. Moreover, when compared to the discrimination in the criminal justice system or wealth inequality, language does not seem to carry the same weight in reinforcing oppression. Yet, empirical evidence shows the invasive effects that language can have on cognition, which makes the commitment to reform crucial. In this paper, I will be advocating for a particular type of linguistic reform, the goal of which is to remove expressions embedded in daily language that carry hidden implications, focusing on the use of gendered language in English.

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[1] I am indebted to my faculty readers, Professor Katie Gasdaglis, Professor Peter Ross, and Professor Alex Madva for their countless hours discussing, reading, editing, and suggesting revisions to this essay. For their extensive time offering feedback, reading and suggesting revisions on earlier drafts, engaging in discussions, offering objections and criticism that have substantially shaped this essay, I owe special thanks to Bernard Granados, Jacob Diaz, Fernando Tamayo, Sara Javidinejad, Aaron Paul Sullivan, the Senior Thesis Workshop Group, and the Symposium at the Agora Facebook group.

To begin, I will introduce the ways specific words carry implicit meanings, and draw a possible correlation between how frequently and commonly they are used and how hidden the meanings can be. I will suggest several ways gendered grammar can harm us as agents and as knowers, namely, through sexist implications (1.1), dog-whistling (1.2), privacy violations (1.3), and finally, effects such as confusion and exclusion (1.4). I will then propose approaches to solving this problem. The proposed reform must consider the weight of language on both structures and individuals, as well as the ways reform can lead to backlash. Next, I will expand approaches to linguistic reform outside of the English usage of gendered grammar and briefly discuss the importance of having an approach to reform that is context specific and sensitive to other factors that are closely tied to language use. Finally, I will consider and respond to the strongest objections to the proposal for reforming language to rid of grammatical biases, including the sentiment that gendered grammar is an innocuous and potentially morally valuable form of gender expression for some people marginalized on the basis of gender (e.g., trans and genderqueer people), reform can limit freedom of speech, and the question of whether other forms of reform should be prioritized, given the limited resources present.

Background: Expressions with Hidden Implications

In standard communication, there is an agreement between the speaker and hearer that leads to the possibility of propagandistic manipulation. This type of manipulation occurs when the speaker's expression carries implicit claims that are not factually supported, usually with the aim of modifying what is being communicated in a way that proves to be beneficial to the speaker. Propagandistic manipulation occurs through the act of engaging with the expression, which would imply acceptance of the code words in the expression given by the speaker. Instances of expressions carrying hidden meanings are inevitable in communication. However, Jason Stanley (2017) has developed a criteria for the specific expressions that are problematic in this way. An expression counts as having 'code words' if:
"1) [the] relevant expression convey[s][that] subgroup x [is] not worthy of consideration/respect/empathy,
2) Expression has reasonable content contributing to reasonable debate, which is separate from (1), and,
3) Mere use erodes reasonableness of statement" (Stanley 2017: 130).

These expressions use common ground, contextual background to convey propagandistic messages. Common ground is essentially a (set of) propositions mutually presumed by participants, which may include background issues that have not been decided on. By using common ground that is undecided or even controversial in expressions, the speaker assumes agreement on the implications of the given expression and deprives the hearer of the opportunity to directly engage with the assumptions of the statement. For example, the expression "man up" uses the common ground that men are strong and ought to carry strength, and that a person who is not acting with strength is not embodying what it means to be a man.

While Stanley is primarily focused on the implicit meanings of particular words, terms, or expressions which are not structurally embedded in language, I will focus on the gendered structural/grammatical aspects of language. I will further argue that we ought to stop using such expressions after they have been identified. The most common structural expressions–or expressions embedded in grammatical use in English–can be found in the

use of gendered grammar. Namely, using gendered pronouns (he, she, him, her, etc.) or gendered titles[2] lead to assumptions about a person that are not based on perceived evidence. For example, the expression "she's bossy" implies that women generally carry a domineering attitude when in positions of leadership. The word "bossy" regularly refers to women and mark the gender of the subject of the expression, even without the gendered pronoun. Once such a statement is made, the hearer of the statement has the option of accepting or denying the statement, but is not readily given the option of questioning the common ground that women are bossy leaders. Moreover, even if the hearer is clever enough to regularly pick up on such implications and bring them up, they will be constantly shifting the conversation and making communication difficult. Assuming that such implications in gendered grammar are agreed upon is problematic, since they usually carry sexist ideologies. Structural usage of gendered grammar serves as a constant endorsement of the sexist implications by indirectly taking stereotypes to be common ground in expressions.

The focus of this paper is not to explain and identify expressions with code words or the project of finding a way to address slurs. Rather, it is to address the problem of expressions embedded in language that carry hidden implications. After identifying the features of such expressions, Stanley discusses the consequences of this realization, but does not offer pragmatic solutions that will ensure that the efficiency of communication is preserved, other than suggesting for people to constantly check their own biases (Stanley 2017: 176). After taking a closer look at structures in language that utilize this type of hidden implication, it becomes clear that there is work to be done to shift language use in a way that is not stigmatizing.

Different languages have different structures and content that fall under this structural stigmatization in expressions. The problem being discussed is not the mere existence of implications in language. Instead, it is exploring structural instances where implications are problematic, yet implicit so that they are not directly addressed. Such implications are problematic due to the stigma and the implications they carry with them. This includes feminist and nonsexist persons using gendered grammar with no intention of reinforcing stereotypes. The common usage of gendered grammar makes gender and stereotypes regarding gender more relevant than it is necessary. Even if a person is intending no harm in using gendered grammar, they are reinforcing gender stereotypes. In a more cynical yet realistic case, having gendered grammar allows for dog-whistling and intended implications. This type of propagandistic tactic of using linguistic tools to push a suppressive political or social agenda is especially difficult to fight because of its hidden and implicit nature. However, finding structures embedded within language that allow for such implicit implications can be a means of reform against such tactics. Slurs[3] are known to carry socially problematic implications that are not true, though the

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[2] For example: the terms 'father' and 'mother' have different implications that reflect on broader, more traditional practices of parenthood.

[3] Currently, the predominant project that is engaged with linguistic reform may be the concern regarding slurs. The work being done to better understand slurs is crucial in understanding how language can have serious social implications (e.g., Anderson and Lepore 2013; Jeshion 2013; Camp 2018).

meaning of slurs is not tacit. This paper is similarly concerned with systematically breaking down the false sense of confidence given to expressions that carry hidden implications.

Obvious vs. Obscure Implications

Finding the underlying causes of how much attention is paid to a linguistic expression is an interesting area of current cognitive science research. It is not controversial that we pay more attention to words that seem ambiguous and take for granted words we believe we fully understand: we tend to direct our attention toward the parts of an expression that seem to be the most ambiguous, interesting, or controversial. The discussion between slurs and non-slurs given by Stanley is helpful in pointing out how words that are not explicitly understood to be problematic can have social implications: "everyday discourse involve apparently innocent words that have the feature of slurs, namely, that whenever the words occur in a sentence, they convey the problematic content" (Stanley 2017: 151). Although the project to take away the power of slurs is extremely important, it does not systematically reform language. Unlike slurs, systematic use of gendered pronouns and more general gendered grammar in English are not as likely to be believed to be unproblematic. Stanley's point about the political efficacy of words that are not understood as problematic is crucial in showing that the implications are not being thought about or addressed. By way of illustration, imagine a linear graph where the (x, y) intercepts symbolize (how hidden the implications can be, and the frequency and commonality in usage), with a positive, constant slope can paint a picture of how what we believe to be as innocuous words may carry the most hidden meanings. In other words, the more common and frequent the word is used, the more potential it carries in having hidden implications. It follows that the most dangerous words would be those that are structurally embedded in common grammatical usage. Slurs get the confrontation and attention necessary. Yet, pronouns and other expressions that are embedded within language do not.

An example of the phenomenon of obscure implications can be shown through the common usage of the word 'wife' being vastly different from 'husband'. The associations and implications in the two different words vary dramatically, due to societal norms based on the roles of partners. For example, "my husband is helping with house chores" is not a shocking statement, yet, if the word was swapped with 'wife', the saying would seem odd or sarcastic. Similarities to this stigmatization in gendered terms exist in different domains: with jobs, e.g. 'waitress' and 'waiter', personal relations such as 'mother' and 'father', and even gendered pronouns, i.e. 'she' and 'he' in a more general sense. All of the aforementioned examples are subject to the problems associated with using code words. Even if the terms are not intended to be coded and are meant to be used innocently, they carry stereotypes of gender roles and so can become oppressive through reinforcing stereotypes. This can happen in many ways, the most obvious being false assumptions being made without the realization of the speaker or the hearer.

1 Problems with Gendered Grammar

The problems with systematic words conveying hidden, problematic implications can be broken down into at least five distinct but interrelated categories. Before presenting my arguments, I will present empirical evidence of the effects of linguistic biases on cognition and different forms of behavioral outcomes linked to linguistic biases to show there are wide ranging consequences of gendered grammar. Many different studies show that using gendered grammar has lasting effects on cognition and behavior.

Different research gives varying evidence on just how much language penetrates cognition. It is safe to say that language has actual effects on thought processing and cognition, though the degree is not yet fully understood. For these reasons, I will be endorsing a weak "Whorfian" view[4], which claims that language has effects on cognition, for example, linguistic categories affect social cognition to some degree.

After discussing some of the empirical evidence showing the actual effects of having gender categories in language, I will present some of the further implications that can be solved through getting rid of grammatical gender categories in language. **First**, due to the common and frequent usage of the pronouns (she, he, her, him, etc.), it is difficult to find and address instances where the use includes intended implications. **Second**, the common usage of gendered grammar can be used as a means to engage in intended 'dog-whistling', or employing coded language that has a different meaning for a specific subgroup than the general population. **Third**, the use of gendered grammar invades the privacy of persons who do not wish to disclose their gender. **Finally**, I will use Saul's arguments to show that gendered grammar leads to confusion, exclusion, and reinforces socially constructed stereotypes; and further argue that they are making gender more relevant than need be.

Using different methods, several studies have shown the ways in which language affects cognition (e.g., Boroditsky 2007, 2008), and many focus specifically on gendered language (e.g., Sato and Athanasopoulos 2018). In one study famously covered by Boroditsky [5], Konishi (1993) had participants describe objects masculine in German and feminine in Spanish (and vise versa) in order to observe the effects of grammatical gender on judgement of meaning of words. Participants rated the masculine words in either language with higher potency, showing that there are effects on subjects' conceptualization of objects from gendered grammar, and that speaking languages that include gendered grammar may indeed be a pervasive influence on cognition. This landmark study shows that language has effects on conceptualization that are not necessarily realized by the speakers of the language. By showing that subjects in the study attribute a rather empty, social understanding of gender to objects, it becomes evident that people will similarly categorize other people. Although we may not be sure of how deeply rooted the effects of language are on cognition, it is clear that the effects are present. I argue that we ought to address these effects by taking action in changing language in a way that does not include social biases through the already dynamical nature of language.

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[4] For more on Whorfianism: https://plato.stanford.edu/entries/linguistics/#Who
https://plato.stanford.edu/entries/culture-cogsci/#lan

[5] NPR's Morning Edition podcast covering this study:
https://www.npr.org/sections/krulwich/2009/04/06/102518565/shakespeare-had-roses-all-wrongLera Borodisky's TED Talk: How language shapes the way we think:
https://www.ted.com/talks/lera_boroditsky_how_language_shapes_the_way_we_think

Another study by economists looks at the relationship between gendered grammar and differences in job participation between the genders. The study looks at various female immigrants to the United States who speak languages with varying gendered grammar. This is measured by whether the language uses grammar for pronouns, nouns referring to people, all nouns, etc. Santacreu-Vasut et al. 2017 demonstrate that female immigrants who speak a language with higher gendered grammar participate less in the labor force. The study concluded, "the already wide gender gap in formal employment among immigrant populations in the U.S. is significantly larger for speakers of gender marked languages" (Santacreu-Vasut et al. 2017), showing that if the language is heavily gendered, women are less likely to be in the labor force and men are more likely to be active in the labor force. Moreover, there are other patterns emerging for the intensity of engagement in the market: immigrant women who speak gendered languages are more likely to work fewer weeks in a year, shorter hours in a week-both of which are reversed for immigrant men who speak gendered languages who enter the labor force. This study found the correlation of decreased gender usage in a language with the economic dynamics of a population. This study is accompanied by many other studies that show the economic and business ramifications of gendered language (e.g. Velde et al. 2015; Liu 2016; Hechavarria et al. 2018). Empirical evidence such as this show that the degree of genderedness in grammar relates to how the degree of the socioeconomic impact. Studies such as this prove that language is an aspect that not only tracks large-scale injustices, but can affect current social and economical dynamics. Additionally, this can be a motivating factor to reform the biases present in language, even if at an incremental pace.

1.1 Finding & Addressing Implications

Using gendered grammar in everyday language makes finding instances where the expression is carrying hidden implications especially difficult. The frequency with which pronouns and other gendered grammar are used biases the hearer not to be susceptible to realizing the hidden implications. The meanings of the words are flexible and context dependent enough to refer to individuals, yet not narrow enough to ensure that hidden implications are not included. This shift in meaning from merely referring to a person's gender to carrying associations makes it difficult for even a well-meaning person to use gender pronouns while completely separating all the implications that are present in the current associations of the terms. Frequently using a term gives the false cognitive bias that the meanings and associations the word carries are fully understood. Intuitively, it makes sense that the rarer a word is, the more we will actively engage in understanding its meaning. For example, I only look up the definition of terms I have not come across before or remember the meaning of as I am reading a text in philosophy. But, more frequently than I would like to admit, I find that I did not fully understand a term that I believed I knew. This false confidence in my knowledge of a word will prevent me from consulting the dictionary. Granting that reasonable persons only investigate the meaning of terms they are not familiar with, it follows that an English speaking person would not ever have a need to look up pronouns that are so deeply ingrained in English. The regular use of gendered terms makes the speakers and hearers of the language negligent in investigating the meanings of the terms.

The gendered pronoun itself is hardly ever the topic of a sentence, any expression where the pronoun has implications is treated as a unit that can be agreed or disagreed with.

But as Stanley (2017: 158) notes, agreeing or disagreeing with the full sentence grants acceptance of the implication in the pronoun. While not impossible, it turns out that actually addressing the stereotypes implied in pronouns is not a task that can be done without careful examination. Even if it was plausible for the hearer to accurately find implications in every instance, they would be constantly engaging in their project of calling attention to hidden implications without actually achieving much in moving the conversation forward. Subsequently, even if a person is well-intended in using gender pronouns or other forms of grammatical gender, the very usage can lead to reinforcement of gender stereotypes. Using gendered grammar does not reveal a negative implicit gender bias in a person or serve as proof in their apathy toward feminism. However, the common usage in language has consequences that ought to be addressed, namely, it makes it especially difficult to clearly distinguish when the associations with the words are especially strong, and to address the expressions for having problematic associations.

1.2 Dog-Whistling

Thus far, I have only engaged with cases where all parties are well-meaning in their language usage and have fallen victim of the systematic shadows of prejudice. This leaves out a portion of the population that effectively takes advantage of the frequent usage of gendered grammar in reinforcing gender stereotypes. People who intend to use gender as a means to push a discriminatory agenda can readily use gendered grammar to do so. Currently, mere indication of gender is standard in English, making gender more relevant than it otherwise would be. Frequent usage and indication of a person's gender in conversation can point to other associations that are directly related to their gender. If all parties involved in dog-whistling share similar sexist views, they can point out a person's gender without other bystanders noticing the sexist implications. Dog-whistle politics regularly employs coded language, which makes the subject difficult to decode. However, when the codes are embedded so finely within the structures of language, decoding dog-whistling is especially difficult. This can be found in cases where a person's gender is casually disclosed in conversation, and due to the frequent usage of gendered grammar, there is no suspicion of coded linguistic tactics to push a prejudicial agenda. For example, due to the use of the gendered pronoun 'she', a sexist person merely making a statement, "she's bossy" can be criticising women as leaders and be pointing to the subject of the sentence being a woman, and the term 'bossy' commonly being referred to women to tacitly point at sexist patterns of women not being equipped to be in leadership positions. Without gender being so relevant in daily usage, we will be better equipped to point out when the relevancy is rooted from sexism.

This is similar to how language gives us tools to combat racially problematic expressions, i.e., we readily point out and question when a person's race is being pointed out without sufficient need or relevance for it. When someone discloses a third party's race but does not show its relevance to the conversation, they might be questioned on why they felt it was needed to point out race, and confronted if the reasoning shows to be problematic. If the racial identity of a person was disclosed in common pronouns, we would not be able to easily confront instances of racial injustice because the pronoun has an innocuous impression. By the same token, if gender's relevance was taken away from language, we would have the opportunity to clearly find and address instances of sexist perspectives. Thus, gendered pronouns have can act as code words used to implicitly convey sexism.

For instance, a person may be making a statement about a particular person, and through the usage of gendered pronouns point at other stereotypical patterns that are consistent with wider sexist beliefs held.

1.3 Privacy Violations

The third reason using gendered pronouns is problematic is a simple but important concern regarding individual privacy. Adding to the concern with avoiding dog-whistling, one may question why disclosing gender has any importance at all. Other qualities of an individual are not as freely disclosed as their gender, and we have language to blame for that. People have visible identities, (Alcoff 2005) including race, age, and arguably class status. Excluding special circumstances, they may not usually possess much control on what their visible identity includes. Assuming gender as a visible identity, gendered grammar makes it so that a person's gender identity is revealed, even when they are not present. All that needs to take place is a simple conversation where they are referred to. From there, the pronouns used can play a role in their perceived identity before they have even had the chance to show their visible identity, let alone get to build a relationship with the perceiver. This is problematic not just in individual relationships, but in structural ways as well. Implicit biases can lead to unfortunate consequences that give privileges while undermining different groups of people based on empty concepts not fully realized or taken into account.

One of the techniques used to alleviate implicit biases of a teacher is anonymous reviewing: grading without knowledge of whose work is being graded. This allows the teacher to grade the work without expectations of a particular student's work, and be able to do grade without biases that they may not be aware they have. Despite the reforms brought about by feminist activism, using gendered grammar is doing the exact opposite work that the anonymous reviewer is employing by bringing an individual's gender to attention without it being relevant. This way of bringing a person's gender to the forefront of any conversation being had about them gives the impression that gender is an important and relevant part of not just a person's identity, but of any topic of conversation that relates to them.

Furthermore, gendered pronouns violate the privacy of nonbinary and transgender individuals, "so long as he and she are predominantly used to refer to persons who identify as men and women (respectively), using 'they' and 'ze' for someone will pragmatically implicate either that someone is non-binary or non-heterosexual or that they have a reason to hide their gender identity or sexual orientation" (Dembroff, Wodak 2018). The current exclusive usage of 'they' and 'ze' for non-binary or non-heterosexual individuals adds to the possibility of implicit biases affecting judgement of a person. Even if the visible identity of a non-binary or non-heterosexual person does not cause judgements based on their gender identity or sexual orientation, language usage of gendered pronouns can. Using gendered pronouns shows to be problematic in preserving the privacy of individuals and ensuring that implicit biases are not playing a role in social perspectives or decision-making.

1.4 Confusion, Exclusion

Another problem with having gendered pronouns is simply the problem of confusion and exclusion. The current usage of male pronouns as a universal means to address all genders can lead to confusion in many contexts. By using a gendered pronoun as a universal pronoun, there can be instances of confusion because there is no way to indicate whether a pronoun is universal or referring only to the specific gender.

For example, a job posting may say, "The successful applicant will have the following traits: he will be friendly…" (Saul 2012), showing that this usage of the word 'he' can be misleading to female applicants, because it is not known that the application is using the gender neutral 'he'. Saul proposes the solution is using actual gender neutral language instead of using male pronouns or nouns as the universal. Showing that even female-specific pronouns for positions of power are pointing out an anomaly in the position: it is being occupied by a female. Another noteworthy consideration, the use of universal pronouns with female instead of neutral grammar can be a constant reminder of prejudice, which can have reverse effects of debiasing (Gendler 2011). Instead of alleviating the confusion, there can be a reinforcement of gender stereotypes added to the primary confusion, because of the constant reminder that the speaker is being conscientious to speak in a way to be inclusive. More importantly, excluding men and non-binary persons is not truly egalitarian: it is essentially following the same model of injustice that male grammar already holds and reversing it to benefit a different group.

Exclusion is another problematic aspect of using male pronouns as a universal measure to refer to all persons. Whether tacit or explicit, instances where persons feel excluded will occur through having pronouns that refer to a specific gender. The example of the job posting is relevant here in showing that the applicant can feel excluded from being able to apply to the job. Even cases of both gender pronouns being present in an effort to be inclusive will be exclusive to persons who do not identify as the two genders that pronouns point at. The concern for nonbinary people is especially important when considering the immense need to recognize their identity as valid.

2 Approaches to Solving Linguistic Biases

In understanding linguistic reform, it is important to note that there are clear misunderstandings of how language operates. The dynamical nature of language allows for the transition toward a less biased version of English to be rather feasible. The transformation from gender-binary pronouns she and he to the singular they will address the different problems raised. The use of they as a singular pronoun is not controversial or an undermining of the grammatical rules of English. In fact, English used to formally use this pronoun as a singular pronoun, traced back all the way to the 1400s[6] (McWhorter 10:12). The standard view misunderstands changes in language in believing that they happen naturally and without any intervention. This viewpoint misunderstands the way in which language is a human enterprise that is subject to human intentions. Still, it is not an understatement to say that reform is costly and difficult at any level. Similar to any other type of reform, tactics ought to be well-thought out and risk calculation must be taken seriously. Linguistic reform has both structural and individual aspects. Structural reform is commonly thought of as having the most impact, because structures have the most power in ensuring the positions within the structure are intact. And although I generally agree with this viewpoint, it is important to note that solely focusing on structures overlooks the complexities of human psychology and may in effect cause backlash. For this reason, I will take Alex Madva's Anti-Anti-Individualism (2016) model in proposing language reform.

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[6] Lexicon Valley Podcast: The Rise of They http://www.slate.com/articles/podcasts/lexicon_valley/2018/08/singular_they_pronoun_john_mcwhorter_says_it_s_time_to_embrace_it.html

Individual and structural change are less effective apart than they are together. Focusing on one strategy, between individualism and structuralism, and neglecting the other does not help reform, especially when the reform focuses on something as complex as language. It is crucial to take into account that transforming language takes both structural and individual change. This is because language takes many forms and has many influences, which makes it especially complex to make an attempt at finding a single approach of reform. In the following sections, I will give proposals of both structural and individual changes.

2.1 Structural Priority

The importance of structural reform to resist oppression is evident (e.g. Young 2011). Structural norms have an influence on the individuals within them. Hence, if we are able to effectively enact structural reform in an incremental way, we should be able to influence individuals within the structure to take on linguistic reform (e.g. Haslanger 2012, 2017). This does not mean structural reform has to be an expensive and a complete overhaul of the English language. Rather, I am suggesting slight shifts in structural models that influence language. An important and easy way that structural reform can take place is within academia. Professors can alter their syllabi and other learning materials to use gender-neutral language. Promulgating gender-neutral language in academia is an especially important place for reform because students are likely to be open to the influence of their professors and other academic figures[7]. Another influential structural reform can be through government factors, such as birth certificates and other forms that documentation communicates gender. Furthermore, the media, businesses, and other institutions can work to enact structural reform by using and enforcing usage of gender-neutral grammar.

2.2 Appreciating Complexities of Psychology and Avoiding Backlash

Structural reform is an important aspect of progress, albeit the effectiveness is often over exaggerated. This mostly derives from the tendency to overlook how complex human psychology can be. Structural reform must take individual attitudes into account to be fully effective. There needs to be a careful calculation of possibilities of backlash and misinterpretations of the messages the representations shown in structures are conveying. It is important to approach people as a whole and not have a condescending viewpoint in enacting reform. Moreover, a form of reform as delicate as language must have individuals who are showing a positive outlook. Backlash can have particularly adverse effects on language reform, mainly because language construction is so deeply dependant by its users. Awareness of the problematic implications of gendered grammar may be a motivating factor in individuals shifting their attitudes to be open to the incremental change in language. An important way to secure individual attitudes to be in agreement with structural reform is through educating the public in creating awareness of the problems that using gendered-grammar may cause. This does not imply that education or awareness of injustice necessarily leads people to act justly; rather, it can serve as a motivating factor for people who are already seeking to be just. This model can be useful even in cases where backlash has been already present, such as the French Government. Through different ways of educating the public, the backlash that is faced may be deferred.

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[7] For studies showing the influence of authority figures on interpretation of implicit bias test results see Cooley et al. 2013, 2014

2.3 Other Languages, Structural Biases Outside Gender

A question comes about after deliberating on reform that only pertains to the English language: What about all other languages that have gender and other forms of structural bias? This question comes from both people who accept and deny this reform as effective and that it should be enacted. Supporters of this reform wish to expand this project and would like to have a structured model that can be used for other languages. This response is a natural further reform and should be taken seriously. However, it is crucial to note that language is closely tied to culture, history, music, and other aspects tied to the identity of the people it is spoken by; a point commonly made by those who do not accept this reform for English or other languages. This makes the project of structurally expanding this reform nearly impossible. For example, the word "Latinx" does not account for the fact that Spanish speakers would not pronounce or utilize the term the way that English speakers are. English speakers may have had good intentions in debiasing the term "Latino", however, they are perhaps being negligent to the language, culture, and history of the people they are referring to. Additionally, it is important to note that gender bias in English is highly structured and effective, but this does not mean that gender biases have the same importance in other languages. Languages reflect the thoughts, history, and cultures of the people who speak it. In a hypothetical society where sexism and gender biases are not present, having gender biases in language would not have much power or relevance. This does not mean that language reform is only relevant to English, it means that the complexity of language as a part of structural prejudice must be appreciated for reform to be truly effective. Other languages and cultures may elect to increase or decrease categories to include aspects beyond gender or exclude gender altogether.

3 Objections

There are several objections presented to linguistic reform. The objections focus on the implications and possible consequences on linguistic reform. The strongest objections argue that using grammatical gender is instrumental in gender identity and expression. Another notable argument against linguistic reform points out that there are many types of reform that are important and given the limited resources we have, it is important to prioritize reform that seems to more directly make an attempt to break up structural oppression. Another objection is the concern for the freedom of speech and restricting language, arguing that people ought to be free to keep the language they speak, especially when gendered grammar seems rather innocuous. This objection does not apply to the arguments I have put forth, because I am not arguing for putting forth institutional restrictions of any kind, especially through legal means. However, if others consider legal restrictions, they should consider that freedom of speech does not need to include instances where more harm is done than good. I consider the first two objections in what follows.

3.1 Gender Identity and Expression

A common objection, arguing against the standardization of gender-neutral pronouns in place of the current gendered pronouns come from the sentiment that pronouns are a part of a person's gender identity and take part in their gender expression. Being referred to as 'she' or 'he' has the value to a person and validates their gender identity. This is a social practice that is believed to be of great importance, which can be shown by how transgender people are denied feel strongly about being referred to as their preferred pronoun[8].

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[8] Thanks to Dr. Madva for this point.

A person P cannot be present to exercise their gender expression through other factors which make gender relevant. Yet, they wish for their gender to be known and made relevant, even if merely being referred to in a conversation they are not taking part in. Those who hold this view believe that their gender is relevant and important enough to be explicitly mentioned in any and all expressions where they are mentioned in. Deriving from this line of thought, there are arguments for freedom of speech, where persons believe they are entitled to their freedom of being referred to using gendered pronouns.

3.2 More Important Forms of Reform Prioritized?

Another common objection to linguistic reform is that it is a waste of resources and may not be actually effective in enacting change. Proponents of this view commonly believe that linguistic biases do not have an influence on cognitive biases, and that phenomena of dog-whistling are not common or substantive enough to justify reform. Alternatively, they take other forms of structural reform to be more important and believe that other reforms will yield better results.

4.1 Response to Identity and Expression

In response to the objection regarding gender identity and expression, I will be drawing a parallel racial expression. Imagine a person who is heavily invested in their racial identity and feels it should be expressed, and commonly makes references to stress the importance of the relevance of their race in different contexts. We can imagine racial identity being expressed in many different ways, through a person's visible identity, customs, culture, nationality, spoken language and dialect, etc. However, it is not a common practice to refer to people using their racial identity. Presumably, a person requesting personal pronouns that disclose race would have trouble attaining agreement from others. Racial expression can be sufficiently achieved through other means, and many would find it problematic to bring up race when it is not relevant. Yet, due to the status quo and the structure of language, gender expression structures within language is considered a valid form of expression. Moreover, it is important to note that we typically believe expression to tied closely with intent, i.e., a person P commits to act A with the intent to be expressive. However, in the use of pronouns, there is little to no intent to act A to qualify under an act of expression because the person themself does not use the gendered pronoun to refer to themself. Still, it is noteworthy to mention that in the case of transgender individuals, gender expression has a different value that may be beyond the scope of what this response can cover. For this reason, I would propose to be sensitive in preserving their right to using gendered grammar. However, it is an important consideration that freedom of speech can be restricted in cases where it is negatively affecting others' freedom or causes oppression, so, this exception does not extend to others who merely wish to keep gender pronouns as a means to be expressive in their gender identity.

4.2 The Question of Whether Other Forms of Reform Should Be Prioritized

As discussed earlier, empirical evidence shows the effects of language on cognition and social structures. Research from different fields point to the conclusive argument that language usage has different ways of affecting people. This is an important aspect of daily society that is not commonly taken into account. Linguistic reform is not intended to break the structure. Rather, it is a piece in the structure that may work to destabilize, or enforce other reforms by not giving constant reminders of gender and making it relevant when it is not. Contrary to those raising the objection that other forms of reform are more compelling in addressing injustices, language is and has the potential to be a powerful means to upholding

or breaking commonly held ideas. For this reason, and that language usage is not addressed as often as other forms of injustice present, I argue that reforming language is as notable as other forms.

Concluding Remarks

The effects of language on social cognition have been highlighted to show that biases that are embedded in language should be addressed and reformed. I presented some of the empirical research available to support my theoretical claims about why having gendered grammar is problematic, and what can be done to reform the usage. This reform can begin to take form in the practice of the use of gender neutral language, or paying more attention to other forms of biases that are embedded in English or other languages. Structures are heavily involved in how people use language, and it is important to bring this problem to their attention and ask for their consideration in reforming their language use. It is also important to note that this reform is not meant to solve structural injustice, but the research discussed prove the importance of paying attention and take action toward having a language that does not carry gender biases and negative or empty concepts.

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Seismic Evaluation of Embankment Dam Systems Using Finite Element Modeling

Abstract

The Los Angeles basin has been known in the past for extensive flooding and significant earthquake activity. Since the mid-19th century systems of levees have been used for agricultural purposes; now levees play a major role in flood protection. California alone is home to about 14,000 miles of levees, about 75 of which belong to the Santa Ana River levee system. In the United States, the organization responsible for the design and construction of levees is The United States Army Corps of Engineers. Although inspections and relevant analysis have been done on the levee's structure by Orange County Public Works, a seismic analysis on how the levees would perform under earthquake loads could identify structural weaknesses before flooding occurs. This study uses USACE design criteria and soil parameters with finite element software to model all three sections of the Santa Ana levee system under seismic loads and scenarios to determine the factor of safety and ultimately identify areas that have the lowest value.

Introduction

Levees have been used to protect people, farmland, and entire cities from natural disasters that may cause flooding. They are constructed and maintained along watercourses by federal agencies such as The Army Corps of Engineers in order to protect citizens. Failure of such levees could have catastrophic consequences- for example, the failure of multiple levees in New Orleans during Hurricane Katrina in 2005 resulted in over 1,500 deaths and $81 billion in property damage. Protected communities depend on the condition of levees to withstand heavy rain events, such as the communities along the Santa Ana River in Orange, San Bernardino, and Riverside Counties.

As of today, the Santa Ana River levee system protects over one million people and $136 billion in property value (USACE). Due to improvements called the Santa Ana River Mainstream Project, the levee is expected to be capable of containing a 200-year flood, or a flood that will have a 0.5% chance of occurring every year. However, some areas along the levee do not have adequate drainage systems to withstand a 200-year flood, and may very well cause flooding regardless of the condition of the levee. This may not be of much concern in Southern California, which does not experience large storms such as Hurricanes. Instead, the many active faults that run through highly populated areas may pose a threat to flood control systems. Earthquakes may cause slope failure, ground rupture, and induced seismic forces, which may damage to the levee embankments.

Problem Definition

This research aims to develop models that can simulate the different failure mechanisms caused by seismic forces on embankments for the Santa Ana Levee system using data from USACE and The Army Corps of Engineers. The results of these simulations will attempt to show the actual conditions of the levee through the type of failure mode on the embankments. This will also highlight the areas of the levee with the lowest factor of safety, and hopefully lead to plans of action to reduce the risk of levee failure in the future.

Finite Element Modeling

Slope stability analysis is often done in two-dimensional software, neglecting three dimensional effects on the slope. What is needed for this analysis is lab and/or field data, and an accurate idea of the geometry of the subject. For this model, field data and channel geometry are found through USACE and Google Eth Pro. Modeling was done in the Rocscience V program Slide2018 and carried out on predetermined sections of each of the three embankment systems. These sections are within the highest-risk zones of each levee and shall represent the entire 75-mile system.

The first section (Figure 1) is at the downstream portion of the levee and passes through the Newport-Inglewood-Rose Canyon Fault zone. This section extends 2.8 miles upstream from the Greenville-Banning channel. The second section (Figure 2) is somewhat close to the active El Modeno fault, and it represents the central part of the levee. The third section (Figure 3) passes through the Peralta Hills Structure and several other areas with high probability of ground shaking.

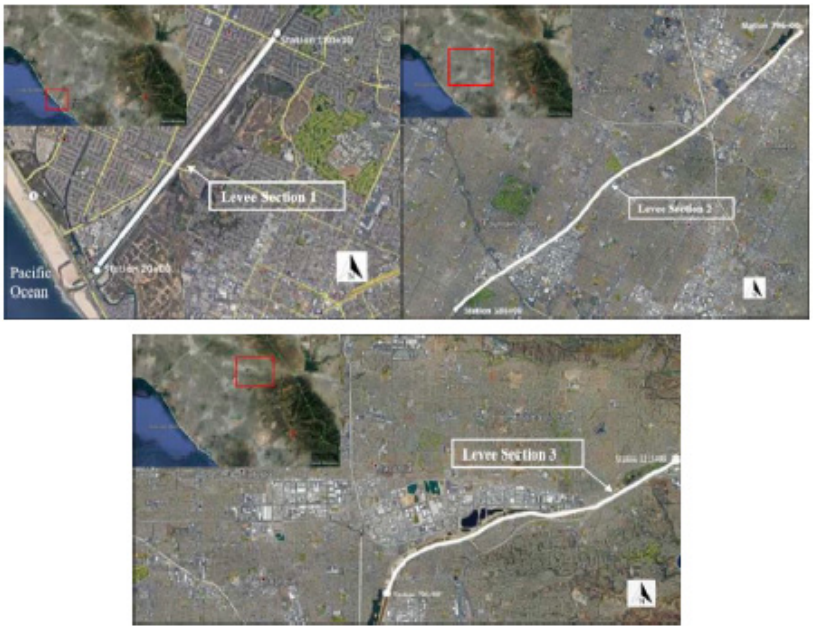

Figure 1: Google Earth images of the three levee segments chosen for modeling.

The model uses right-to-left slip direction in the analysis, and a two-dimensional section that encompasses parts of the slope on both sides of the embankment. Slide2018 will use the section geometry, field data, and lab data to model the three sections of the levee under static and pseudo-static loads, as well as analyzing the slopes for the critical seismic coefficient.

Model Geometry

The United States Army Corps of Engineers Design and Construction of Levees manual suggests a minimum crown width of 10 feet with side slopes flatter or equal to 2H:1V. The actual levee does meet this requirement, and varies in height from 0 to 26 feet. The average of the height and slope measurements for each of the sections are used to create the model. Table 1 summarizes these values. The external boundaries for the models are in a 2D (x, y) Cartesian coordinate system, beginning at the origin and extending six times the vertical measurements and three times the horizontal measurements to encompass all potential failure surfaces.

Table 1: Geometry of chosen levee segments, based on Google Earth and Army Corps of Engineers Design and Construction of Levees Manual.

	Area	Slope	Riverward Width (feet)	Riverward Height (feet)
Section 1	Downstream	2H:1V	25	16
Section 2	Middlestream	2H:1V	35	22
Section 3	Upstream	2H:1V	15	18

Soil Properties

Stability issues in the embankments are due to the geometry and the heterogeneous mixture of sand, silt, clay, and peat. Soil sampling on the embankments were done in the 1960's and 1970's by the Army Corps of Engineers and a contracted consulting company. The soil used to build the embankments came from the channel excavation. The parameters for the soils found in the channel are summarized in Figure 4. In order to create soil layering in the model, a quantitative method was developed using the initial and final stations of each levee section. Thus, the sections of the levee that were modeled are defined by the available boring logs and their corresponding stations.

The boring logs were analyzed by adding up the number of occurrences of each soil type at each depth and picking the soil type with the total largest number of occurrences to represent the soil at that depth in the model. A summary of this is in Table 2. The boring logs can be analyzed in excel using colored cells to visually represent the soil types at different depths.

Table 2: Analysis of boring logs used to assign soil types in the model.

Depth (ft)	SP	SM	SP-SM	SC	SC-SM	ML	MH	CL	CL-ML	CH	SW	GP	Highest Occurrences	Soil Type
1	9	6	0	3	1	0	0	0	0	0	11	2	11	
2	8	6	0	3	1	0	0	1	0	0	11	2	11	
3	8	6	1	3	1	0	0	0	0	0	11	2	11	SW
4	6	11	3	1	0	1	0	0	0	0	9	1	11	
5	5	11	3	1	0	1	0	1	0	0	9	1	11	
TOTAL	36	40	7	11	3	2	0	2	0	0	51	8		
6	8	11	3	1	0	1	0	0	0	0	8	0	11	
7	8	9	7	1	0	0	0	0	0	0	6	0	9	
8	8	10	6	2	0	0	0	0	0	0	5	0	10	SM
9	7	10	5	2	0	0	0	0	0	0	6	1	10	
10	10	9	5	1	0	0	0	1	0	0	4	1	10	
TOTAL	41	49	26	7	0	1	0	1	0	0	29	2		
11	11	8	5	0	1	0	0	1	0	0	5	0	11	
12	11	8	5	0	1	0	0	1	0	0	5	0	11	
13	8	6	2	0	1	0	0	0	0	0	13	1	13	SW
14	8	6	2	0	1	0	0	0	0	0	12	2	12	
15	6	6	2	0	1	1	0	1	0	0	12	2	12	
TOTAL	44	34	16	0	5	1	0	3	0	0	47	5		
16	8	5	2	1	1	2	0	0	0	0	9	2	9	
17	10	5	2	0	1	1	0	0	0	0	9	2	10	
18	10	6	2	0	1	1	0	0	0	0	9	1	10	SP
19	13	5	1	3	0	1	0	0	0	0	6	1	13	
20	12	4	0	3	0	1	0	2	0	0	5	3	12	
TOTAL	53	25	7	7	3	6	0	2	0	0	38	9		
21	10	6	0	3	0	1	0	2	0	0	5	3	10	
25	9	8	2	2	0	1	0	1	0	0	3	4	9	
30	3	8	1	2	0	1	0	1	1	0	5	5	8	
35	1	7	4	2	0	1	0	0	0	0	6	4	7	SM
40	1	9	2	2	0	1	0	1	0	0	4	5	9	
45	4	7	2	2	0	1	0	1	0	0	3	5	7	
TOTAL	28	45	11	13	0	6	0	6	1	0	26	26		

Although soil properties have been defined for the model, the field data is far from current. Effects of the soil conditions described could vary quite a bit from the actual condition of the levee. In fact, the peat underlayer in the channel is succeptibale to substansial settlement. As the channel runs deeper, water will push the walls open farther and cause the embankments to spread. This may cause nearly horizontal failure planes and damage nearby structures.

Results and Discussion

This project uses qualitative and quantitative reasoning to analyze the Santa Ana River Levee system under pseudo-static loading using finite element software. The results of said analysis would reveal the areas of the levee with the lowest factor of safety when introduced to seismic forces. The loadings applied were static loading and pseudo-static loading, followed by a critical seismic coefficient analysis. The factor of safety for static loading must be at least 1.5, and 1.1 for pseudo-static loading. The seismic coefficient analysis determines the seismic coefficient resulting from a factor of safety of 1.0. The results of the analysis are summarized in the following table:

Table 3: Results of finite element analysis.

		Factor of Safety (FS)			
	Area	Static load	Pseudo-static Seismic load	Drop Percentage	Seismic Coefficient (k_h)
Section 1	Downstream	3.436	1.897	45%	0.406
Section 2	Middle stream	1.599	1.145	28%	0.215
Section 3	Upstream	1.709	1.242	27%	0.262

Analyzing the slope using static conditions as well as pseudo-static may help verify sections of the levee that are the most unsafe. In addition, the difference between the Factors of Safety for both conditions could differentiate between sections of the levee that are especially susceptible to seismic loads. Finding the critical seismic coefficient and comparing it to the seismic coefficient of 0.15 used for pseudo-static loading and the corresponding factors of safety reveal the kind of earthquake conditions which could cause the levee to fail.

Conclusions

The proposed sections of the Santa Ana Levee system were modeled using finite element analysis software to find out the safety of the current condition under seismic loading. Referring to Table 3, the downstream section has the highest factor of safety. This may be due to it's proximity to active faults, but it also has the largest drop in it's factor of safety when a seismic load coefficient of 0.15 is applied. The middle stream section has the lowest factor of safety, and according to USACE, this section of the levee is at high risk. Redesign may become necessary soon, as the factors of safety are very close to the limits. The upstream section is also close to the limits, but it is also very close to active faults. This section may also require redesign. In addition, a more recent soil investigation would be necessary in order to use the most current data and parameters in the model. Field visits should also be done to examine the actual conditions of the levee and verify the model. Also, future research involving the seismic coefficient used for the sections of the levee could yield better results, since 0.15 is an arbitrary value due to the nature of seismic coefficients.

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The Effect of Omega-3 Supplements on the Weight Change in Mice

With over 160 million people overweight in America, there has not been any clear indication of whether or not Omega-3 has an effect on weight loss according to the National Institute of Health (NIH). With weight loss in mind, Omega-3 supplements were added to the feed of male mice for four weeks in order to see the weight change that could occur within them. To minimize lurking variables, there was also a control cage of male ICR mice with the same base feed. At the end of the experiment, both the experimental group and the control group had gained weight. However, the experimental group gained less weight than the control group. Although the t-tests were not significant, our latest weight calculation had a p-value of 0.0059.

Introduction

According to the National Institutes of Health, Omega-3 supplements, known as fish oils, can improve brain function, cardiovascular health, inflammation, and even eye development. These popular supplements usually consist of two types of long chain omega-3 fatty acids: eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which have both been suggested to have many health benefits. In 2012, Dr. Barry Sears stated that EPA reduces cellular inflammation and neuroinflammation while DHA reduces the risk of atherosclerotic lesions, lowers triglyceride levels, and plays a crucial role in visual development. Despite these benefits, doctors warn against taking more than 3 grams of it a day, because it can lead to undesirable side effects, like bleeding, suppressed immune system, and loose stool.

Although there are many benefits with consuming omega-3 fatty acids, there has been some arguments about whether or not fish oil can lead to weight loss. In a 2015 study, they saw that mice who ate fish oil typically burned more calories due to an increase of brown fat, which is defined as a special type of body fat that converts large amounts of energy into body heat (Minji Kim et al. 2015). This type of fat is particularly abundant in hibernating animals and newborns.

However, their weight loss seemed to be dependent on the receptor that activates UCP1, which is an uncoupling protein found in the mitochondria of brown fat. This factor disputed the theory that the weight loss found in the mice that ate omega-3 supplements were entirely because of their diet. Furthermore, a 2016 study stated that weight loss in mice relied on their apolipoprotein E gene, which is a protein that combines with lipids in the body to form lipoproteins (Slim et. al 2016). Lipoproteins are responsible for determining cholesterol, and Omega-3 fatty acids decrease the plasma concentrations of LDL cholesterol, which are also known as bad cholesterol. This is why a decreased risk of heart disease is seen in people who take omega-3 supplements.

In another study, it was concluded that there are mixed results in regards of body fat effect because weight loss could result from other lurking variables, such as genetic differences and appetite-suppressing effects (Howe and Buckley 2014). Because of these reasons, it’s not proven that omega-3 fatty acids can directly cause weight loss.

In our study, we explored the relationship between n-3 fatty acids and weight loss in mice over a span of 4 weeks. Through this study, we hoped to see significant weight change in our experimental mice as we provide them Omega-3 enriched feed daily. This study's null hypothesis was that the Omega-3 supplements added to the feed will not have a significant change in the weight of each mice while the alternative hypothesis was that the Omega-3 supplements added to the feed will have a significant change in the weight of each mice. Because of past research, if the mice fed on the Omega-3 supplements, then they would lose weight.

Methods

Using Naturemade Omega-3 with Xtra Absorb liquid softgels with a dosage of 500 mg EPA+DHA, we had 2 cages of the Institute of Cancer Research (ICR) mice, each having nine male mice inside per cage. One cage of mice received Omega-3, and the other did not. Mice were kept in the animal facility at Cal Poly Pomona. We identified each mouse by drawing colored lines on the bases of their tails by using different colored Sharpies.

From anytime in between 10:00 AM and 12:00 PM each day, one of the researchers would go in and record the temperature, humidity levels, daily humidity ranges, check the experimental cage and Nalgene 15mm Petri dish for any leftover pellets and feed the experimental mice. If fading of the identification colors occurred then recoloring of the mice's tail was initiated; however, coloring was done every other day regardless of fading. Pictures were taken as needed.

During feeding, the lid was removed from the container along with the wire rack and was placed to the side. Once the Petri dish was taken out, excess Omega-3 pellets left in the cage were counted and recorded to examine how many had been eaten throughout the 24- hour period. All used/disposable materials were discarded into the designated trashcan within the procedure room, where the feeding took place. Next, 1 mL of the oil from the Omega-3 capsule was carefully extracted using a COVIDIEN Monoject Seringue 3mL syringe and 20 gauge needle. Then, the oil was dispersed onto 2.5-4 mouse pellets, depending on the size of each pellet.

Furthermore, the weights of the mice were recorded every Monday for a total of four weeks. An OHAUS CS Series (C5200-001) portable scale and a plastic container were utilized for measuring the weights. Once the portable scale was turned on, the weight of the plastic container was tarred in preparation for weighing of each mouse. For handling, each mouse was grabbed by the base of their tail and was placed inside the plastic container (tried to abstain from grabbing substrates within the cage). Due to the level of movement that each mouse produced when being handled, the first steady value and the date of weighing was recorded. grabbed by the base of their tail and was placed inside the plastic container (tried to abstain from grabbing substrates within the cage). Due to the level of movement that each mouse produced when being handled, the first steady value and the date of weighing was recorded.

Once all the tasks were completed, the working surfaces were cleaned with a provided chemical cleaner and disposable paper towels. All single-use equipment such as gloves, face masks, and lab coats were discarded after each feeding. Observations and other collected data were recorded onto the online document.

The collected data consisted of a time of arrival, completion, how many pellets were eaten, how many Omega-3 oil-drenched pellets were placed into the experimental cage, the weekly weight of each mouse, the current temperature, daily temperature range, the current humidity, and daily humidity range.

With the data collected, five t-tests were performed using excel. The first t-test conducted was between the control group's weight and the experimental group's weight in determining if every mouse attained the same initial weight. With the rest of the four t-tests, the weights of each mouse were compared for viewing the differences in weights that occurred weekly such as week one minus week zero, week two minus week one, and etc.

Results

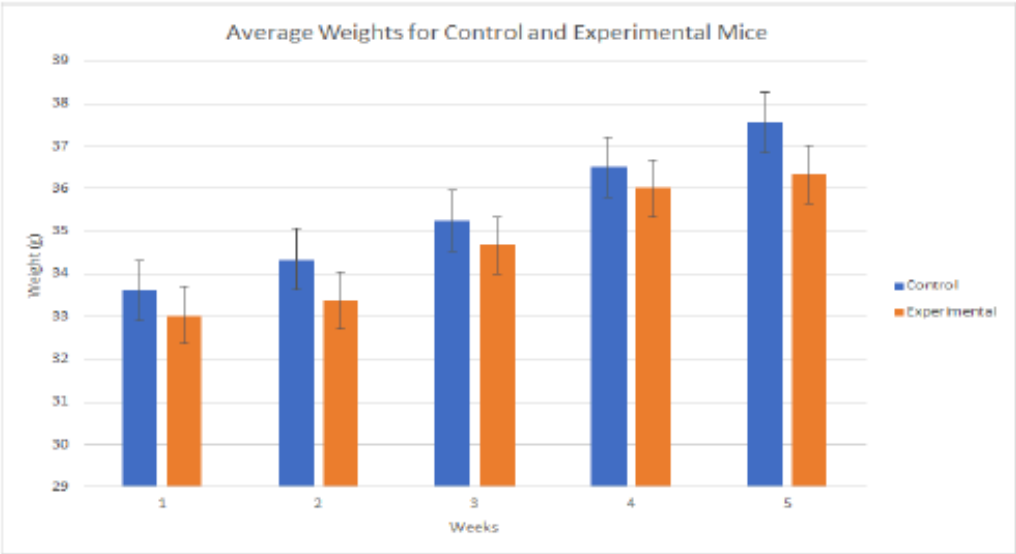

Figure 1. Comparison of the average weights of the experimental and control mice over the span of the experimental procedure.

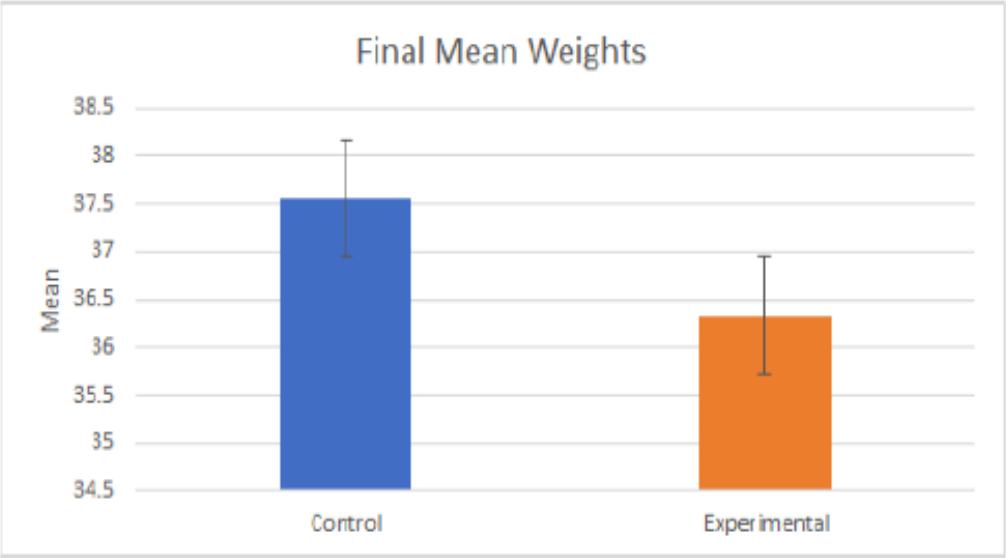

Figure 2. The final mean weights for the experimental and control mice with error bars set at their standard errors.

Table 1. The initial t-test comparing the control mice with the experimental mice

Comparison of Week 0 Weights		
	Control	*Experimental*
Mean	33.6	33.02222222
Variance	1.195	3.084444444
Observations	9	9
Pooled Variance	2.139722222	
Hypothesized Mean Difference	0	
df	16	
t Stat	0.837892673	
P(T<=t) one-tail	0.207216454	
t Critical one-tail	1.745883676	
P(T<=t) two-tail	0.414432909	
t Critical two-tail	2.119905299	

Table 2. The t-test comparing the difference between week 1 and week 0 in the experimental mice

Comparison of Difference Between Week 1 and Week 0		
	Control	*Experimental*
Mean	0.744444444	0.355555556
Variance	0.262777778	0.332777778
Observations	9	9
Pooled Variance	0.297777778	
Hypothesized Mean Difference	0	
df	16	
t Stat	1.511769745	
P(T<=t) one-tail	0.075045494	
t Critical one-tail	1.745883676	
P(T<=t) two-tail	0.150090989	
t Critical two-tail	2.119905299	

Table 3. The t-test comparing the difference between week 2 and week 1 in the experimental mice

Comparison of Difference Between Week 2 and Week 1		
	Control	*Experimental*
Mean	0.9	1.3
Variance	0.305	1.7675
Observations	9	9
Pooled Variance	1.03625	
Hypothesized Mean Difference	0	
df	16	
t Stat	-0.83355445	
P(T<=t) one-tail	0.208401448	
t Critical one-tail	1.745883676	
P(T<=t) two-tail	0.416802896	
t Critical two-tail	2.119905299	

Table 4. The t-test comparing the difference between week 3 and week 2 in the experimental mice

Comparison of Difference Between Week 3 and Week 2		
	Control	*Experimental*
Mean	1.255555556	1.333333333
Variance	0.367777778	2.8375
Observations	9	9
Pooled Variance	1.602638889	
Hypothesized Mean Difference	0	
df	16	
t Stat	-0.130329866	
P(T<=t) one-tail	0.448964988	
t Critical one-tail	1.745883676	
P(T<=t) two-tail	0.897929975	
t Critical two-tail	2.119905299	

Table 5. The t-test comparing the difference between week 4 and week 3 in the experimental mice

Comparison of Difference Between Week 4 and Week 3		
	Control	*Experimental*
Mean	1.055555556	0.322222222
Variance	1.642777778	0.129444444
Observations	9	9
Pooled Variance	0.886111111	
Hypothesized Mean Difference	0	
df	16	
t Stat	1.652584183	
P(T<=t) one-tail	0.058950244	
t Critical one-tail	1.745883676	
P(T<=t) two-tail	0.117900489	
t Critical two-tail	2.119905299	

When comparing the initial weights of both mice groups to the final weights, we determined that the data was insignificant based on the p-value that is greater than 0.05 ($p = 0.207$, Table 1). Furthermore, when comparing the difference between weeks, we determined that week 1 to week 0 ($p = 0.075$, Table 2), week 1 to week 2 (0.208, Table 3), week 2 to week 3 (0.449, Table 4), and week 3 to week 4 ($p = 0.059$, Table 5) to be insignificant. Despite all of the mice gaining weight throughout the experimental process, the control mice gained more weight than the experimental mice (Figure 1, Figure 2). Therefore, we fail to reject the null hypothesis; in that the Omega-3 supplements added to the feed did not have a significant change in the weight of each mice.

Discussion

Throughout the four-week period with observing the Omega-3 mice diet, our research has concluded that there was no significance in the values of our results. Since we were working with a time constraint, we were not able to test out the Omega-3 supplements for as long as we would have wanted. As seen in Appendix C, the experimental mice were either not eating the Omega-3 covered pellets, or they were only nibbling on them. Furthermore, a lack of mouse identification interfered with the overall status of determining the diet of each mouse, due to the color identification fading quicker than expected.

Despite our insignificant data, we are still able to determine that four weeks can show that Omega-3 oil has an influence on the experimental mice as opposed to the control mice. We have shown that the control mice were gaining weight much quicker throughout the experiment's time span than the experimental mice (Figure 1). However, human-based factors would apply differently since mice respond to experimental interventions in a different way from humans (Perlman 2016).

Yet, animal models have been used in solving diseases such as vitamin-deficiency diseases like scurvy, rickets, and night blindness (Baker 2008). At least 90% of the veterinary drugs used to treat animals are almost identical to the ones used in humans (Barré-Sinoussi and Montagutelli 2015). Multiple scientific breakthroughs, such as most of the vaccines, have been discovered in basic science and medical research due to the usage of animal models (Barré-Sinoussi and Montagutelli 2015). With that said, the breakthrough of our data proves that there is no guarantee that a person can lose weight in a time span of four weeks, but if they were to continue to take the supplement, their weight may stay the same.

As we had utilized Omega 3-oil throughout our experiment, we would further focus on: an increase of dosage and its effects, extra activities required to lose weight, and the amount of pill intake required to lose weight in the future. We would also alter the way we identified the mice by notching their ears for a better indication of which animal is gaining weight change the method of how we fed them such as crushing up the pellets and mixing in the oil instead of just administering the oil on top of the pellet. For other research studies involving Omega-3 and mice models, we would like to video record the mice to observe their behavior and view which one of the animals was actually eating the Omega-3 covered pellets. Overall, the addition of time for conducting this research would have potentially produced evidence that our hypothesis of the mice losing weight through consumption of Omega-3 oil was or was not correct.

Acknowledgments

We would like to thank Dr. Sohn for supporting us through this project as our PI, Cindy Tessler for training us to meet Building 92's standards while also letting us use her facility to conduct our experiment. Finally, we would like to thank Dr. Beardsley for buying the necessary supplies while also helping us figure out the most efficient way in analyzing our data and being able to teach us in the CPU 2990A ECRT class with Dr. Abramzon.

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Appendix A

Control Mice Weight (g)

Mice	Dates				
	Week 0	Week 1	Week 2	Week 3	Week 4
Mouse 1	32.6	33.3	34.5	35.1	35.7
Mouse 2	35.0	36.2	36.9	39.1	37.7
Mouse 3	32.8	33.7	34.0	35.8	37.1
Mouse 4	33.5	34.5	35.3	36.6	37.9
Mouse 5	32.7	32.6	34.5	35.1	37.0
Mouse 6	34.8	36.1	36.5	37.5	38.9
Mouse 7	34.5	35.3	35.8	37.8	41.1
Mouse 8	34.4	35.4	37.0	38.0	39.0
Mouse 9	32.1	32.0	32.7	33.5	33.6

**first drew lines on 03/29, then had to redraw lines on 04/01, 04/03, 04-05, 04/07, 04/09, 04/12, 04/14, 04/17, 04/21, 04/24*

Appendix B

Omega-3 Mice Weight (g)

Mice	Dates				
	Week 0	Week 1	Week 2	Week 3	Week 4
Mouse 1	32.8	33.0	33.4	35.3	35.7
Mouse 2	33.5	33.6	34.8	37.4	37.4
Mouse 3	28.8	29.2	33.5	30.8	31.7
Mouse 4	34.9	34.0	34.0	35.1	35.0
Mouse 5	32.2	33.2	33.4	35.9	35.8
Mouse 6	34.0	34.8	37.0	38.5	39.1
Mouse 7	34.0	34.8	35.8	36.2	36.4
Mouse 8	33.5	34.2	34.9	37.0	37.3
Mouse 9	33.5	33.6	35.3	37.9	38.6

**first drew lines on 03/29, then had to redraw lines on 04/01, 04/03, 04/05, 04/07, 04/09, 04/12, 04/14, 04/17, 04/21, 04/24*

Appendix C

The number of pellets given to the experimental mice for the entire experimental procedure

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
Week 1 (04/01-04/07)	4	3	3	3	3	2.5	3
Eaten/Not Eaten	No	Ate one	No	Ate all of them	**Petri dish not found*	Ate 1.5; 1 left	Ate 2
Week 2 (04/08-04/14)	3	3	4	4	3	3	3
Eaten/Not Eaten	Ate 2	None eaten	None eaten	Had been nibbled on	No	Ate one	Had been nibbled on
Week 3 (04/15-04/21)	3	3	3	3	3	3	3
Eaten/Not Eaten	None	Had been nibbled on	Had been nibbled on	Had been nibbled on	Had been nibbled on	Ate one	Had been nibbled on
Week 4 (04/22-04/28)	3	3	3	3	3	3	3
Eaten/Not Eaten	Had been nibbled on	None eaten	Had been nibbled on	None eaten	Nibbled on half of one	Had been nibbled on	None eaten

**lab technician took the Petri dish out*

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Cardiotoxicity of Oil in Louisiana Seaside Sparrows (Ammospiza maritima) after the Deepwater Horizon Oil Spill

Background

In the year 2010 the Deepwater Horizon (DWH) oil spill released approximately 700,000 m3 of crude oil into the Gulf of Mexico (Crone and Tolstoy, 2010). It is considered one of the biggest oil spills in history (Crone and Tolstoy, 2010). The DWH oil spill exposed pelagic and costal marine ecosystems and saltmarshes to oil (Crone and Tolstoy, 2010). In the relatively complex environment of saltmarshes exposure lasted a prolonged time due to the lack of efficient clean-up techniques (Zengel et al., 2015). Initial exposure to crude oil resulted in the deaths of thousands of birds and hundreds of marine mammals and reptiles (Antonio et al., 2011). The understanding of the long-term impacts of exposure to crude oil on organisms is still ongoing.

The main toxic component of crude oil are polycyclic aromatic hydrocarbons (PAHs). Exposure to PAHs increases the expression of the cytochrome p4501A (cyp1a) gene, which is responsible for metabolizing PAHs into a more water-soluble substance that the organism can easily expel (Williams et al., 2005). For this reason, cyp1a expression is used as a biomarker for PAHs exposure.

The toxicity of PAHs has been extensively studied in aquatic organisms. Studies have shown that crude oil exposure negatively impacts the physiology and morphology of exposed organisms. PAHs exposure is known to cause differential gene expression that is both dose and time dependent (Xu et al., 2017). PAHs exposure is also known to cause cardiotoxicity by increasing pericardial area (Xu et al., 2017) and causing pericardial edema (Xu et al., 2016; Sørhus et al., 2016). The inhibition of potassium and calcium ion channels necessary for excitation-contraction (EC) coupling has also been detected in exposed organisms (Brette et al., 2014; Incardona et al., 2015). In a study examining the effects of the 1989 Exxon Valdez oil spill, cardiorespiratory performance using critical swimming speed was found to be lower in pink salmon (Oncorhynchus gorbuscha) and Pacific herring (Clupea pallasi) exposed to crude oil (Incardona et al., 2015). Ventricular length and outflow tracts were also morphologically altered in exposed organisms (Incardona et al., 2015).

The impact of PAHs exposure is less known in terrestrial organisms. Since these differ in the routes of PAHs exposure, it is important to independently investigate their exposure to spilled oil and its consequences. The seaside sparrow (Ammospiza maritima) is a year-round resident of the Louisiana coastal salt marshes (Perez-Umphrey et al., 2018). Previous studies using 14C and 13C analyses of the feathers and guts contents of sparrows have shown exposure to oil by ingestion (Bonisoli-Alquati et al., 2016). In addition, differential gene expression has also been observed in seaside sparrows, with higher expression of the cyp1a gene, among others (Bonisoli-Alquati et al., 2020; Perez-Umphrey et al., 2018).

To determine whether cardiotoxicity due to PAHs exposure is an effect in common between aquatic and terrestrial organisms, this study will measure the expression of the jun

gene, a proto-oncogene linked with cardiac enlargement and congenital heart anomalies, from heart tissue samples of seaside sparrows. We hypothesis that the jun gene will have increased expression in exposed organisms relative to the control group.

Methods

Sampling sites and Sample collection

Sampling was conducted in Barataria Bay within Plaquemines Parish, Louisiana. Oiled and lightly oiled sites were selected using the Shoreline Cleanup Assessment Technique (SCAT) established by the National Oceanic and Atmospheric Administration (NOAA) (Nixon et al., 2016). Birds were captured in 2014 using mist nets and were then euthanized following protocol approved by the Institutional Animal Care and Use Committee of the Louisiana State University AgCenter (permit A2012-05). The hearts were the extracted and frozen suing liquid nitrogen and were then transferred to a -80o C.

Preparation of heart samples

Prior to grinding the hearts, diethyl pyrocarbonate (DEPC) treated water was made to prevent cross contamination while preparing the hearts. 1 mL of DEPC was added for each 1000 mL of double distilled water. The mixture was then put in a water bath at 37o C for 12 hours. Then the mixture was autoclaved at 121o C for 15 min. Hearts were taken out of the -80o C freezer and stored on dry ice. Individual hearts were weighed and then placed into a mortar cooled with liquid nitrogen to prevent thawing. The hearts were then quickly crushed and grounded using a pestle to a powder, and placed into new cryogenic vials. Between grinding each heart, all utensils were cleaned with soap, RNase, DEPC, and then rinsed with DI water. The crushed hearts were then placed back into the -80o C freezer until DNA extractions.

DNA extractions

DNA extractions will be done using DNeasy Blood and Tissue kit from Qiagen. The standard Qiagen protocol will be used. The grounded hearts will be weighed out to approximately 20 mg and placed into a 1.5 mL microcentrifuge tube. The frozen heart samples will be allowed to reach room temperature prior to adding the lysis buffer. This will ensure complete lysis. After that, we will add 180 µL of buffer ATL along with 20 µL of proteinase K. The solution will then be homogenized using a vortex and placed into a 56o C water bath overnight. Lysis can be achieved in only a few hours and even quicker if the initial tissues are cut or grounded into small pieces. However, we will incubate the samples overnight to ensure complete lysis. Next, 200 µL of buffer AL will be pipetted along with 200 µL of ethanol (95%). We will quickly mix the solution, then pipet it into a DNeasy spin column and placed into a 2 mL collection tube. Then, the samples will be centrifuged at 8,000 rpm for 1 min. The spin column will be placed in a new 2 mL collection tube and the flow-through will be discarded. To the spin column, 500 µL of buffer AW1 will be added and then be centrifuged at 8,000 rpm for 1 min. For the final washing step, we will add 500 µL Buffer AW2 and the then centrifuge for 3 min at 13,300 rpm. This step is critical as the centrifuging will allow the spin column membrane to dry and prevent residual ethanol from interfering with the elution of the DNA. To elute the DNA, the spin column will be placed in a new 1.5 mL microcentrifuge tube and 100 µL of buffer AE (eluting buffer) will be added. The tube will then be centrifuged at 8,000 rpm for 1 min. To increase DNA yield, the elution step of adding 100 µL of buffer AE will be repeated. The final flow through (DNA) will then be stored in a -80o C freezer until qPCR analyses.

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The Interplay of Price Endings and Product Symmetry

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Abstract

Prior research have shown that there is a preference for symmetry when given the choice between a symmetrical and asymmetrical product and other studies have concluded that consumers perceive a rounded price ending (.00) to be higher value than a non-rounded price ending (.99). However, there has been no connection made regarding the relationship between the two. With this research, we aim to bridge the gap and find out if product symmetry and price endings work together to influence consumer responses and how.

Introduction

Within the retail world, symmetry can be found in various forms. For example, it can affect not only the product, but the package it comes in. Sometimes, symmetry or asymmetry can be found in the design of a logo as well. Various research has documented that when interacting with symmetry, people will have a more positive association with what is dubbed a "harmonious" visual and that can lead to a more favorable opinion with a higher probability of purchase intention (Cruesen, Veryzer, and Schoormans 2010; Bajaj and Bond 2017; Dobson, Gorman, and Moore 2010; Orth and Malkewitz 2008; Orth, Campana, and Malkewitz 2010; Bettels and Wiedmann 2019).

However, one of the main attributes that can influence a consumer's decision is price. To have a successful and effective "marketing mix", one of the ingredients to focus on is determining at what a product is worth. Primarily, price can determine the profit margin and it is heavily influenced by supply and demand, but scholars have found that price-endings can play a role as well in a consumer decision. Round price endings, or prices ending in ".00", have been more preferred in studies as opposed to their counterpart and not only are they easier for calculating totals in their head, products with round price endings will be perceived as a better quality by consumers and that a "better deal" is found in products with a non-round price ending (Wieseke, Kolberg, and Schons 2016; Schindler 2001; Avichai et al. 2012; Stiving 2000; Schindler and Kirby 1997).

For all that we know about the two, what can be said when they both come into play? Some scholars have found that there is a certain expectation of price when something is attractive, and that higher prices are associated more with a symmetrical composition (Orth, Campana, and Malkewitz 2010; Ampuero and Vila 2006). What is lacking though is how consumers respond to design and whether or not it affects the response towards non-round price endings versus round price endings. Using previous investigations, it can be assumed that there the more asymmetrical (versus symmetrical) a product is, consumer responses towards non-round price endings (versus round price endings) will be diminished.

Background

Symmetry and consumers

As humans, we are drawn to symmetry and can find comfort when looking at it due to how orderly it is. Following the Perceptual Bias theory, symmetry is easier for us to perceive and therefore takes less energy and less stress for our brains to interpret an object.

Research has found time and time again that people will tend to have a more positive association when it comes to things that are symmetrical. (Bertamini and Makin 2014; Seckler, Opwis, and Tuch 2015).

Continuing on, humans have a bias for symmetry that can stem beyond facial structure and inanimate objects. Symmetry/asymmetry can also influence valence in foods and numbers can be "aesthetically" pleasing and people will respond to it more if they possess greater visual symmetry (Salgado-Montejo et. al 2015; Dobson, Gorman, and Moore 2010).

How does this play in the world of retail? To increase a positive bias of products in the minds of consumers, and therefore increasing a "top of mind" awareness, retailers will want to present their products with a design that is pleasing. A product's aesthetic, whether it be with the design of a label or in the package itself, can exert a significant influence on the behavior of consumers (Veryzer 1995). Prior research further demonstrates that with symmetry, there is a decreased visual complexity which led to a positive influence on purchase intention (Bigoin-Gagnan and Lacoste-Badie 2018).

Price endings

Price is one of the many attributes when it comes to evaluating different products in the consumer decision making process. When companies determine what their products should be priced at, they take into account the cost of production and the need for their product. What is it worth and when facing their competitors, how can they make a profit? These firms have an opportunity to lead consumers to perceive that it is of quality. However, a study shows that sometimes that doesn't necessarily signal quality (Stiving 2000). Companies will prefer for consumers to perceive that they will be saving more by using non-round price endings, specifically those with ".99" endings, and they hope to further the use of non-round price endings under the guise of promotions, believing that due to a lower price information processing fluency, consumers will be less likely to notice a larger price with a ".99". (Schindler and Kirby 1997; Schindler 2001; Gaston-Breton and Duque 2015; Snir et al. 2012). However, other scholars have demonstrated that consumers find round price endings to be more convenient to calculate when making their purchases and therefore, they'll have a preference for them and it'll lead to an increase in sales in utilitarian products with high importance (Wieseke, Kolberg, and Schons 2016).

Something to note is while sales may increase with a rounded pricing due to a higher cognitive accessibility, more hedonistic products will be purchased more under a non-rounded price ending. Scholars have concluded that due to the reduction of monetary guilt, consumers find it easier to purchase hedonistic products (Choi et al. 2014; Choi, Singh, Rangan 2011).

Putting it all together

As stated above, humans will always have a bias for symmetry that stems from their biology and the need for survival, even if it isn't used for that certain purpose anymore. Previous scholars have attempted to create a connection between symmetry and numbers, finding that people will find a way to view numbers in an aesthetic fashion as a way to simplify a decision-making process in regards to products while others have found that high

price products appear to be associated with an element of symmetrical composition (Dobson, Gorman, and Moore 2010; Ampuero and Vila 2006). However, these studies only focus on perceived connections or qualities and not how consumer responses can be influenced if both are working together. Given the literature above, it is highly likely that attention will shift to a product's design if it is more asymmetrical, away from whatever price ending it may have.

Consumers already interpret a price ending in ".00" with less difficulty than a product with a price ending in ".99", but with the added attribute of a symmetrical/asymmetrical package or design, the processing fluency increases/decreases. The visual complexity of a product will increase when an asymmetrical component creates a "chaotic" image when humans are biased for a "harmonious" design and being paired with a non-round price ending will add an assumption that it is of low quality. Therefore, with our study, we hope to show that companies should take into account an aesthetic of a product that the subconscious of a consumer will pay attention to, increasing the likelihood of a purchase decision being made in their favor.

Study 1 (N = 231)

The purpose of study one was to use wine bottles in order to test the assumption that a product with an asymmetrical design would have the ability to shift attention from the price to a product's appearance. The design for this study was a two-level (asymmetrical vs. symmetrical wine bottle) B-S.

Procedure

In exchange for compensation, 255 participants on MTurk were given a scenario that a wine brand is testing package designs. They were then presented with a wine bottle with either a symmetrical or an asymmetrical design, in addition to either a round price ending ($15.00) or non-round price ending ($14.99) (see Fig. 1). After viewing, subjects were asked how likely they were to buy the product, what percentage of the suggested price would they pay (on a sliding scale from 0-200%), their attitude to the product above and various questions on how they would describe the product.

Figure 1. Two sets of wine bottles, symmetrical and asymmetrical in design.

Results

What was revealed was that there was a higher focus on the bottle when there was an asymmetrical design (M = 7.26; SD = 1.29) compared to the symmetrical design (M = 6.11; SD = 1.89; F (1,229) = 29.303; p < .001).

Study 2 (N = 245)

In study two, our goal was to test the main hypothesis an asymmetrical product (vs. symmetrical) will diminish a consumers' response towards non-round price endings (vs. round price endings). The design was two (asymmetrical vs. symmetrical salad bowl) x 2 (price endings: $3.99 vs. $4.00) B-S.

Procedure

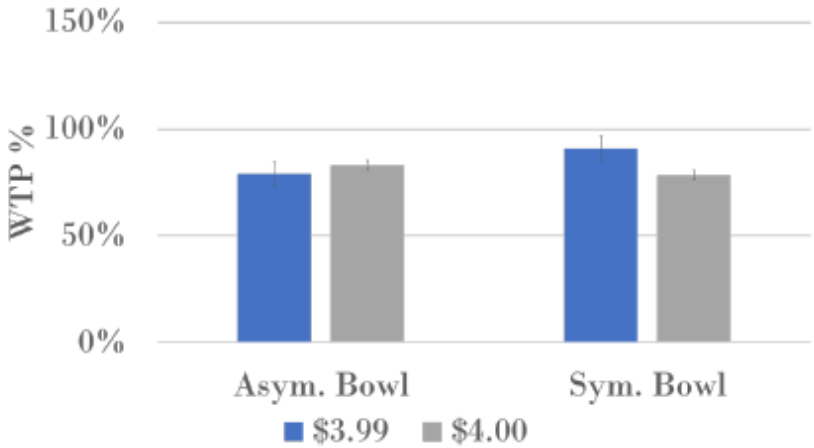
In exchange for compensation, 252 participants on MTurk were shown one of two bowls, paired with a round or non-round price (Fig.2). After viewing the bowls, participants were asked their willingness to pay (WTP) for the set they viewed based on a scale from 0-150% as well as their ability to process the image and price.

Figure 2. Two salad bowls, symmetrical and asymmetrical in design.

Results

As shown in Figure 3, results from study two showed that with the asymmetrical bowl, the consumer response was focused more on the design and attention on price-endings diminished. On the other-hand, consumers who viewed a symmetrical bowl, attention was focused on price-endings more and WTP decreased.

Figure 3. Study 2 Results



General Discussion

Theoretical Implications

Addressing the objectives set out, the two studies provide initial evidence for the hypothesis that asymmetrical product shapes shift attention from price endings, seemingly diminishing the advantage of non-round price endings. Some prior research found that higher prices are associated with a more symmetrical composition (Ampuero and Vila 2006). However, our research is suggesting that in addition, when an asymmetrical product produces a lower processing fluency from consumers, there is more of a response to the asymmetrical composition as opposed to the price, indicating that WTP increases.

Managerial Implications

The findings carry implications for managers as well. Retailers should consider using an asymmetrical design if they would like to use a round-price ending if they would like to increase their profit. The asymmetrical product increases a WTP that could prove to be beneficial in terms of sales and choosing between, for example, to price a product at $13.99 vs. $14.00.

Limitations and Future Research

Our limitations of this investigation are the lack of more studies to establish mediation, test additional product contexts, and discover moderators. Future research should also investigate how the relationship between visual complexity may shift attention further. Would color also have the ability to shift consumer response from price-endings to the product? Is it only limited to the actual shape of a product?

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Battery as Integrated Structure High Endurance UAV

Abstract

Electrically-powered unmanned aerial vehicles (UAVs) have become increasingly important for military, commercial, and private applications, and there is a need to improve their endurance to extend their mission capabilities. To fulfill these increasing range and flight time requirements, a multi-disciplinary senior project consisting of the aerospace, electrical, computer, mechanical, chemical engineering and chemistry departments has been researching various ways to integrate power generation devices and substitute the aircraft's structure with power storage mechanisms, hence create a "flying battery". This paper discusses the ground and flight testing involved in measuring and gauging the improvement in endurance and efficiency of the baseline aircraft1.

1. Goals for Research

The main goal of this undergraduate research project is to optimize the efficiency and endurance of a radio-controlled, electrically powered propeller UAV through the implementation of power generation and storage devices into the structure of the aircraft, as shown in Figure 1.1. Additionally, the team will investigate the feasibility and integration of various power generation devices where thermal and kinetic energy is locally generated. Such power generating devices include a power generation pod through the use of atmospheric gust, thermoelectric generators, and solar cells to collect energy during the day. The implementation of these methods will be carried out in 5 distinct phases.

The Volantek ASW 28 R/C UAV was chosen for its 98-inch tapered wing to allow the installment of several solar panels and the hollow fuselage was necessary for integrating the power management system and other electronic components. The original wing structure consisted of hollow cylindrical aluminum wing spars.

The original Phase 0 Endurance Flight was conducted in February 2020. This served thepurpose of providing baseline data to gauge improvements in endurance and aircraft performance in future test phases. Due to an uncontrolled descent into terrain that resulted from errors in the failsafe in the flight controller, the aircraft's original wings were damaged, necessitating the manufacturing of a new wing for phase 1.

The new Phase 1 (flying 3/21/2020) endurance flight serves to evaluate the aircraft's baseline performance with the addition of a new stronger fiberglass wing structure, a larger rectangular wing, and a power management system added. Phase 2 will fly at the same time as phase 1 and involves gluing on the solar panels to the top of the fiberglass wing and integrating the power management system to charge the aircraft's battery during flight. In addition, the simulated weight of all the other power generation/storage devices will be added in to compare endurance with the baseline aircraft. Phase 3 (flying 4/17/2020) further optimizes flight endurance by replacing the top-half of the wing with laminated solar panels, therefore reducing parasitic weight. Phase 4 (flight date TBD) involves replacing the bottom half of the wing with structural graphene supercapacitors. The wing spars will also be replaced with structural batteries. Similar to Phase 3, the integration of this power storage device would further increase the aircraft's efficiency and performance by replacing the

existing structure with usable energy capacity.

2. Methodology

Lab (Ground) Testing

After the selection of the UAV, requirements and mission profiles were derived to simulate the altitudes and flight profiles of the aircraft. Ground testing involved measuring the thrust capabilities at different throttle inputs using a load cell to ensure that thrust requirements were met. A power meter was used for measuring the battery's voltage, current, and power as the UAV's main motor drained power over time to gauge the endurance of the aircraft. The required input from the integrated power generation devices to sustain longer flight than the baseline measurements was also determined.

Vibrational kinetic energy from the wing is converted into electricity by allowing a motor shaft to rotate via a gear coupled to a mounted gear rack, which is mounted inside a "power generation pod". This mechanism is shown in Figure 2.1 and is designed to match the resonant frequency of the wing to maximize its deflection and power output. From ground vibration testing (GVT), it was determined that the mechanism is optimally mounted 30° rotated toward the wingtips.

Atmospheric and/or aeroelastic flutter induces multiple modes of oscillation that are difficult to simulate accurately on the GVT. A gust system in the Cal Poly Pomona low speed wind tunnel will be used to excite aerodynamic wing vibrations to further optimize the orientation of the mechanism and measure its wing vibration dampening capabilities.

Flight Testing

Flight testing is done because added weight from the power storage and generation mechanisms, as well as aerodynamic loads, have an impact on UAV endurance. Every flight replicates identical takeoff, loiter, and landing profiles to accurately compare how much longer the UAV is able to carry out its mission.

Power Management

The power management system (PMSys) includes an Arduino Nano, a buck-boost converter, a relay board, and two balance charger boards, along with all necessary wiring to provide a dual battery switching approach. This PMSys utilizes one battery for charging while the other battery is being balanced-charged. The PMSys has inputs for all types of power inputs, whether they be alternating or direct current. The current configuration of PMSys requires a minimum of 5.5 Volts and 3.0 Amperes. This amount of power is required simply to charge one of the dual batteries that is not being utilized by the electric propulsion motor at a given time.

Testing the PMSys with the Propulsion System

The schema for charging and managing the input power has been and will continue to be tested to utilize the most efficient algorithm to efficiently charge and discharge the power storage systems. Preliminary study of the battery charging suggests that discharging a battery a small amount and recharging would increase the overall endurance of the UAV. These power storage systems have been tested with lithium polymer batteries and Maxwell supercapacitors.

Structural Solar Cell Upper Wing Skin

The structural properties of the solar cells are utilized to replace the fiberglass upper wing skin to reduce weight. The solar cells were structurally joined by encasing them in a transparent plastic laminate sheet, and then bonding the electrical connections between them with a thin foil metal bus bar between the solar cell edges. This provides tension and compression strength, which was proved through destructive structural testing. Also, C-bar metal stringers are bonded to the solar cells to increase buckling rigidity.

Structural use of Supercapacitors as a Lower Wing Skin

As a collaborative effort with University of Riverside and Chemistry Department, the project team has constructed a variety of substrates, electrolytic gels, and designs to optimize the use of supercapacitors for electrical capacity as well as structural strength. These supercapacitors utilize graphene as an internal element which adds to the structural capability of supercapacitors. Stainless-steel is used as the substrate to replace the lower wing skin while still maximizing the capacitance of the supercapacitors. Through testing and research, it was found that polyvinyl alcohol hydrogel combined with phosphoric acid gave the greatest charge/discharge potential. To separate the electrolyte coated graphene from the substrate layers, Teflon was used because it has a very thin cross-section (which increases capacitance) and it is very durable. A proof of concept testing was performed on the manufactured supercapacitors, which can be seen in Figure 2.2.

Robotics

To increase the efficiency and capabilities of any power storage device, automation of manufacturing was deemed necessary. As a result, the team created a robotic arm and programmed it to automate this process. Using a software called 'YOLO' (You Only Look Once), objects within a given frame can be detected, recognized, and manipulated. When the robotic arm is outfitted with a suction device, the arm can precisely control the stacking procedure of all the elements necessary to create a supercapacitor. For the future, the team is producing a method of distributing precise amounts of electrolytic gel either through modularity in the tooling system within the arm, or through another robotic arm working in tandem.

3. Conclusions

Replacing the current R/C aircraft structure with power generation methods and power storage materials that have structural strength properties similar to, or better than their original parts shows promise to reduce aircraft UAV weight which increases flight endurance. Further research is being conducted to maximize the efficiency of the implemented power systems, and flight tests will soon be conducted to compare the improvements in endurance.

Figures

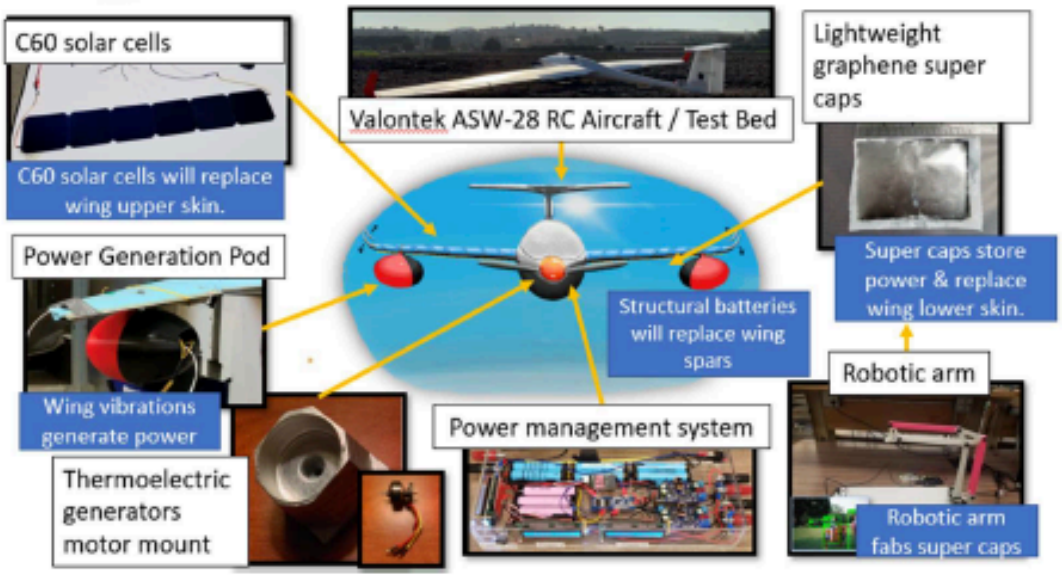

Figure 1.1 Replace aircraft structure with power storage and power structures to reduce weight and increase flight endurance

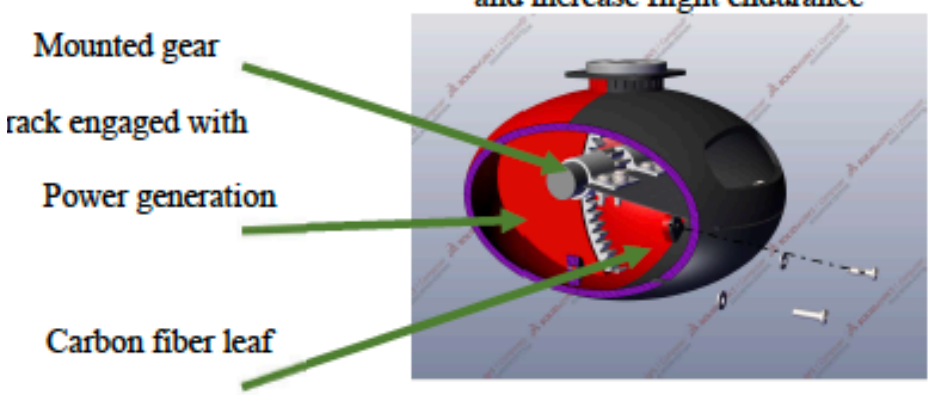

Figure 2.1 Cutaway View of Motor-Leaf Spring Mechanism Inside Power Pod

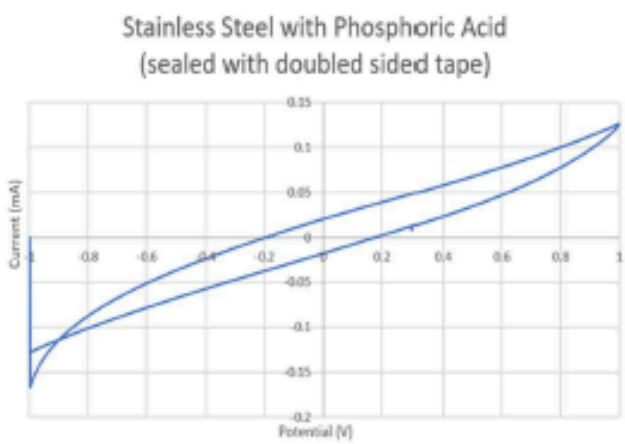

Figure 2.2 Supercapacitor Proof of Concept Testing

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Motivation in Student Employees in the Workforce and the Effect it Has on Their Work

Introduction

Motivation is defined as "forces within an individual that account for the level, direction, and persistence of effort expended at work" (Uhl-Bien, Schermerhorn, & Osborn, 2014, p.100). The rapidly changing state of the employment system has made humans resources an indispensable asset in an onganization (Abbas, Ishaq, & Ullah, 2018). This in turn has led researchers and businesses to focus on finding outstanding employees and motivating them to produce quality work and stay within a company. The topic of motivation has now been studied extensively in order to find how it affects the way an employees behave towards work. A study done in 2010 on work ethic in new employees in the workforce states:

> Understanding the values of employees is a requirement for any company that wishes to operate with vigor and vitality, and it offers potential benefits to an entire society as healthy organizations can translate into economically prosperous cultures. Key to the future success of any company is its ability to manage, train, develop, and reward a satisfied and motivated workforce at all levels of its organization. (Van Ness et al., 2010)

Yet, most of the studies focus on employment within a big industry or company, which widely varies from that of students.

In the last few decades the number of undergraduate students who work to support their education and financial needs has increased, and it does not seem to be going down any time soon (Lee, Leon, & Youn, 2013). Statistics show that 80% of part-time students and 45% of full-time students face the struggle of juggling their education and professional responsibilities (Lee et al. 2013). Students are an important group that impact both the jobs they hold while continuing their education, as well as the future jobs they will hold once they graduate. For this reason it is important to consider how to motivate student employees and how motivation impacts the work they produce.

An important difference to make note of is that the majority of student workers are employed part-time (Lee et al. 2013). These part time jobs are mostly within the service industry, like retail and food services. Not only is it more cost effective for businesses to hire part-time employees, but these type of jobs give students the flexibility they require to dedicate time to their academic endeavours while holding down a job (Hyun-Woo, Eun-Kyong, & Taylor, 2018). The fact that these jobs held by students are part-time then raises questions as to the attitudes they portray toward them and how it translates into their work. A study done on differences in attitudes between full-time and part-time employees in the foodservice industry revealed that part-time employees have a more negative view of their job in general than full-time employees (Hyung-Woo et.al, 2018). This was seen in the level of commitment to an organization, the satisfaction levels, and the perception of the rewards system (Hyung-Woo et.al, 2018).

Intrinsic and Extrinsic Motivation

As for motivation itself, the contrast between the intrinsic and extrinsic branches of it give light to how students are motivated in their employment. Ellis et.al (2010) defines intrinsic motivators as "those that are internal to the individual, such as satisfaction or pride from completing a task," whereas extrinsic motivators are external forces that incentivize. Examples of extrinsic motivators include a monetary rewards, praise, reminders, and punishments. Employees are better motivated when both types of motivations are incorporated into work areas (Ellis, Arendt, Strohbehn, Meyer, & Paez, 2010). Multi-unit manager Sandra Cain, who has 32 years in the food industry and has been managing students in on-campus dining sectors, agrees with other managers that intrinsic motivation is preferred in an employee as it facilitates job training and requires less use of extrinsic motivators (personal communication, September 25, 2019; Taccone, personal communication, September 23, 2019). A problem that exists is that judging the intrinsic motivation levels is difficult to do and cannot be provided or forced in an employee. For this reason, extrinsic motivation cannot be ignored, and it is up to the managers to provide it.

A concept that ties into the extrinsic motivators is the employee value proposition. The employee value proposition (EVP) according to Uhl-Bien et.al (2014) is an exchange of value between what an employee brings to an organization and what the organization can offer in return. An employee brings in their skills, efforts, time, and commitment, and on the other hand an organization offers pay, benefits, opportunities for personal development, and other perks (Uhl-Bien et.al, 2014, p.120). This concept is set upon the idea that both parties agree on a fair value for what they exchange with each other, and any imbalance leads to less work put in by the employees or less rewards from the company respectively (Uhl-Bien, 2014, p.20) This then leads to the role managers play in motivation their employees.

For a student, there are extrinsic motivators that are unique to them as a group. When looking for a job, students look for organizations that will respect their education and allow them to revolve the work schedule around their classes. It is also likely that a student part-time employee is not looking to advance within the organization they are working at. Because of this, upwards job mobility might not be a viable motivator like in a full-time professional position. On the other hand, if the job is related to their field of study and the experience is valuable for future opportunities, a student is more likely to use that as motivation even if other benefits are not as high (Smith, Holmes, Haski-Levenhal, Cnaan, Handy, & Brudney, 2010).

The Role of Management

Findings in studies have shown that management's behavior and the motivation practices they utilize impact employees' job performance and satisfaction (Abbas et.al, 2018). When employees are motivated to perform their job well and are satisfied with their job, they help the organization achieve its mission and goals (Abbas et.al, 2018). For this reason, organizations dedicate a lot of effort into finding efficient managers. Managers must understand employees as treat them "as humans with social, interpersonal and emotional needs" (Abbas et.al, 2018). When this fact is remembered, managers are better able to find what motivates their employees and what they must do to have a job environment that encourages satisfaction in employees.

Managers must understand and implement the importance of employee recognition programs that celebrate members for their contribution and value (Brick, 2012). According to Brick (2012), rewarding and recognizing employees is one of the six essential elements of a successful organization's infrastructure. It is important to set up the expectations and standards for the job first and then reward successful accomplishments of them (Brick, 2012). Even just vocal recognition on a job well done or a task well accomplished can be very motivating. A point Brick (2012) makes is that rewarding employees has to show that they are valued and not just "make them feel like they are valued." The manager must demonstrate this value to the employees in a sincere and genuine manner.

Although employee recognition is important in any organization, it can be difficult to implement for businesses with a part-time staff and/or mainly consisting of students. Such is the case in college campuses. In many cases it is simply not possible to give raises or bonuses like with a full-time profession. Some managers, like Dawn Taccone, who has been a manager in a university on-campus store for 11 years, opt for giving small rewards like gift cards and certificates of recognition (Taccone, personal communication, September 23, 2019).

Real Managers' Experience

The attitude a manager has towards the work they do and the employees under them plays an important role in how a manager recognizes employees and creates an enjoyable work environment. Manager Dawn Taccone, mentioned before, mentions that when managing students, she sees them as young professionals barely getting experience in "the real world" (2019). She says that she recognizes the need to provide guidance and mentoring, while at the same time giving them her employees the freedom to learn and have fun (personal communication, September 23, 2019). Since she manages a grocery store, her employees' job duties consist of mainly cashiering and store maintenance, as well as customer service. There are hardly any opportunities to move up to a management position there or to make a professional career out of that job. For this reason, she knows that the job is often the first step into stepping into adulthood for some students, and therefore she treats them like a mentor (personal communication, September 23, 2019). Taccone claims to love the store and the people there as if they were her child, who she nurtures and helps grow and flourish (personal communication, September 23, 2019). However, she has a clear distinction of her personal life with that at wok, as, despite everything, does not consider any of her employees or ex-employees her friends (personal communication, September 23, 2019). Because of these attitudes, the store has continued to thrive, and Dawn claims that many employees that graduated have returned, saying that the job taught them significant skills (personal communication, September 23, 2019).

Multi-unit manager Sandra Cain, previously mentioned, has a similar attitude towards her staff. To a customer, her job may seem like it is about managing restaurants in a college and a catering business, or that it is about teaching employees to make sandwiches. She says that anyone can learn to build good sandwiches, but that her job is about people (Cain, personal communication, September 25, 2019). Cain (2019) considers herself a mentor to her employees and genuinely cares about them as people, as student, and as her protégés. She emphasizes this point by saying that with every employee, she takes the time to get to know them at a more personal level, establishing trust level from the beginning (Cain, personal communication, September 25, 2019).

In contrast with employment outside of a university setting, where employers focus on having staff only, Cain knows that for her employees, their education comes first, and she sees it as a responsibility to allow the job to cater to this (Cain, personal communication, September 25, 2019). She summarizes her motivation strategy as:

> [1] Developing a high trust relationship, [2] learning about that person and finding out what motivates them [3] and give that to them. If it is praise, if it is [good job], if it is being recognized in a group setting, or a private note. Just find out what motivates people extrinsically and then just building that relationship. (2019)

Cain (2019) believes that in the industry she is in, a strategy like that of Amazon could never work. A former Amazon employee, Breanna Ramirez, who is also a student at a Cal State University, describes the job as very demanding and tiring (Ramirez, personal communication, September 22, 2019). She worked at a warehouse locating packages in storage and bringing then down in a lift to be shipped, a duty that was physically strenuous (Ramirez, personal communication, September 22, 2019). Employees there must meet a quota daily, which mean there is hardly time to rest or do anything else, and it causes stress. Despite the negatives of the job, Ramirez (2019), thinks the job provides enough extrinsic motivators to encourage employees to stay. Amazon offers competitive pay, multiple benefits like health insurance and financial bonuses to help pay for college (Ramirez, personal communication, September 22, 2019). But even with the high incentives, a student could hardly accept the job without many sacrifices. Amazon adjusts to a student's school schedule, but that simply means working nights instead of giving flexibility and being less demanding (Ramirez, personal communication, September 22, 2019). Managers do not put effort into knowing their employees, but rather depend on small "team-building exercises" and meetings at the end of shifts, which do not help with motivation (Ramirez, personal communication, September 22, 2019). In environments like these, there is hardly, if any, intrinsic motivation in employees. Students would have a difficult time making their education the primary concern with a job in these organizations.

Hypotheses

Motivation alone is a topic that is expanse and difficult to implement because, when in practice, not all employees are the same. What works to motivate one person might not motivate another. This topic specifically with student workers presents different challenges. Managers can find it difficult to motivate their student staff when for the students, their job is temporary and insignificant in their professional career. The differences in student employees' motivations led to the following hypotheses:

H1: Student employees dedicate less effort into jobs that do not relate to their future careers than jobs that do.

H2 Student employees valuing a close relationship with their manager feel more individually appreciated at work when given praise from said managers.

H3: Students working in the service industry value sympathetic manager skills (Patience, Kindness, Understanding) and a deep bond with a manager.

This hypothesis essentially is divided in four sections where student workers in the service industry are compared to students working in other industries.

- H3a: Students working in the service industry value Patience as a manager skill over students in other industries.
- H3b: Students working in the service industry value Kindness as a manager skill over students in other industries.
- H3c: Students working in the service industry value Understanding as a manager skill over students in other industries.
- H3d: Students working in the service industry value a close bond with a manager skill over students in other industries.

H4: Student employees will put more effort into a job that holds their role of students as important and a main concern.

Methodology

Design and Procedure

In order to collect data to test the hypotheses, a twelve-question survey was sent out among the university students of Cal Poly Pomona. This survey was done using the free template on SurveyMonkey. The first question asked student participants to rate four choices in order from most to least important consideration when searching for employment. The four options were good benefit (time off, health insurance, etc.), pay, a good/enjoyable work environment, and a flexible schedule. The second question asked students to rank the effort they personally felt they put into their current job from one to ten, the latter being the most effort possible. The next question asked students to give their opinion on how valuable to them was a close relationship with their manager. The options ranged from "Extremely valuable" to "Not at all valuable". The fourth question, once again, asked student participants to rank the kinds of attitudes they valued most in a manager from most to least valued. These attitudes and traits included a range of what are considered "nice" to "strict" such as being kind, understanding, patient, reliable, honest, trustworthy, authoritative, and strict. Following this question was another ranking question asking students to rank, from most to least important, what made them feel appreciated at work. The options for this question included "verbal praise from manager," "recognition in front of peers," "rewards system based off performance," "relative freedom/low strictness derived from trust," and "incentives/perks." Question six asked students to pick how important it was to them personally that their manager respected and took into consideration their status as a student at work. The five options here ranged from "greatly important" to "not at all important." The seventh question was directly related to the previous question, as it asked students to, from one to ten, rank how much they thought their current manager respected that role as a student. Question eight was a yes or no questions asking students to state whether their job now related to their future career. The following four questions were mostly asking for demographics. Question nine and ten asked students what their current academic standing and age was, respectively. The next two questions asked students what industry their job belonged in, whether the service industry, manufacturing, an office job, or self-employed, and then whether this job was part-time or full time.

Due to the online nature of the survey, distribution was done online as well to gather the responses. The first attempt was sharing a post with the link to the survey on the Cal Poly Pomona subreddit, which is frequented by almost 9,000 users. The subreddit is a popular site that many students across the colleges of the university use to post surveys required for class assignments.

The post invited students currently employed to take the survey, which only took three minutes or less to complete and would maintain their responses anonymous, encouraging them to help a fellow student in their coursework. The survey was up for two weeks, and during this time 65 students responded to the survey. To obtain additional responses, students employed in places on campus were asked to take the survey as well, since they already fit the targeted demographic. Students were asked to share the survey among friends if possible. Both a web and a mobile link were provided for students to take the survey. At the end of the two weeks a total of 89 responses were collected from students across campus. Attempts were made to collect a minimum of 100 responses by posting the survey on other social media pages such as Facebook and to groups of students from other universities, but they were not obtained.

Results

Participants

The total number of participants for this study amounted to 89 random, willing students (n=89). The only requirement for a student to take the survey was to be employed, but aside from that no specific demographic was targeted. All the respondents were Cal Poly Pomona students. Based on the demographic questions included in the survey, the results revealed that the majority of respondents, 34 to be exact, were Senior level standing. This constituted 38.20% of the total number of participants. This category was followed by students at a Junior level with 28 participants (31.46%), and then Sophomore with 17 participants (19.10%). There were only 7 (7.87%) Freshman standing students and only 3 (3.37%) Graduate level students. Most of the students fell under the age range of 18-21 years old, with 61.8% belonging to this category. 22.47% of the 89 participants were 22-25 years old, and lastly 6.74% were under the age range 26-30. None of the respondents fell in the “30+” years old category. Most of the students surveyed overwhelmingly put that they worked part-time, with 81 of them picking this option. Only 9 of the participants worked full-time jobs. The last demographic categorized student respondents based on industries they worked at. A majority of them, 45 to be exact, worked in the service industry. 23 students worked office jobs, followed by 14 that picked the “other” option, and only 7 worked in the manufacturing industry.

Perceived Effort Put into Jobs

In order to test Hypothesis 1, that student employees dedicate less effort into jobs that do not affect their future careers than jobs that do, the answers to the second and eighth questions of the survey. All the responses to the question asking students to rank the effort they put into jobs were positioned side by side with their respective responses to whether the future job of the student related to their career. Based on these responses alone, in excel, the number of students who claimed they put effort as less than or equal to five on jobs not relating to their career, the median option, was only seven out of the 65 total students that responded that their current job was not related to their career. The number of students that claimed their effort was greater than or equal to 8 in jobs not relating to their careers was 46 out of the 65 totals. The “greater than or equal to 8” variable was considered in this data to evaluate the effort as “high” At a glance, these results already appear to not support H1, as the majority of students that are not working at jobs relating to their future careers consider themselves to put high effort.

Excel was also used for the actual hypothesis test. A t-Test was done using the Data Analysis feature in Excel to find the p-value in "Two-Sample Assuming Unequal Variances" t-Test. The independent variable was whether the job students had related to their future careers. Therefore, there were only two variables: Yes and No. The test was conducted using an α= 0.05 value.

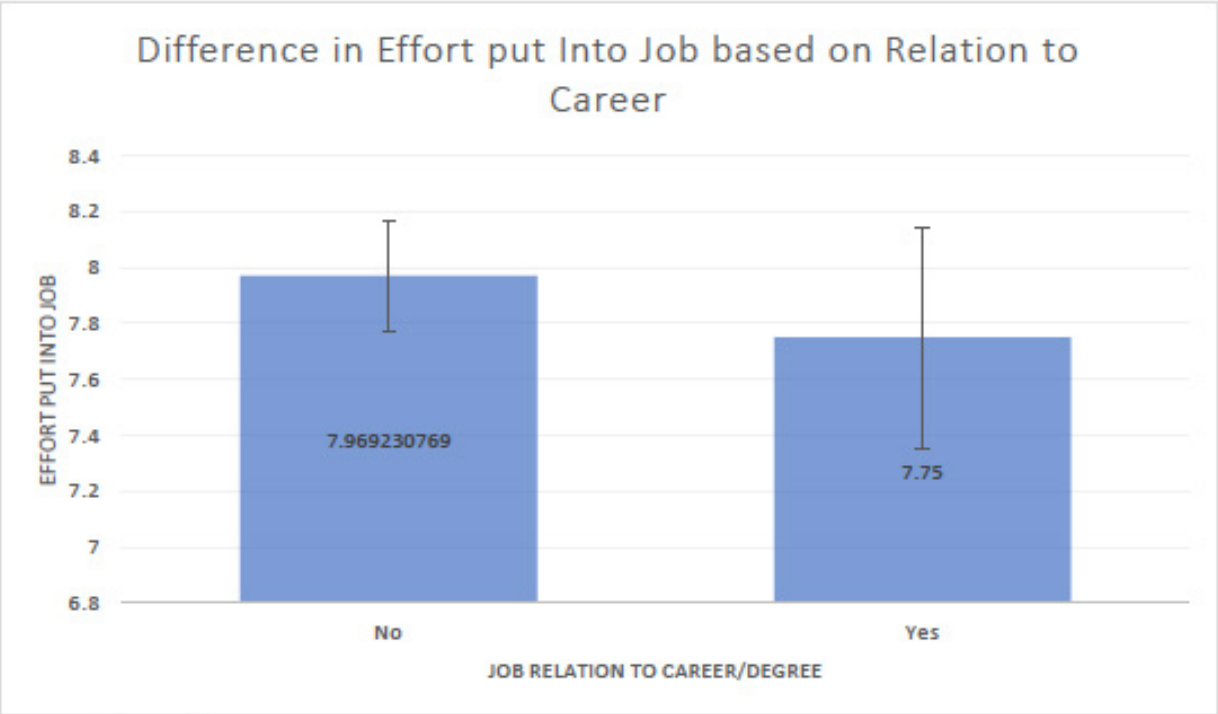

Figure 1

The results from the t-Test revealed that the mean effort put into the jobs by those that responded that they do not work on jobs related to their career was 7.969. Whereas those that stated that their job did relate to their career had a mean of 7.75. Figure 1 shows the chart summarizing the means of each option and the standard error of each. For the variable "No" the standard error was 0.196 while for "Yes" it was 0.396. The t-Test also revealed the p- statistic to be p= 0.311 for a one-tail test, and therefore was not less than the α=0.05. H1 is rejected as there is not enough evidence support the hypothesis that student employees dedicate less effort into jobs that do not relate to their future careers in comparison to those in jobs that do.

Value of Manager Praise

H2 stated that student employees valuing a close relationship with their manager would feel more individually appreciated at work when given praise from said manager. Based on the responses to questions three and five, specifically the rankings for the option "Verbal praise from manager, the data was used to create another t-Test of two samples assuming unequal variances. The independent variable constituted the value of the relationship between the student worker and their manager to said student. Those that ranked the value of a close relationship as "Very valuable" and "Extremely valuable" were used to make up the number of students that valued the close relationship. This group was made up of 57 students (64.04%). Those that ranked the value of manager praise as a one or two on the question of what made them feel more appreciated at

work made up the category of students that valued manager praise. 48 (53.93%) participants in total claimed to highly value manager praise, with 34 students ranking it in the number 1 spot and 14 students ranking it as second. Using these classifications, a total of 12 students (13.48%) both valued a close relationship with a manager and valued manager praise to feel appreciated.

Data Analysis was again used to conduct the t-Test, and the α= 0.05 as well. The results yielded a mean of 2.386 for those that valued a close relationship and a mean of 2.343 for those that did not value a close relationship with the manager, expressed as "Close" and "Not Close" respectively. As can be observed in Figure 2, which also shows the standard error for both options, provides an image of the closeness of the means. The p-value for of this one-tail t-test came out as 0.442, which again, was not less than the α= 0.05. Therefore, the null hypothesis fails to be rejected, which means there is not enough evidence to show that student employees having a close relationship with their manager feel more individually appreciated at work when given verbal praise by said managers.

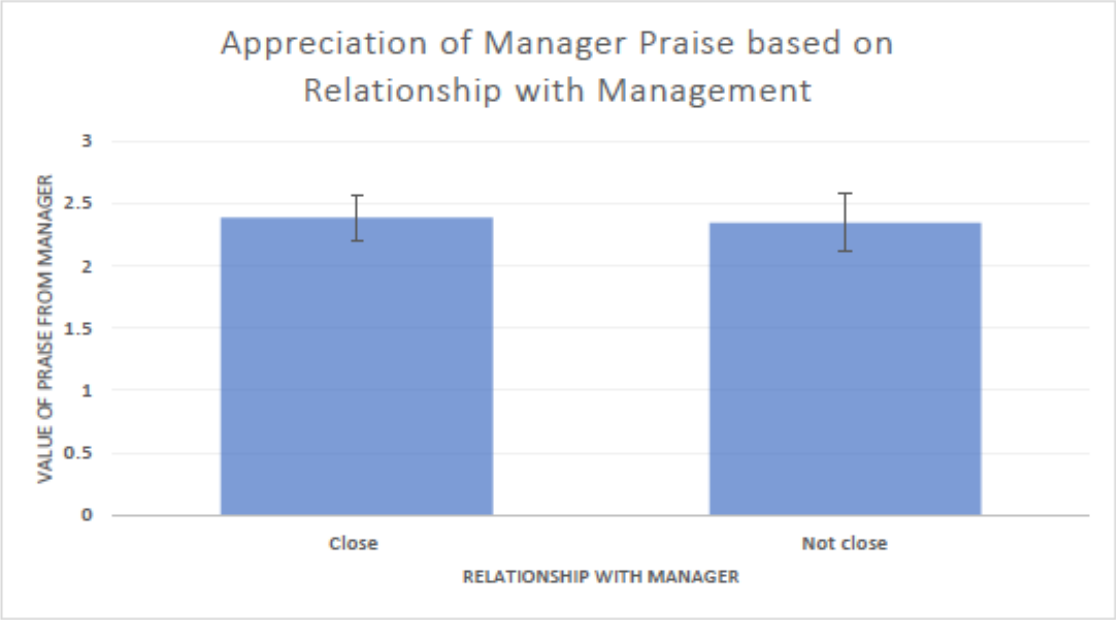

Figure 2

Values Within the Service Industry Compared to those Elsewhere

H3 was separated into four sub-hypotheses in other to better analyze the results of the data and conduct four separate one-tail t-Tests for two samples assuming unequal variances. Before using the data analysis tool, the answers to the survey were gathered and grouped, revealing that 45 students (50.56%) worked in the service industry. As calculated during H2 data analysis, the number of students that valued a close relationship with the manager, given the same parameters as in H2, were 57 (64.04%). The perceived value of the skills/attributes was based on the responses that classified the skills at rank 1 or 2 above all other skills for each of them. The results were as followed: 18 (20.22%) of students valued patience in a manager above all other skills, 46 (51.68%) valued an understanding manager above all other skills, and 27 (30.33) valued kindness in a manager above all other skills. At first glance this appears to support H3 as a whole, when grouping all students that value the three sympathetic skills (patience, kindness, and understanding). Further grouping revealed that a total of 40 students out of those in the service industry (88.89%), highly

valued sympathetic manager skills and a deep bond with a manager, which also supported H3. The induvial t-Tests for each skill revealed otherwise. All t-Tests used service vs non-service jobs as the independent variable and α=0.05.

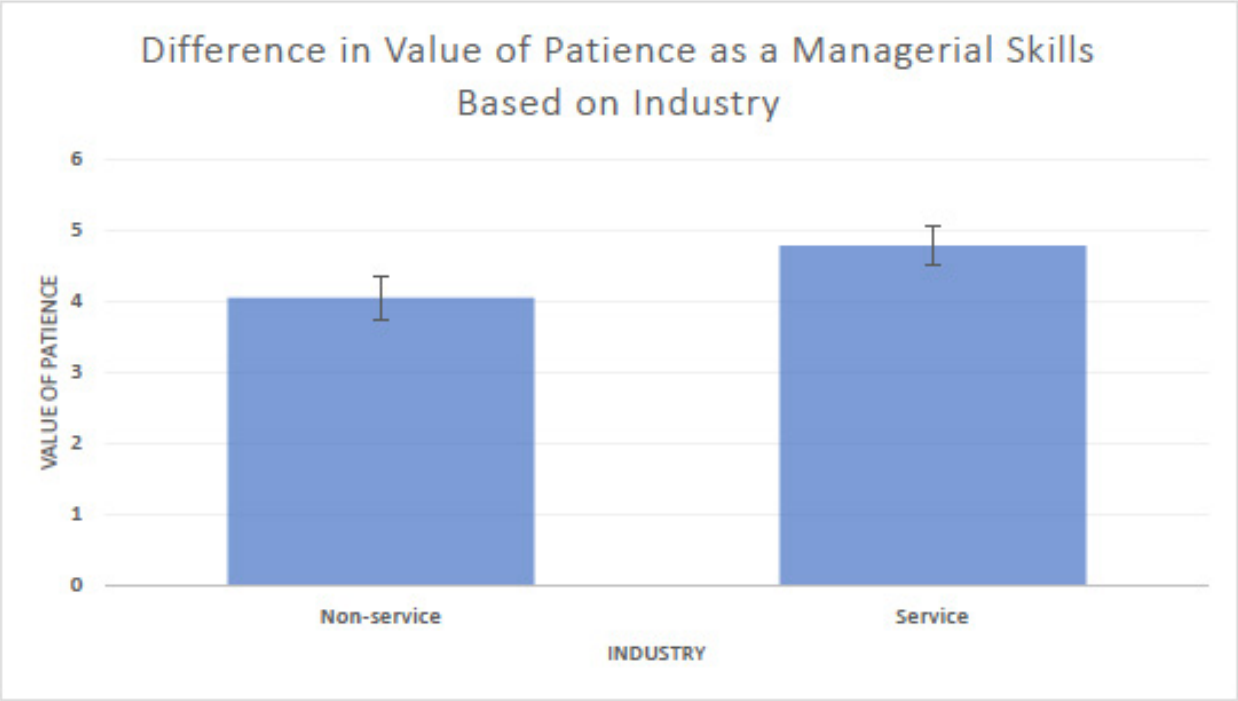

Figure 3

The first t-Test conducted aimed to test hypothesis H3a, which tested the value of Patience. As shown in Figure 3, the means between those in the service compared to those in a non-service industry hardly varied (4.777 compared to 4.045), with a very similar standard error as well (0.271 and 0.299 respectively). The p-value for the one-tail test was p= 0.036, which meant that the null hypothesis would be rejected. Therefore, there is enough evidence to show that students working in the service industry do value Patience over those in other industries.

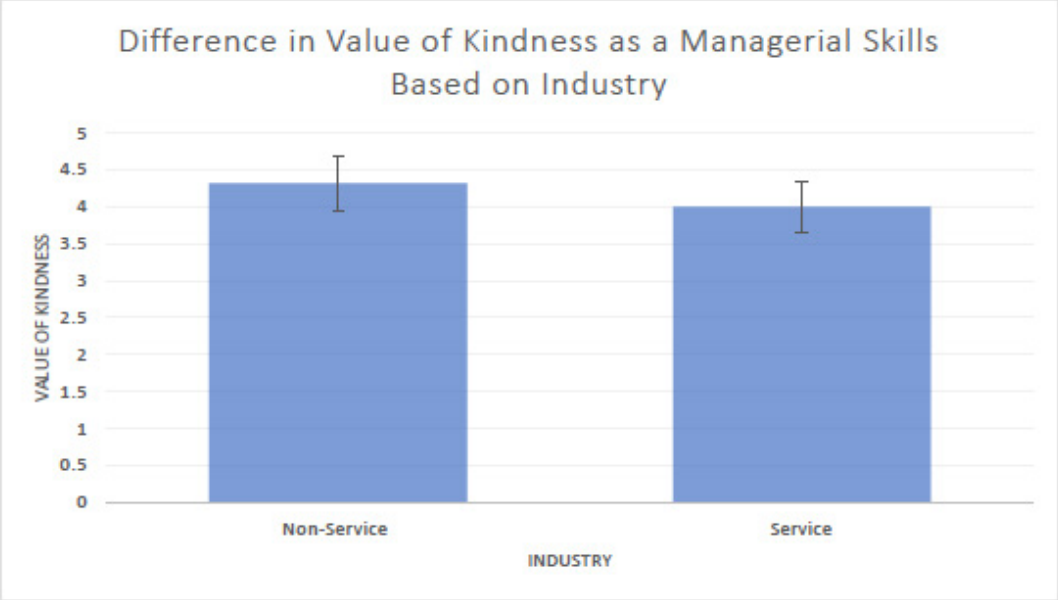

Figure 4

The second test conducted tested hypothesis H3b to find evidence of whether students in the service industry valued Kindness above those in other industries. Figure 4 shows the mean value of kindness within students in non-service industries (4.318) compared to the mean of value of those in the service industry (4). The standard errors, (0.299 and 0.271 respectively) are also displayed in the graph. The p-value of this one-tail test came out as p= 0.37, which is not less than α= 0.05. Therefore, the null hypothesis fails to be rejected, as there is not enough evidence to show students in the service industry value kindness over those in other industries.

H3c was tested in the same manner as the other hypotheses before, but this time testing the value of Understanding as a managerial skill in relation to the industry the students worked at. The means of the value of Understanding hardly differed between industry sectors. Those not in the service industry had a mean of 3.022 and standard error of 0.289, whereas those in the service industry had a mean of 3.133 and a standard error of 0.351, as can be seen in Figure 5. Using the data analysis function on excel, the p-value for the one-tail test was p=0.404, which again was less than the α= 0.05. This meant that the null failed to be rejected again, as there was not enough evidence to show that students in the service industry value the quality of being understanding in a manager over the students working in other industries, according to the n=89 sample size.

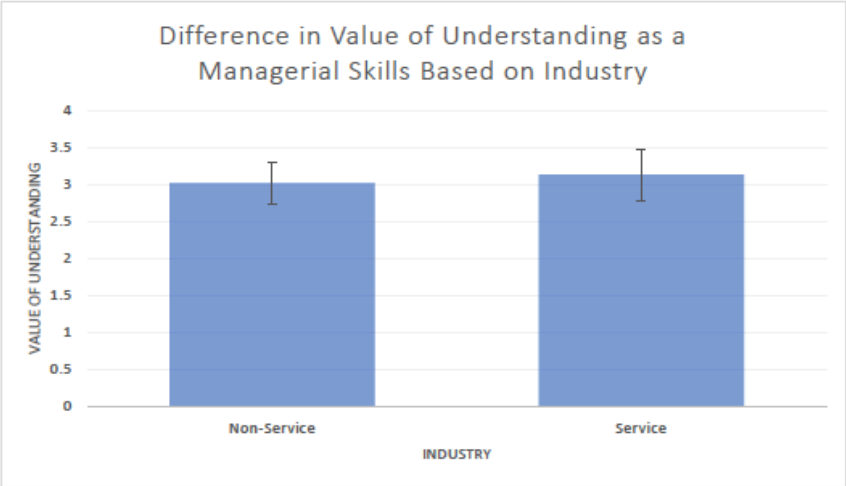

Figure 5

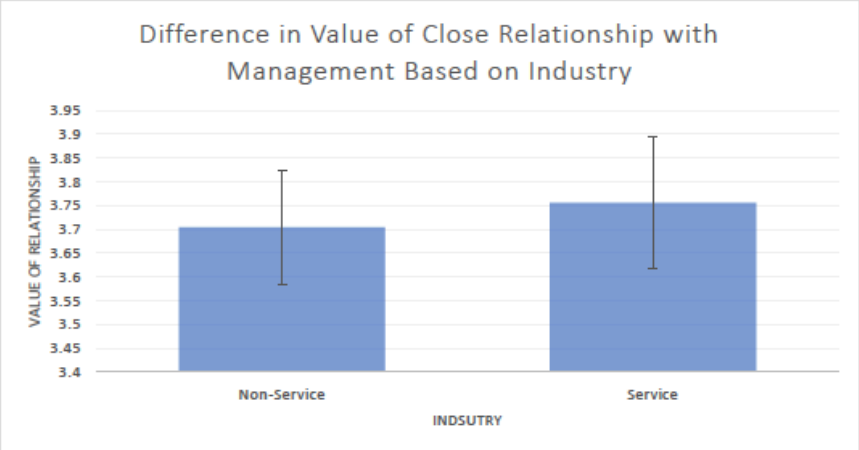

Figure 6

H3d was the last sub-section of H3 to be tested regarding the value students put on having a close relationship with their manager based on the independent variable. The variable was the industry the student respondents worked at. Once more, the means between the independent variables varied only very slightly, with the students working in the non-service industry having a mean of 3.704 and those in the service industry having a mean of 3.755. The standard errors, similarly, were 0.119 for those in the non-service industry and 0.139 for those in the service industry, as seen in Figure 6. A t-Test was conducted using the data, that revealed a one-tail p-value of $p= 0.391$. This p-value, too, was not less than the $\alpha= 0.05$, meaning that the null failed to be rejected. There was not enough evidence to show students in the service industry valued a close relationship with their manager over those in other industries.

Role as Student in Relation to Effort Demonstrated

The last hypothesis, H4, predicted that student employees would put more effort into a job that holds their role of being a student as important. The data on the second question of the survey was used to determine the levels of effort. "High effort" was made up of those student respondents that stated they put higher than or equal to "8" effort on a scale of 1 through 10. The number of students claiming this were 59 out of 89 (66.29%). The importance of managers respecting a student's role as being of high importance consisted of those respondents of question six on the survey that chose the options "Greatly" or "Significantly" important. Combined, this gave 67 students (75.28%). For the responses to question seven, about the actual importance managers put into student's role, only the ones greater than or equal to 8 were also used to determine managers that considered the role important. The yield of this was 66 students (74.15%) that had managers who respected their student role. Using these parameters, a total number of students who put high effort into a job and have managers that highly respect their roles as students was 49 out of 89 (55.05%), so a majority. Based just on these statistics, H4 seems to be supported.

A t-Test of two-sample assuming unequal variances was conducted here as well using the data analysis tool in Excel. The independent variable here was the determining factor of whether the job students currently held saw their role of students as important or not. The means here varied significantly. The mean of the "Important" variable was 8.166 and had a standard error of 0.180, whereas the mean of the "Not Important" variable was 7.173 and the standard error was 0.424. The results of this can be observed in Figure 7. As for the p-value for the one-tail test, the results came back as $p= 0.019$. This value is less than the $\alpha= 0.05$, which meant that the null hypothesis could be rejected. Therefore, there was enough evidence to show that students do put more effort into a job that holds their role as students as important and a main concern.

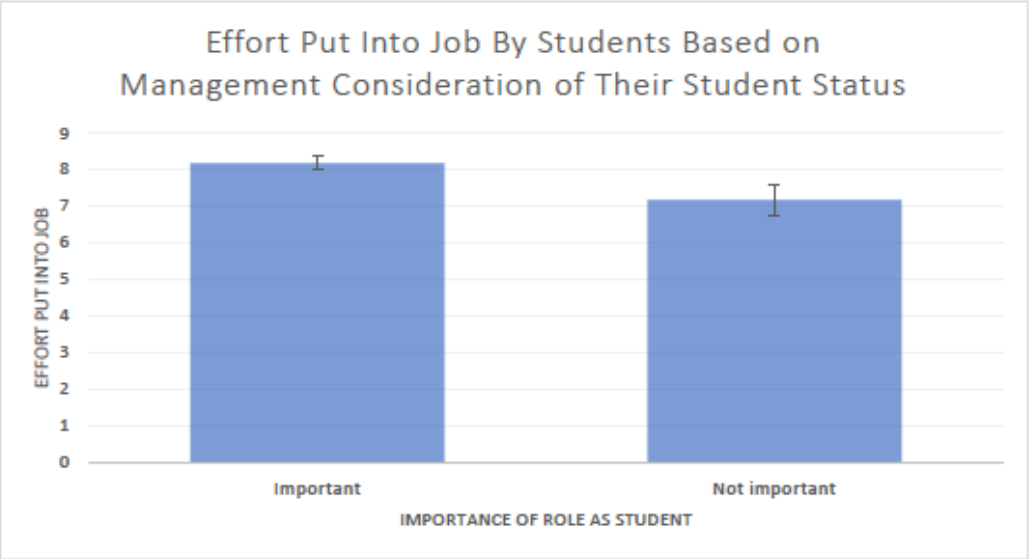

Figure 7

In addition to the t-Test, a simple regression analysis was also performed. This was done because both the "Effort" and "Importance" variables are continuous, so the regression analysis was to find the correlation between the two. This way, the importance of the role as a student being over or equal to 8 did not disregard the rest of the data about it (Kukita, personal communication, December 4, 2019). Likewise, with the effort, so this way the rest of the data could be taken into consideration. Using the Regression option in the Data Analysis function, the data under the "Effort" column was entered as the Y-range and the data under the "Actual Importance" column became the input for the x-range. The regression analysis was run under a 95% confidence level. The results showed that the p-value equaled 0.0002, and therefore still less than the α. The chart, Figure 8, shows the linear predicted effort based on the actual effort from the data in regard to importance. This is proof that a positive relationship does exist within the x- and y- variables. Therefore, effort put into jobs by student workers increases as they perceive that their manager puts more importance into their role as a student.

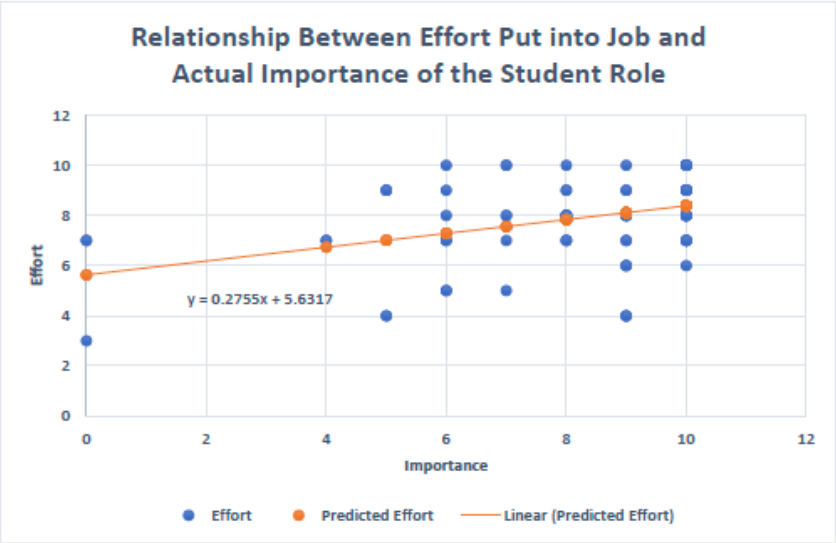

Figure 8

Discussion

The results of the survey study aimed to show possible differences between student employees, given that the fact that they are students affects the jobs they can obtain and keep. As mentioned in the introduction, student employees do face the challenge of managing employment and education (Lee et al. 2013). Thus, this led to hypotheses that strived, not to expose these challenges, but rather to discover characteristics and attitudes towards jobs and management. A misguided belief that conducted the direction of the hypotheses and research was that student employees put less effort in general and cared more about their future opportunities instead of the present job responsibilities. This was proven wrong based on the responses from the sample population. Contrary to this belief, a majority of students in jobs that did not relate to their future careers put, what they consider to be, high effort, if not the most effort possible. H1 turned out to not be supported by the findings.

This study did not research the reason why student employees turned out to put more effort into jobs not relating to their career than those in jobs that did. Therefore, it is difficult to pinpoint the reason behind these results, and only speculations can be made. A significant factor that could have played a role in these results is the money or pay motivator. Most students chose this as the most important factor to consider when looking at a job opportunity. This can be interpreted as students deciding to put effort based on the pay, regardless of whether the job related to their career or not.

Another possible influencing factor to job effort could be work culture, which was not explored in this study. According to the results from Ellis et.al (2010) "Varying influences of motivation factors on employees' likelihood to perform safe food handling practices because of demographic differences," part-time jobs lead to considerably different work culture than full-time jobs. Students tend to obtain mostly part-time jobs, as proved in the survey data, which can in turn mean that the work culture plays a role in the enjoyment at the workplace and effort put into the work.

The study did not prove the importance and value of a close manager relationship, as hypothesized in H2 and H3d. While this may show that managers need not strive to create a meaningful relationship with their student employees, it does support other research that establishes management's behaviors as an indispensable factor in job performance and satisfaction (Abbas, Ishaq, & Ullah, 2018). H4 directly supports this since it proves that students do put more effort into their job if this job holds their job as important, and that effort has a direct positive correlation to how much importance is placed in this role. Managers are the ones responsible of taking this role of being a student in their student employees as important. This importance can be perceived, for example, in the schedule. By giving them hours that do not interfere with their classes and allows them time to dedicate to their studies, managers show care and consideration to their student employees.

The research done based on H2, however, proved that student employees place high value in verbal praise from their managers and leads to them feeling appreciated. Solely on this data, managers can assume that their words do matter and that simple praise can boost spirits and motivate. Managers are encouraged to find what motivates their individual employees in order to have more satisfied employees that perform well (Brick, 2012).

H3 directly observed the values of student workers towards certain characteristics and behaviors of managers. This hypothesis focused on comparing the difference in values between those in the service industry and those in other industries. Based on the results, only the characteristic of patience was shown to be valued by students working in the service industry compared to students working elsewhere. In the service industry, patience in a benefitial and often essential quality to have, since it involves working directly with the public. Therefore, it is not too surprising that student workers value this attribute and value that a manager displays it with customers and employees.

Without taking into consideration other variables and just based on raw data, students did overall value a close relationship with their manager and sympathetic qualities in them. This directly supports the claims manager Sandra Cain (2019) made, that building trust and a close relationship with her student employees based on their motivatiors has led to better employees. Other studies have shown that positive and sympathetic management behavior can even resolve conflicts before they occur or create further problems (Abbas, Ishaq, & Ullah, 2018).

Study Limitations

This research study in no way represents the attitudes and beliefs of a majority of student in the workplace. The sample size of 89 students who completed the survey is not large enough to be accurate. A bigger sample size could better reflect the thoughts of students. Due to the survey being shared on social media, the results excluded a large portion of the student population at Cal Poly Pomona that do not frequent that particular site.

Another limitation is that this study did not consider the demographics of the respondents. Since demographics involving ethnicity or race, gender, and economic status were not present in the survey that was distributed, the results could be an inaccurate representation of the Cal Poly Pomona population. The study only consisted of Cal Poly Pomona students, which means that the results also do not reflect the thoughts of the student population at other colleges that is employed overall . This university is more diverse than others in terms of demographics, and because the survey did not record that, it is impossible to know if these factors influenced the responses. Studies have shown that demographics affect whether a student decides to get a job or not (Lee, Leon, & Youn, 2013). For example, Asians are less like to work and study, choosing to focus on their education, and students with more economic needs will most likely be working while studying (2013). Therefore, in regards to the survey, it is possible that some groups of students were excluded from the study completely.

Further Research

The results of this research project pave the way to do future research in specific motivating factors of students and how much each influences the quality and effort of their work. This study glossed over the things that motivate student workers without tying it directly to other factors. Future research can be done on how managers utilize these factors to motivate their student employees. The impact of intrinsic compared to extrinsic motivation was not explored in this research, as it can be difficult to find ways to measure intrinsic motivation. With further research, a method to measure this motivation can be used to then apply it to independent factors, like how it relates to the effort put into jobs and if students

are more prone to display one over the other.

Another topic worthy of research is the effect that a job during the higher education years of a person has on their future career and attitudes towards their future jobs and managers. The years a student in in college are often a time that shape a person's work ethics and molds them to be future professionals (Cain 2019). It would be interesting to analyze how the views of a person have changed from their college years to their post-college life. This would require following a set of participants for a considerable amount of time, but the research from this study could be used to document the general attitudes and thoughts of student employees as a group.

The findings of this research can be used to further study if the thoughts of students widely vary from those peers their age that did not attend college. A thorough study that better compares working students and employees who are not students could reveal improved methods to motivate and manage both groups in a more efficient manner.

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The Interplay Between Stressors and Resilience from Adolescence to Young Adulthood

Executive Summary

This study examines person attributes and environmental characteristics to assess the relationship between resilience and adolescents' mental health. The adolescents are 13-18 years old and at developmental stages when they are most likely to become more independent from their parents and start to build up and manage their emotional independence and decisions. Although it is understood that resilience encompasses the ability to push through, overcome, and ultimately 'bounce back' from experienced adversities, the measurement and approaches to resilience still differ across disciplines. The current study expands on existing research on resilience. The notable difference in depressive symptoms is the result of resilience and additional supportive familial relationships. The interrelationships of external and personal characteristics contribute to differences in resilience and changes over the early life course from adolescence to young adulthood.

Introduction

Historically the concept of invulnerability from harmful influences has been associated with the concept of resilience (Masten & Obradović 2006). While the concept of resilience is understood in a general sense, measures associated with the concept are not always well understood. For example, in developmental psychology and social science research, coping, hardiness, adaptation, mastery, adjustment, and persistence are often used to describe resilience (Windle 2011). The idea of resiliency refers to processes that are at work, interrupting the path for being at risk for problem behaviors. Resilience is viewed as a positive concept that implies strength, power, and hardiness. The concept of resiliency represents an explanation of why some children show successful adaptation despite exposure to threatening situations. Resiliency and vulnerability are often viewed on opposite ends of a continuum (Masten & Obradović 2006). When an adverse life situation occurs, the individual either becomes vulnerable to the situation and is unable to cope with the consequences, or is not susceptible to the negative impact, thereby exhibiting resilient characteristics. Resiliency is often discussed in combination with risk factors and protective factors. The literature suggests that resilience can result from the interplay between these factors.

One of the main goals of resilience research is to better understand what resilience means and to identify the diverse factors that make someone a resilient individual. What is the relationship between resilience and emotional wellbeing among adolescents?

One in five adolescents, ages 12 to 18, suffer from mild to severe mental disorders, which tend to develop in their early lives (National Institute of Mental Health, 2017). This is a problem that is of importance since suffering from mental health disorders can be detrimental to a person's life. Thus, this study examines resilience connected to children's emotional wellbeing (e.g., depressive symptoms). Understanding the mechanisms that generate resilience in children, can inform us about the nature of resilience and how to overcome hardship or strainful situations to decrease the risk of mental health issues.

Before we discuss the preliminary findings, we review some relevant findings from psychology and social science researchers about resilience and additional concerns they raise for the study of resilience.

Research on Resilience

Developmental psychology and social science studies have examined the concept of resilience from a range of perspectives – accounting for personal characteristics, environmental factors, or viewing resilience as a process (Luthar et al. 2000, Masten 2007, Vanderbilt-Adriance 2008). While most research agrees that resilience represents some form of overcoming adverse circumstances or "bouncing back," the complexities of defining resilience or measurement of resilience remain challenging (Windle 2011). Moreover, how resilience is conceptualized varies by discipline. This report explores resilience from a socio-psychological perspective. The main focus is to understand further the relationship between resilience, risk behavior, and depressive symptoms. We also examine items of resilience compared to a resilience scale to further understand the dynamic effects of resilience during adolescence. We argue that some of the resilience measures may matter at different points in time -through learning how to handle adverse experiences, children's resilience may evolve. Using a resilience scale might mute potential factors or characteristics to effectively capture the process of adapting or managing experiences or observations of stress or trauma. For this report, we review resilience from a person and environmental perspective as well as the early life course.

Personal Attributes and Environmental Perspectives on Resilience

From a person-focused perspective, a person's qualities determine whether and how the individual goes through and overcomes adversities and most likely "bounces back" (Roth 2007). Given these personal attributes, research assumes resilience to be more invariable or fixed. Personal characteristics may protect against adverse life events, trauma, or stress through useful resources (Roth 2007) and healthy coping skills.

Other factors associated with resilience are family and community conditions. In a study of Mexican-American immigrant families, the researchers aimed to describe and examine how the issues for Mexican parents that are raising American-born children can affect the child's resiliency and how these obstacles differ from other immigrant populations in America in the way they support the children (Chavez 2018). They found that interventions at the macro-level have the most impact in all communities, and these interventions can benefit immigrant communities, such as parenting groups. This research demonstrates that family upbringing can affect the child's resilience, highlighting the importance of parenting styles and the support that children need to be more resilient. Another study also argues about how vital outside support can be for resilient children (Turner 2013). In this study, the researchers examined resilience in the presence of community disorder, mental distress, victimization, family support, and adverse life events to further explain the association between these variables and resilience. The researchers concluded that youth that lives in highly disordered communities experience higher levels of psychological distress (Turner 2013). In other words, if children grow up in highly disordered communities, they will be more susceptible to psychological disorders. In another study, researchers examined the relationship between educational resilience and family support. The focus of this research was to explore familial and outside familial relationships across groups and whether support from non-parents protects against academic risk. The AddHealth findings

suggest that while the relationship between the adolescent and parents and the relationships between the adolescent and other peers can interact, they are not significant enough to be considered a protective factor for academic resiliency. One of the limitations mentioned in this study was that the researchers could have measured resiliency more directly from the participants. Overall, these findings demonstrate the significance of outside support in the children's upbringing and how external factors play a role in mental health and resilience.

Resilience in Mental Health

One of the common themes in the resilience literature has been focusing on mental health outcomes such as depression, anxiety, and addiction, associated with resilience. A foundational article on vulnerability and resilience, examines stress, competence, and depression among high-risk adolescents (Luthar 1991). Luthar questioned whether resilient children exhibit higher symptoms of anxiety and depression, in the presence of high degrees of competence. The measures used include a Life Events Checklist (Johnson & McCutcheon, 1980) and a Children's Depression Inventory (Kovacs, 1982). The results revealed that children who were considered to be resilient were more depressed and anxious than other competent children who did not endure as much stress. In terms of the variables, ego development was compensatory (meaning it influenced competence) to stress, internality and social skills were protective factors, and intelligence and positive events were vulnerable during these events. The findings of this study demonstrate that looking at mental health is important to better understand a possible relationship between mental health and resilience.

Other research explored the relationship between substance abuse and resilience (Larm 2010). The goal in this longitudinal study was to examine resilience in adolescents who had received treatment for substance misuse, to explain the continuity or discontinuity of resilience, by investigating person characteristics (Larm 2010). Latent growth models (2004) were used to identify the trajectories of resilience. The findings revealed that those who had misused substances during their adolescent years were significantly less likely to develop resiliency later in their life (Larm 2010). The common theme within these two studies was that the researchers both placed importance of resilience associated with mental health during adolescence. Some gaps in the literature point to the need of expanding research to different settings and diverse populations of children across different developmental stages (Turner 2007).

Resilience and the Life Course

A key assumption of the life course perspective is that human development advances in the context of social relationships that consequently shape and alter the development of human behavior and emotions (Elder et al. 2003, Thornberry et al. 2003). A significant first social connection is the parent-child relationship (Ross 2017). This important relationship is also associated with various positive (self-reliant social behavior) as well as adverse behaviors (poor conduct in children as a result of poor parenting) (Bariola et al. 2011). Studies have linked the impact and intensity of parental stressors to children's development trajectories (Elder et al. 2003, Galambos et al., 2018; Lerner & Steinberg, 2009; Yap et al., 2007). Thus, different mechanisms may apply to explain the responses to parental and environmental adversities on depressive symptoms and resilience at different stages from

adolescence to young adulthood (Elder et al. 2003).

The life course approach considers the complexities of resilience by examining resilience as a process – instead of a static concept (Windle 2010). This further implies that resilience potentially shifts and changes throughout the developmental stages. Resilience operates across different person-level characteristics (e.g., wellbeing, age, gender) and contextual-level characteristics (e.g., neighborhood, school context), which also can interconnect with each other. For example, in a prominent study of neighborhood context and deviance, Sampson and colleagues argued to consider dynamics of change to better understand behavior (Sampson, Morenoff and Gannon-Rowley 2002). Very few researchers have been able to follow this suggestion due to data or methodological limitations. An exception has been a longitudinal study from Chicago which shows that moving from crime-prone neighborhoods to safer areas increased adolescents' self-efficacy (Dupéré, Leventhal and Vitaro 2012).

Resilience has also been identified as an essential factor that helps individuals in coping with stressful factors or circumstances (Masten 2001). While some studies have identified factors that contribute for example to negative mental health outcomes of risk of adolescent offending (Dahlberg and Simon 2006), research remains sparse about the impact of resilience of youth transitioning from adolescence to young adulthood.

Study Description

The sample of adolescent respondents for this research was drawn from the National Longitudinal Study of Adolescent to Adult Health (Add Health-Public Use data files). The Add Health study has been designed by researchers at the University of North Carolina with a focus on adolescent health. The Add Health study is the largest and most comprehensive longitudinal study of adolescents. Initiated in 1994, Add Health has been supported by four program project grants from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), National Institutes of Health (NIH) with co-funding from 23 other federal agencies and foundations (University of North Carolina 2020).

The study started with an in-school questionnaire administered to a nationally representative sample of 7th to 12th graders during the 1994-95 school year. The study followed up with a series of in-home interviews conducted in 1995, 1996, 2001-02, 2008, 2016-2018, and still ongoing. Other data sources consist of survey responses from parents, siblings, fellow students and school administrators, and interviews with romantic partners, only available with a restricted data-use contract. Add Health also provides information about neighborhoods and communities.

The Add Health study consists of survey responses from five waves of data. Each wave combines longitudinal survey data on respondents' social, economic, psychological, and physical well-being with contextual data on the family, neighborhood, community, school, friendships, peer groups, and romantic relationships. Thus, providing unique opportunities to study the relationship between social environments and behaviors in adolescence connected to health and achievement outcomes in young adulthood. Publicly four out of the five datasets are available for study.

Public-use data for Add Health are collected from multiple sources. Wave I was conducted from September 1994 through December 1995, Wave II was conducted from April 1996 through August 1996, in Wave III responses were collected from August 2001 through April 2002, and in-home interviews in Wave IV were conducted from January 2008 through February 2009.

For this report, we examined responses from Wave I. We also explored the longitudinal nature of the data in our preliminary findings. However, this component is still in a data exploration phase. Overall, in our study, we take advantage of the waves that focus on adolescents' health and risk behaviors to capture the influences of these factors on depressive symptoms in the presence of resiliency.

This study uses regression analysis and a mixed model approach to analyze resilience and depressive symptoms among a representative sample of adolescents in the United States.

In order to measure depressive symptoms, items were chosen based on the Epidemiologic Studies Depression Scale (CES-D). A scale was created using a total of 13 items with a Cronbach's Alpha of .75. The items were all coded to reflect high levels of depressive symptoms. The scale includes the following items: (1) "You don't feel like eating, your appetite was poor", (2) "You felt that you could not shake off the blues, even with help from your family and your friends", (3) "You felt that you were just as good as other people", (4) "You had trouble keeping your mind on what you were doing", (5) "You felt depressed", (6) "You felt that you were too tired to do things", (7) "You felt fearful", (8) "You talked less than usual", (9) "You felt lonely", (10)"People were unfriendly to you", (11) "You felt sad", (12) "You felt that people disliked you", and (13) "It was hard to get started doing things."

The measure of resilience consists of six items with a Cronbach's Alpha of .68. The items were coded to reflect high levels of resilience. The following items assess resilience: (1) "You were bothered by things that usually don't bother you", (2) "You felt hopeful about the future", (3) "You thought your life had been a failure", (4) "You were happy", (5) "You enjoyed life", and (6) "You felt life was not worth living."

Additional person attributes and external factors employed in the analyses are presented in Table 1.

Table 1. Summary Statistics for Regression Analysis (N=6,446)

	Mean	Std.	Min	Max
Depressive Symptoms	1.354	1.93	0.00	13.00
Resilience	23.293	3.23	0.00	28.00
Risk Behavior	3.016	1.13	1.00	5.00
Suicidal Behavior	.127	0.33	0.00	1.00
Neighborhood strain	2.923	1.02	0.00	4.00
Warm relationship with parent	1.695	0.88	1.00	5.00
Age	15.808	1.60	13.00	18.00
Sex	.516	0.49	0.00	1.00
Religiosity	1.637	0.75	1.00	4.00

Preliminary Findings

Descriptive Analysis

The findings in Table 2 indicate a negative relationship between stress (depressive symptoms and resilience. Additionally, high neighborhood strain (low cohesion) is positively correlated with depressive symptoms. As for resilience, we find that risk behavior, suicidal behavior, a less affectionate parent-child relationship, and low religious engagement are negatively associated with resilience. Moreover, we find a negative relationship between high levels of perceived neighborhood strain and adolescents' resilience for environmental characteristics.

For the age and child gender, the descriptive findings correspond with previous work on resilience and mental health, showing a negative relationship for girls and depressive symptoms, and a negative relationship for older children and depressive symptoms (Anyan and Hjemdal 2016). In comparison, resilience is negatively associated with younger male children.

Table 2. Correlations among Depressive Symptoms and Resilience and other Personal and Environmental Characteristics (N=6,446)

	Depressive Symptoms	Resilience
Depressive Symptoms	1.00	-.585***
Resilience	-.585***	1.00
Risk behavior	.127***	-.167***
Suicidal Behavior	.302***	-.316***
Warm relationship with parent	-.215***	.305***
Neighborhood strain	.182***	-.525***
Age	.056**	-.093***
Sex	.114**	-.060***
Religion important	-.034*	.107***

***. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Next, present the findings of the regression analyses in four models. The results in Table 3 Model 1, show that high levels of resilience decrease depression symptoms in adolescents. This direct relationship has also been established in other studies (Anyan and Hjemdal, 2016; Cole et al., 2014; Tram and Cole, 2000). As for personal characteristics, age does not show a significant effect on the outcome measure. However, in support of previous research, we also find that female adolescents have higher depression symptoms than their male counterparts (Plickert and Pals, 2019).

The third model examines the effects of risk behavior in the presence of resilience. We find that suicidal behavior over less dangerous risky behavior is strongly associated with higher levels of depression. However, less risky behavior has a small but still significant effect on depressive symptoms. The inclusion of risk behavior and suicidal behavior increases resilience-based differences in depressive symptoms. These interrelationships contribute to differences in the size of the resilience coefficient from -.347, -.344 to -.317 across models 1, 2, and 3.

The final model assesses the effects of neighborhood strain (e.g., low cohesiveness), quality of the parent-child relationship, and a child's religious engagement. We find that high neighborhood strain heightens adolescent depressive symptoms, while positive parental relationships and religiosity potentially protect from depressive symptoms. Stress and resilience predict depressive symptoms by showing a positive relationship between stress and depressive symptoms and a negative relationship between resilience, religion, and positive parenting.

Table 3. Regression of Depressive Symptoms, Resilience, Risk Behavior, and Supportive Personal and Environmental Factors

	Depressive Symptoms Model 1	Depressive Symptoms Model 2	Depressive Symptoms Model 3	Depressive Symptoms Model 4
Resilience	-.347***	-.344***	-.317***	-.366***
Age	—	.006	.008	.010
Child Gender	—	.307***	.292***	.260***
Suicidal Behavior	—	—	.716***	.682***
Risk Behavior	—	—	.066***	.054***
Warm parent relationship	—	—	—	-.069**
Neighborhood strain	—	—	—	.306***
Religion	—	—	—	-.075***
Constant	9.431***	9.111***	8.570***	8.766***
Model R^2	.340	.344	.360	.380

Source: AddHealth Public-use data wave 1

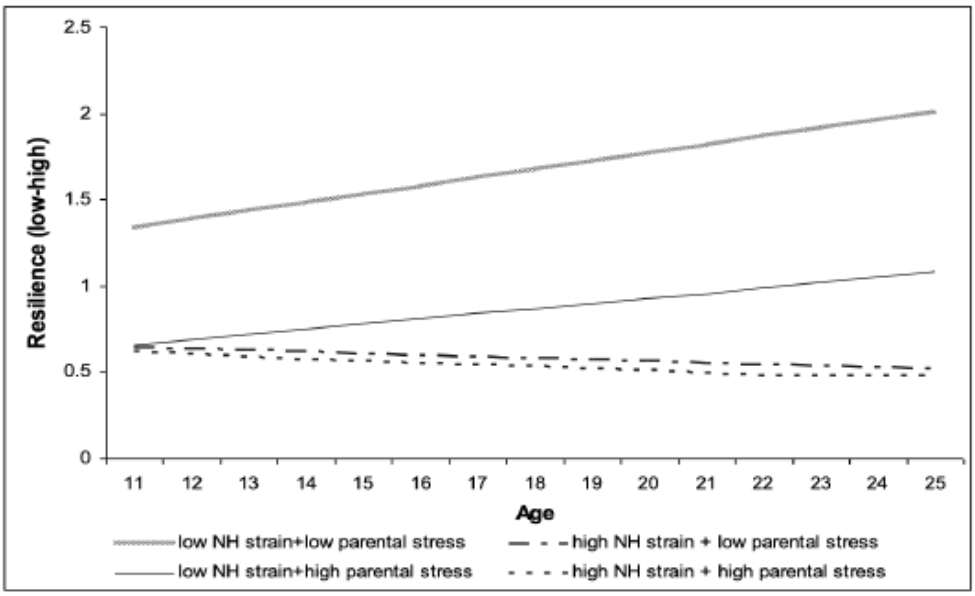
For the next steps of the analysis, we propose examining interaction effects between resilience and other child stressors. A significant interaction between these concepts would support the assumptions of resilience operating in protective ways – supporting the hypothesis of handling adversities.

Longitudinal Approach

We also examine resilience as a process by applying a life course approach. We employ multilevel growth curve models (see also Singer and Willett 2003) to analyze trajectories of resilience and neighborhood strain and parental stress during adolescence. Methodologically we can separate within-person differences from between-person differences, therefore controlling for the effects of unobserved heterogeneity that may affect differences in resilience and other stressors across adolescents. That means more precise estimates of neighborhood strain and parental stress on changes in resilience across trajectories of adolescents are estimated (Lee, Wickrama, O'Neal, and Lorenz 2017, Raudenbush and Bryk 2002, Singer and Willett 2003).

Figure 1 illustrates that early experiences of high neighborhood strain and parental stressors act in concert and show low adolescent resilience. However, resilience seems to be differently affected by each of the stressors, implying that the experience of high parental stressors but low neighborhood strain still promotes increases in resilience from adolescence to young adulthood. Thus, strain and stressors experienced in early adolescence generate differences in resilience in young adulthood. We also find that in early adolescence, when children begin to choose and manage some of their own decisions in their daily lives, that resilience represents a process of interacting with these developmental stages.

FIGURE 1. Effects of Neighborhood Strain + Parental Stress on Resilience over time



Conclusion

The concept of resilience underscores how interrelations of personal attributes, environmental characteristics, and developmental pathways explain adolescent resilience. We find that resilience reduces mental disorders. Some personal attributes may have only short-term direct effects on adolescents' wellbeing; however, the life course approach suggests that persistent external experiences (parent-child relationship, quality of neighborhood one is living in) contribute to differences in adolescent degrees of resilience. It is vital to take into account the interplay of these dimensions to determine potential short-or long-term effects that promote resilience throughout the development stages of children.

In light of these preliminary findings, we also acknowledge some limitations. First, the scales for depressive symptoms and resilience follow established scales from psychology and social science research; however, the list of items to include was limited for both scales. We do acknowledge that the information is drawn from self-reports. We, therefore, apply a measure of depressive symptoms instead of depression. For future research, a clinical measure of depression might further inform us about the interplay of resilience and mental health.

Second, the scale of resilience adapted responses that closely matched the Resilience scale READ (see Oshio et al., 2003). However, the current data does not offer the range of measures that could capture resilience in ways of novelty seeking, emotion regulation, and positive future orientation. Our measure only includes items that correspond to positive future orientation as part of resilience. The longitudinal analysis has provided a snapshot of resilience as a process.

The need for items of resilience to be measured into adulthood is a necessary step to expand our understanding of changes in resilience in response to adverse experiences or circumstances.

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An Evaluation of the Traveling Salesman Problem

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Abstract

The Traveling Salesman Problem is a popular NP problem in combinatorial optimization which asks, given a list of cities, what is the shortest route a salesperson can travel from one city to another, while having a Hamiltonian cycle. This paper aims to discuss the research of the Traveling Salesperson Problem's theory along with the implementation of exact and heuristic algorithms.

Keywords— Traveling Salesman Problem, P=NP, Heuristics, Optimization

Introduction

The Traveling Salesman Problem, or TSP, is one of the most intensively studied problems by computer scientists. The concept of the Traveling Salesman Problem was first proposed in a board game created by mathematicians W.R. Hamilton and Thomas Kirkman [1]. The main objective of this game was to find the Hamitonian cycle, which is going through every point on the game board exactly once and ending at the starting point. This game concept became known as the Traveling Salesman Problem in 1930 when mathematicians started studying this problem [1]. Since then, there were a large number of exact and heuristic algorithms developed to solve the problem. Traveling Salesman Problem can be modelled as a graph problem where the cities are the vertices and the path are the edges. The graph of the Traveling Salesman Problem could be symmetric, where the graph is undirected, or asymmetric, where the graph is directed.

The Traveling Salesman Problem can be solved with exact solutions such as a brute force approach or the Held-Karp algorithm [2]. These exact algorithms require solving an optimization problem for the most optimal result. Unless P = NP, the Traveling Salesman Problem's exact solutions are slower than polynomial time. Due to the slow nature of exact algorithms, even smaller problems would require a large amount of time. More approaches for exact solutions to the Traveling Salesman Problem include branch and bound algorithms and use of linear programming techniques, however these still suffer from the P = NP constraint making them slower than polynomial time.

The Traveling Salesman Problem (TSP) is a NP problem with the TSP decision and search problem both being NP complete. They are both NP Complete because the solutions of these can be tested in polynomial time, yet a solution cannot be found in polynomial time. For example, in a decision problem, a solution is given and the question would be to find out if it is less than a certain distance. Verifying the question would take polynomial time because the answer could be found by going through the cities in the solution and adding up the costs. However, the TSP optimization problem is NP- hard but not NP, which means that the solution and the verification cannot be done in polynomial time. For example, there hasn't been an algorithm found yet that can find the solution of the most optimal cycle in polynomial time. In order to verify that solution, there is no way to do it except by going through an algorithm with longer than polynomial time. However, there are heuristic algorithms that may solve the Traveling Salesman Problem in polynomial time.

Such heuristic algorithms include the Nearest Neighbor algorithm, Ant Colony Optimization, or the Christofides algorithm [2]. A heuristic requires an algorithm to solve an optimization problem with the most optimal speed, while risking that the solution may not be the absolute best. A larger problem can be solved with these algorithms because using a heuristic means shorter run time. This is useful as there are many cases where it is better to lose some efficiency for a massive decrease in run time.

This problem's popularity extends beyond research into real life applications as it could be used for scheduling, logistics, and the manufacture of microchips. For example, the Traveling Salesman Problem is applied with package delivery planning. The houses are the “vertices” and the company must find the shortest path for delivery and returning to the delivery center in order to save the most money on delivery costs.

Algorithms

A. Brute Force Algorithm

The brute force algorithm is the easiest algorithm to implement for Traveling Salesman Problem exact solutions. However, it also has the slowest time complexity because the algorithm requires every permutation of a solution to be checked. When every solution has been processed, the cheapest one is chosen. The brute force algorithm functions as follows, with G being the graph representing theTSP:

1. Pick a starting point vertex in G
2. Calculate the number of tours from the starting point and mark each tour.
3. Calculate the distance of each tour.
4. Select the cheapest tour, which would be the most optimal solution.

The brute force algorithm has exactly n^1 permutations that need to be checked. Thus the time complexity is O(n!) . Although the brute force algorithm is the slowest exact algorithm, there are many improvements for it that can achieve times that are less than n!, such as the use of branch and bound, linear programming, and dynamic programming techniques.

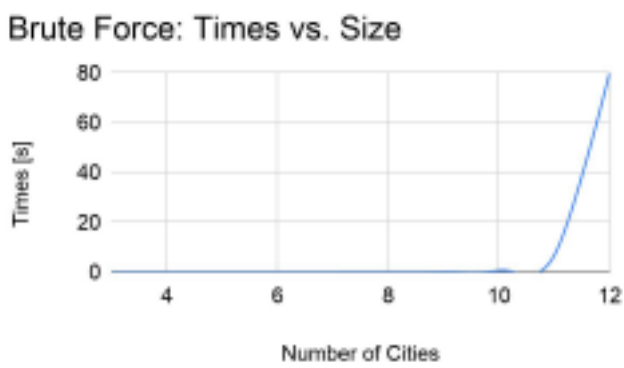

Figure 1.
Time in milliseconds vs. the number of cities in a Traveling Salesman Problem.

Being of factorial time complexity, the algorithm can process a very small Traveling Salesman Problem in a reasonable amount of time. This is evident in Figure 1, where it took almost 80 seconds to find the path for just 12 cities. This just demonstrates how ineffective the factorial time complexity is. On top of this, as the brute force approach runs recursively, the system can easily run out of memory errors. After running 11 cities the Java heap size needed to be increased to 22 GB to run for 12 cities. This algorithm is expressed in the following pseudocode:

```
paths = {all possible paths}
optimal = min( paths.map( path => C(path),
path))
return optimal
```

B. Held-Karp Algorithm

The Held-Karp algorithm was developed by Held and Karp in 1962, and independently by Bellman in the same year [3]. The Held-Karp algorithm uses dynamic programming to find more efficient solutions to a series of sequencing problems, including the Traveling Salesman Problem. As this algorithm uses dynamic programming, it offers a solution to a sub-problem that can be recursively called to get the solution to the overall problem. This is done by first creating a distance matrix from each city/node to another city/node. For a situation of S = {1,2,3,..., n} where S is the set of n cities, this distance matrix would be n x n in size. A minimum cost function is then defined as C(U, l) where U S such that all the cities in U are visited on the way to l where l S . C(U, l) is then defined such that:

$$(1)\quad \begin{aligned} &\text{(a) } (n(U) > 1): \quad C(\{l\}, l) = a_{1l}, \text{ for any } l \\ &\text{(b) } (n(U) > 1): \quad C(\{S\}, l) = \min_{m \in S-1}(C(S - l, m) + a_{ml}), \\ &\qquad\qquad\qquad\quad \text{where } m \text{ is the city that before } l \end{aligned}$$

If the original city is l and it is returned to after the journey, then the shortest route would have a cost of

$$(2)\quad e = \min_{l \in \{2,3,\ldots,n\}}(C(\{2,3,\ldots,n\}, l) + a_{l1})$$

The first step of the Held-Karp algorithm uses (1) to recursively compute all values for C(S , l) and (2) to compute the shortest possible circuit. The Held-Karp paper also states that a permutation of cities is optimal if and only if:

$$(3)\quad e = C(\{2, 3, \ldots, n\}, i_n) + a_{i_n 1}$$

and

$$(4)\quad C(\{i_2, i_3, \ldots, i_p, i_{p+1}\}, i_{p+1}) = C(\{i_2, i_3, \ldots, i_p\}, i_p) + a_{i_p i_{p+1}}$$

The second step of the Held-Karp algorithm then uses (3) and (4) to find the optimal path to visit each city [3]. The algorithm first find in then in–1 and so on until the optimal path is found. This technique allows for an improvement on the brute-force approaches O(n!) time complexity. Instead the first step involves

$$\left(\sum_{k=2}^{n-1} k(k-1)\binom{n-1}{k}\right)+(n-1) = (n-1)(n-2)2^{n-3}+(n-1)$$

operations while the second step involves

$$\sum_{k=2}^{n-1} k = \frac{n(n-1)}{2} - 1$$

operations. This yields an approximate time complexity of O(2 n n 2) [2]. While this time complexity is exponential, it is still much better than the factorial time complexity of the brute force approach, and offers an exact ultimate solution.

C. Christofides Algorithm

The Christofides algorithm was developed by Nicos Christofides in 1976 [4]. The Christofides algorithm was designed with the purpose of finding approximate solutions for the Traveling Salesman Problem. It has some prerequisites for the situation, such as being symmetric and obeying the triangle inequality. The triangle inequality states that for every three vertices x, y, and z, it should be the case that for the weight of the edges, w, w (xy)+ w(yz)≥ w(xz) [4]. To solve the Traveling Salesman Problem, start out by letting G be he symmetric complete graph. The pseudocode of Christofides algorithm is as follows:

1. Construct a minimum spanning tree, T, from G
2. Next find all the odd degree vertices in T and place them in set O. A vertex with an odd degree means that an odd number of edges are connected to the vertex
3. Connect odd degree vertices using the minimum weight perfect matching adding the edges to the matched odd degree vertices, which would create an Euler cycle for T. Every vertex in T should have an even degree after this step
4. Remove repeated edges from vertices with a degree greater than 2 to create a Hamiltonian cycle

best approximation ratio that has been proven for the Traveling Salesman Problem on general metric systems though there are some special cases where other algorithms are better. It is an approximation algorithm because the solution is guaranteed to ne within a factor of 3/2, but is able to achieve this results in far less time than an exact algorithm. Often this time complecity comes down to the algorithm used to find the minimum spanning tree [5].

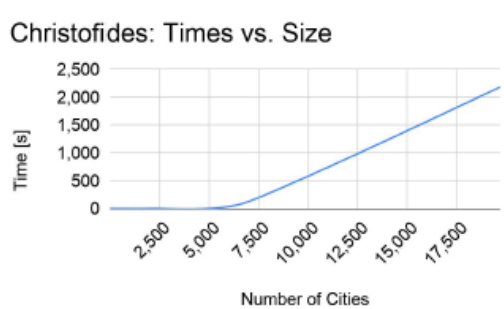

Figure 2.
This graph shows the time in seconds it takes to run the Christofides algorithm on a given number of cities.

With a time complexity of O(n4) , this algorithm can process larger Traveling Salesman Problem situations with greater efficiency than the brute force method [5]. However this comes at the cost of accuracy as Christofides only finds an approximate solution as opposed to the optimal.

D.Ant Colony Optimization

The Ant Colony Optimization algorithm, or ACO, was proposed by Marco Dorigo in 1992 in his PhD thesis. ACO is an algorithm that searches and finds the most optimal solution for the Traveling Salesman Problem graph based on the behavior of ants between their colony and a food source. The algorithm is a probabilistic technique due to the ants wandering randomly. The idea is that as ants search for food, they leave a pheromone trail for other ants in the colony to follow. However, the pheromone trail starts to evaporate as time goes on. The longer it takes for an ant to travel a path, the more the pheromone trail evaporates, leaving a weaker attractive strength. Thus, the shorter the path to the food source is, the stronger the attractive strength due to a greater number of ants following the stronger scent [6].

Given an n-city Traveling Salesman Problem with distances di j , artificial ants aredistributed to these n cities randomly. Based on the pheromone trail remaining on the paths, each ant will choose the next city to visit. The main differences between artificial ants and real ants are that artificial ants will not visit cities that they have already visited, and they can also know the distances between two cities, unlike real ants. Thus, the probability that city j is selected by ant k to be visited after city i could be written as follows:

$$(1)\quad p_{ij}^{k} = \begin{cases} \dfrac{[\tau_{ij}]^{\alpha}\cdot[\eta_{ij}]^{\beta}}{\sum_{l\in allowed_k}[\tau_{il}]^{\alpha}\cdot[\eta_{il}]^{\beta}} & j \in allowed_k \\ 0 & \text{otherwise} \end{cases}$$

where τij is the intensity of pheromone trail betweencities i and j, α the parameter to regulate the influence of τij , ni j the visibility of city j from cityi, which is always set as 1/ dij (di j is the distancebetween city i and j), β the parameter to regulate the influence of and allowed k the set of cities that nij have not been visited yet, respectively.

After n iterations, every ant completes a trip. The ants with shorter trips should leave more pheromone than those with longer trips. Therefore, the trail levels are updated as on a trip each ant leaves a pheromone quantity given by Q/Lk, where Q is a constant and Lk the length of its trip. On the other hand, the pheromone will evaporate as time goes by. Then the updating rule of τ ij could be written as follows:

$$(2)\quad \tau_{ij}(t+1) = \rho\cdot\tau_{ij}(t) + \Delta\tau_{ij}$$

$$(3)\quad \Delta\tau_{ij} = \sum_{k=1}^{l}\Delta\tau_{ij}^{k}$$

$$(4)\quad \Delta\tau_{ij}^{k} = \begin{cases} Q/L_k & \text{if ant } k \text{ travels on edge } (i,j) \\ 0 & \text{otherwise} \end{cases}$$

where τ is the iteration counter, $\rho \in [0, 1]$ theparameter to regulate the reduction of τ_{ij} , $\Delta\tau_{ij}$ thetotal increase of trail level on edge (i, j) and $\Delta\tau_{kij}$ theincrease of trail level on edge (i, j) caused by ant k[5].

E.Nearest Neighbour Algorithm

The Nearest Neighbour algorithm, or NN, is an approximation algorithm and was one of the first algorithms used to solve the Traveling Salesman Problem. Because it is a greedy algorithm, the solutions may not be optimal, however, it is easy to implement and quick to run with a worst case time complexity of O(n2) and a worst case space complexity of O(n) . The pseudocode is as follows:

1.Set all the cities to unvisited
2.Select an origin city
3.Find the shortest edge
4.If the city is unvisited, connect that city tothe previous city
5.If every city is visited then go back to theorigin city, otherwise go back to step 3

This algorithm's optimality is around 25%of the Held-Karp's lower bound. The cost of the path depends on where the origin city is for the Nearest Neighbor algorithm. The Repetitive Nearest Neighbor, or RNN, says to try every city as an origin, then select the shortest path. The best path found will be better than at least n – 1 other tours, with n being
2 the number of cities [7].

Real Life Applications

A.Wiring

The Traveling Salesman Problem can be used to help find the most efficient way to route power lines through rural areas in between major power grids. This setup would follow very closely to the original TSP with cities acting as the vertices with the distance between them as the edge weights. Minimization of the distance to visit all the cities would result in decreased construction costs, and more efficient power delivery. Not only does TSP help with large scale electrical grids, but it can optimize the layouts of small circuits. In this case varying wire distances can affect a circuit's heat, resistance and operating speeds.

B. Deliveries

Once again, the original TSP, of finding the most efficient method of travel between multiple stops, can be used to optimize long distance deliveries. In this use case, the vertices would not only be the cities for delivery, but the gas stations and rest stops between them. The weights for the edges would not only be distance, but could be based on a heuristic that takes into account travel conditions, distance, and gas prices to optimize for not only the shortest route, but the cheapest as well.

C. Aerospace

The Traveling Salesman Problem can be used to find the most efficient flight paths for planes that need to stop at multiple cities. Another example would be the Starlight Interferometer Program, which is a program designed to optimize flight paths for satellites that need to point at far away celestial objects [8]. In this situation the vertices of the TSP problem would be the positions needed to point at stars, while the cost to travel between the positions in orbit is the edge cost.

Comparisons

A. Brute Force vs. Christofides

In comparing the brute force approach to the Christofides solutions to the Travelling Salesman Problem, it is quite clear that Christofides runs much faster and uses less space.

Figure 3.
This graph compares the runtimes for the brute force approach and the Christofides approach. Note: Brute force is the blue line on the left.

As Figure 3 shows, the brute force approach takes so much memory and time it becomes a nearly vertical line in comparison to the Christofides algorithm. This also shows that a brute force approach on a situation with more than 20 or so cities is impractical for most cases. While Christofides does not always guarantee the absolute optimal solution, it does guarantee a pretty good solution that is at most 1.5 times the optimal distance. While this can be costly in some situations, such as circuit board design, this increased distance is likely to be worth the time and memory cost of running the brute force algorithm. Especially since if the system that performed the presented computations were to run with 24 cities, the computation would take roughly 3.280x109 years, or roughly the age of our sun. Even in situations where it is absolutely necessary to get the exact optimal solution, it is inadvisable to run the brute force approach and instead run the Held-Karp algorithm or some other optimized exact algorithm. Given Held-Karp's theoretical time complexity of O(2n n2), and the given times for this system, the Held-Karp algorithm should be able to calculate 24 in approximately 26.5 minutes. While this is much better, it is still exponential time and unrealistic for thousands of vertices.

B. Exact Approaches

While all of the exact approaches have incredibly inefficient time and space complexities, the worst by far is the brute force approach. The upside of the brute force approach is that it is the easiest to implement and understand. However, it is still best to implement the branch and bound technique and save even a few possible path calculations that need to run all possible paths in the direct brute force approach. This is due to the fact that although the branch and bound methodology has at worst the time complexity of a direct brute force, it often runs faster. This is due to the pruning which can save up to (n-1)! paths to compute for a given situation. Beating the worst case of both of these approaches is the Held-Karp which runs in exponential time rather than factorial. While this is still horribly impractical and inefficient, it is much better than factorial time. Ideally an exact approach would not be needed as there is no known exact algorithm that runs in polynomial time on

a deterministic Turing machine. This means the Traveling Salesman Problem is an NP-hard problem. As section IV. A. mentions it is often preferably to run a heuristic algorithm due to time and space complexities.

C. Heuristic Approaches

Among the heuristic algorithms, the most commonly used to this day is the Christofides method. It has been considered the most effective ever since its development in 1976. There are still some specific cases in which some methods may take less time. Though for most general cases Christofides will still be the most effective since its solution is within 32 of the optimal solution.

Conclusion

In conclusion, unless absolutely needed, it is better to get an approximately optimal solution via an approach like Christofides, Nearest Neighbor algorithms or even ant colony simulation than to run a brute force approach for an exact solution. Even if an exact solution is needed, it is more efficient to run an algorithm like branch and bound or Held-Karp than a direct brute force. However, as this is presently an NP-Hard problem, any exact solution will not run in polynomial time on a deterministic Turing machine. It is better for the sake of speed and memory to run an approximate or heuristic algorithm to get a pretty good solution than to get the absolute best.

Given the numerous applications and importance of this problem, a solution in P would be incredibly beneficial, but depending on the approach's time complexity, it may still be better to find approximate solutions for certain situations.

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3D Reconstruction Using Multiple Depth Cameras

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Abstract

In this paper, we present an approach to creating 3D models, through the RGB-D data captured by multiple aligned Azure Kinects surrounding an object. To improve the quality of the point clouds of the entire object, a background subtraction method is employed to isolate the high fidelity point clouds from scan frames. We then construct an aligned 3D surface using the point clouds' geometry.

Keywords—Point cloud registration, Azure Kinects, 3D reconstruction

Introduction

Creating realistic 3D models of physical objects plays an important role in a variety of real-world applications including game development, computer generated art, and digital visualization. 3D scanning through depth cameras is one of the popular ways to digitize an object, which allows people to rapidly obtain the geometry and texture information of real objects, without having to manually model every detail, and paint the textures from scratch.

Much of the current research into this application uses the older scanners, such as the Kinect v2, or present methods based around a single camera. One of the most popular applications for 3D reconstruction using Kinects is the Kinfu application [1]. This program builds textured models from a single Kinect moving through a space. While this program creates a complete textured model, it does not leverage multiple capture angles from multiple cameras. While other works such as Alexiadis, Zarpalas, and Daras, present systems that utilize multiple cameras, but use last gen hardware to do so [2]. This means they miss out on leveraging the newer capabilities and high resolutions of the newer Azure Kinect cameras. In terms of reconstruction and alignment, the Open3D library contains fast implementations of a variety of algorithms [3]. This library features extensive I/O support as well as point cloud and mesh operations.

In this project, we present a 3D scanning pipeline that digitizes a real object using the RGB-D data captured by multiple depth cameras. In particular, we place multiple depth cameras at different angles around a real object. While scanning, the depth cameras are synchronized with overlapping views to capture RGB-D images of the object at different viewpoints. This helps to reduce the number of scan operations required for complete scanning coverage to estimate the shape and surface appearance of the scanned object. The result demonstrates the effectiveness of the presented pipeline in reconstructing a 3D surface from a single scan from each camera.

Methodology

The proposed pipeline in this project consists of three main stages: initial alignment, cropping, and surface reconstruction.

A. Initial Alignment

The initial alignment stage involves taking a single capture from each camera in the system. We use two Azure Kinects, and each is connected directly to the computer. As each camera uses an infrared projection to register depth, there needs to be some delay between

each camera's capture to avoid interference. When testing with more cameras, it is preferable to use a daisy chain or subordinate configuration between the cameras with a preprogrammed capture offset [4]. The captured data is loaded into the Open3D library where the data is decoded into the RGBDImage structure [3].

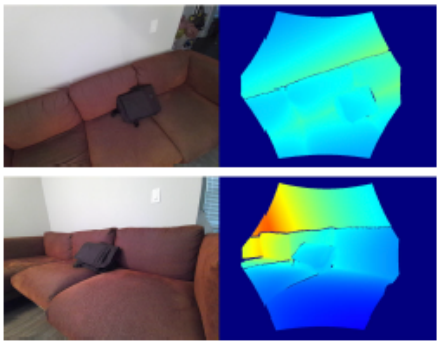

Figure 1. RGBDImages from both cameras. The left shows the color image captured, which right side shows the depth data captured.

From these RGBDImages we read each Kinect's intrinsic matrix to obtain the transformations needed to combine the color data and the depth data into a single colored point cloud with accurate depth information. As the intrinsic matrix is slightly different for each camera, each both must be polled for the calibration data. Using the intrinsic matrix, the RGBDImages are converted into colored point clouds. These point clouds display the geometry from the depth data as a series of points in 3D space, with each point's color being determined by the color data from the camera. As the point density for the Azure Kinect is very high, the point clouds often appear as solid objects in the visualizer. When first loaded into the visualizer, there is no data about how the point clouds line up, meaning their geometries are misaligned. This is shown in Figure 2.

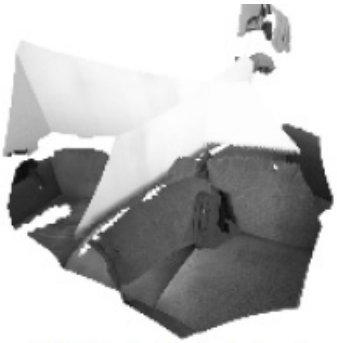

Figure 2. Misaligned point clouds from the two cameras.

These point clouds can then be aligned using a variety of techniques. The first is Fast Global Registration [5]. This method allows a rough alignment between the point clouds using common features. The alignment transformation from this step is then passed as the initial transform matrix for the Colored ICP registration stage [6]. This method of iterative closest point registration uses the color data as well as the geometry of the two point clouds to more accurately align the point clouds. The more overlapping and distinguishing colored objects between the two point clouds, the better this registration is. Below is the output point cloud after performing colored ICP.

Figure 3. Point clouds are aligned after Fast Global Registration and Colored ICP registration.

The alignment shown above has an accuracy of 0.5420. It is important to note that as each camera is seeing slightly different images, the two point clouds can not 100% match. The more extreme the angle and placement is between the cameras in the setup, the lower the initial alignment accuracies will be. Ensuring the scenes captured by each camera overlap a fair amount and are equally exposed as to provide similar colors between the point clouds, helps to achieve a more accurate alignment. After aligning the point clouds, we merge them into one point cloud by combining the points and performing a small voxel down sampling to ensure duplicated points are removed. If the setup has more than two cameras, the underlying alignment and merging process would be continued using the merged point cloud and the initial capture from each successive camera. This is repeated until a transformation matrix is calculated for each camera and the merged point cloud contains the sum of the captures from all of the cameras. If the scanning setup requires cameras to be moved to capture different angles of the subject without the use of additional cameras, then the transformation matrices are discarded, and this alignment process can be repeated.

B. Cropping

The next stage is to isolate the subject from the background. To this end, a bounding box is needed to be generated around the subject. This bounding box can be found by performing object segmentation, or by manually closing in on the subject. For the following example manually subject selection is used as it is more reliable for complex objects and incomplete point clouds.

To begin selecting the object a bounding box is generated around the entire point cloud. The user can then move and scale this bounding box to close in on the subject.

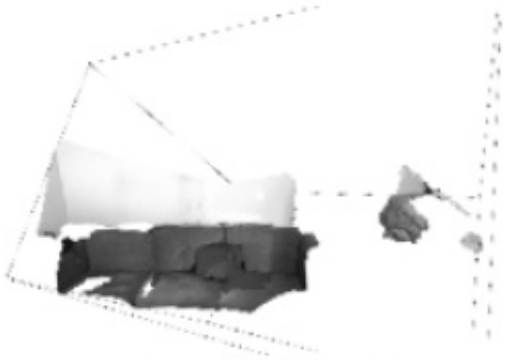

Figure 4. Bounding box around the total capture

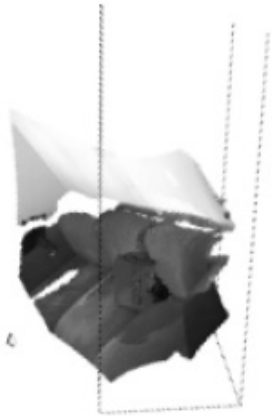

Figure 5. Bounding box moved around the target

Once the bounding box has been closed around the subject being scanned, the point cloud can be cropped with the built in method. This removes the background and additional point cloud points that were only needed to get the alignment of the cameras. This leaves only the subject's point cloud, and some floor base around it.

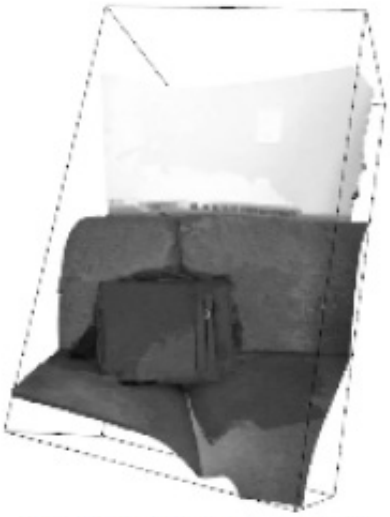

Figure 6. The cropped point cloud

Cropping the point cloud can be useful if the subject is spinning or on a turntable in which case further alignment can be performed between captures, that ignores the features and alignment of the background, and just aligns the captures of the subject (See Discussion A.).

C. Surface Reconstruction

The final stage of the reconstruction is creating a solid surface from the point cloud. Once the subject has been isolated through cropping, the pipeline will perform post-processing on the pointcloud to remove outlier points as well as any extra or internal points. It is often useful to calculate the normal of the point cloud data for the surface reconstruction algorithms

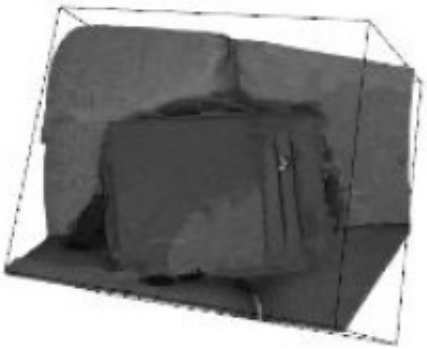

Figure 7. Cleaned up point cloud which has been further cropped.

Once the point cloud has been cleaned up, we begin surface reconstruction to generate a triangle mesh based on the colored point cloud. We investigate three different surface reconstruction algorithms based on the Open3D library, i.e., Poisson reconstruction [7], Alpha Shape reconstruction [8], and Ball Pivot reconstruction [9]. Depending on the scanning situation certain methods may work better than others. Below is a comparison for the previous scans.

Figure 8. Poisson reconstruction

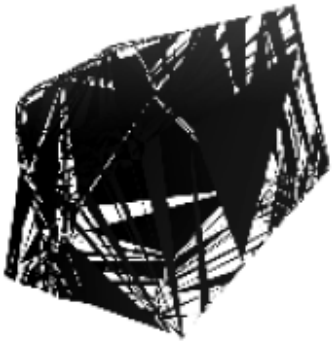

Figure 9. Alpha Shape reconstruction

Figure 10. Ball Pivot reconstruction

One can find that for the above example, Poisson produces a smooth watertight mesh at the cost of surface resolution. Alpha Shape was unable to compute an efficient convex mesh resulting in an unusable mesh. Ball Pivot was able to produce the highest resolution mesh of the point cloud, though it had missing faces and took an incredibly long time to calculate.

Discussion

A. Turntable Sequence Processing

The next milestone for this program will be turntable sequence processing. Following the cropping stage, the bounding box as well as the transformation matrices for the cameras will be saved for quick use in aligning a capture sequence. This extension of the program is designed for scanning scenarios in which the subject is turning in front of the cameras and a fixed number of cameras remain stationary. By using the already calculated transformation matrices to orient each camera's capture with the capture of the primary camera, we can quickly align captures across cameras with the same time stamp. Further, by removing the backgrounds of the captures using the bounding box, we are left with partially aligned captures of the subject at different rotations. These fragments can then be aligned to each other using multiway registration to generate a more complete model of the subject [10].

B. Instant Scene Snapshot

This extension would rely on the precomputed transformation matrices to provide a live, aligned point cloud visualization of the scene in front of the cameras. After aligning the point clouds, and cropping in on the subject, the program would perform captures across devices in rapid succession to provide a rendering of the point cloud from multiple cameras at an instant in time. The user would then have the ability to save an instance, like taking a photo on a camera, however the 3D scene would be processed and exported as a 3D model of the scene at that instance. This would be best suited for reconstruction scenarios where there are chaotic changes in the scene such as moving objects.

C. Parallelization

This final extension of the program would be a series of optimizations to allow the program to more efficiently utilize multi-core processors and compute clusters. While the core library, Open3D, already performs some parallelized optimizations in visualization and reconstruction techniques, this milestone would seek to turn this program into a more scalable solution for 3D reconstruction.

Conclusion

In this work, we propose a 3D scanning pipeline for 3D digitization of a real object using multiple depth sensing cameras. The proposed pipeline presents a scalable configuration scheme that allows for more complete scans in a single pass than with a single camera alone. By saving the alignment of stationary cameras, we perform rapid realignment of captures without the need for more additional computational power. This is useful for recapturing shots from a specific camera or, as outlined in Future Work, allowing for a wider variety of scanning scenarios.

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Populist Discourse in African President Speech

Project Synopsis

From an idea to a strategy this study explores how poor urban voters in Africa are influenced through a populist discourse during elections.

Summary

During elections in Africa, political figures running for a position in office tend to leverage against the opposition party by utilizing a populist approach that best resembles the interest of the people. In order to be favored and elected by the voters, political figures make the effort to relate to ordinary people by proposing ideas that appeal best to voters. However, this approach comes with a cost, a cost that the people have to endure. In this study, one will acknowledge the distinct definition(s) of populism throughout history by evaluating presidential speeches performed by coders. Coders will use a Holistic scoring technique that is used to evaluate the validity of populism in a presidential speech.
The prefered method utilized to collect data is qualitative analysis, as it fits to measure populism in surveys, interviews, and speeches. This can help readers understand the intent and impact of populism. Historically, populism has led to competitive authoritarianism like violence, revolutions, and dictatorships. Today, populism has shown the revival of democracy in areas of Africa. The question we will be researching is: Do politicians in Africa employ populist discourse?

Populism Defined

This project is an extension of Kirk Hawkins' publication "Is Chavez Populist?: Measuring Populist Discourse in Comparative Perspective." As we continue to research our question through scoring African leaders' speeches, we utilize the definition of populism that Hawkins outlines in his paper, focusing on the four main ideas that he pinpoints: Manichean discourse, cosmic proportions, a romanticized will of the majority, and an evil minority.

Firstly, Manichean discourse emphasizes morality, wherein all issues to be addressed include moral implications that must be taken into consideration. Additionally, dualism is employed, resulting in ideas being right/wrong or good/bad with no possible gray area. With a stress on maintaining high morality, speeches often exaggerate issues to cosmic proportions. The consequences of actions, or lack thereof, are claimed to have worldwide effects that could span a period of time. Populist speakers will often discuss how their ideas will impact history, and they tie their ideals to respected prominent leaders. Despite Manichean elements, speeches still appear to be democratic, as the will of the majority is emphasized. Typically seen as the good unified whole, the majority is represented by the image of the common man. At its core, however, the good majority is often inflated in its meaning.

Lastly, and perhaps most prominently, populist discourse attacks an evil minority, of which changes depending on location and time period. Evil minorities may include elites, capitalism, neoliberalism, entire countries (i.e. the United States), or other prominent institutions (i.e. financial). The evil minority is typically the opposition that is currently, or was, in power and that utilized their position for self-gain, disregarding and stealing from the

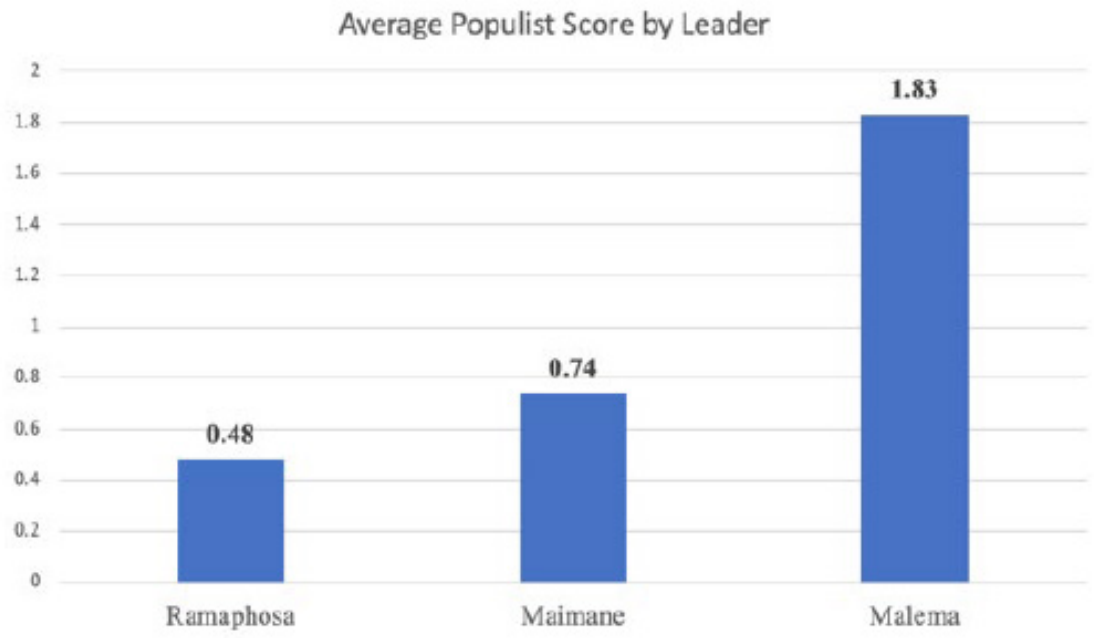
majority. To overthrow the evil minority, populist discourse often calls for systemic change in the form of a "revolution" or "liberation." In order to mobilize the majority, data and statistics may be inflated to make the opposition appear more immoral. Since the minority threatens morality, nondemocratic means may be stressed to rid of the evil. If not done, the evil minority will continue to abuse their power, according to populist leaders.

Scoring

As we scored each speech, we considered populism as a descriptive term instead of a pejorative one. By doing so, three independent research assistants could assign a score to each set of speeches (speeches were given a score between 0 to 2). In order to ensure accuracy, each research assistant practiced scoring at least three speeches that were either populist or pluralist. By existing between representative democracy and mob rule, populism can be either left of right in a conventional political spectrum. The populism score of each speech represents the methodology of how populism is implemented.

With regard to numbers below 1, politicians appeal to the common people's emotions in order to perpetuate a positively humanizing philosophy. Scores that were 1 or higher tended to blame an 'elite' entity for the unresolved problems of the country, and a dehumanizing philosophy is normally present. Our preliminary findings indicate that populism was indeed present in South African politics in 2019; this is important, as the average populism scores derived from analyzing numerous speeches allows us to recognize the current political climate for what it is truly like.

Two members scored each speech, and the score was averaged as shown below. The results are as follows:



Each leader employed populist elements in different frequencies, a large indicator of how populist their discourse is. Cyril Ramaphosa has the lowest score, meaning that he utilizes populist discourse less frequently. Mmusi Maimane remains below a score of 1, similar to Ramaphosa, as populistic elements are scattered unevenly throughout their speeches. On the opposite end, Julius Malema is highly populist, reaching the closest to a score of 2, signifying that he emphasizes populist discourse throughout his speech. Overall, populism is present in South Africa, though at varying degrees.

Moving Forward

In addition to what we have already found, we plan on scoring speeches from Ghana and Zambia as well. We hope to compare our findings in order to derive a meaningful conclusion. We already know that populists capitalize on the notion that political legitimacy derived from the consent of the governed. From becoming more knowledgeable of populism, we can better prepare ourselves for its negative effects, such as anti-intellectualism and mob rule. As our research continues, we hope to provide a clearer insight into the inner-workings of African politics and how it personally impacts all of us.

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On the Ethics of Involuntary Commitment of Psychotic Individuals: A Multifaceted Approach to Understanding the Morality of Current Policy

Abstract

Involuntary commitment ('assisted treatment', 'mandatory care') is the practice of providing medical care, in one form or another, to individuals who are deemed as incapable of consenting to treatment under the mandate of the law. There is a specific set of rules that qualify one as requiring involuntary commitment, typically on the basis of psychosis, being a harm to oneself/others, or being gravely disabled[1]. This paper addresses ethical dimensions to the current set of laws and practices regarding involuntary commitment in California[2]. I combine dedicated research into the laws around this practice with a multifaceted approach to ethics, drawing from John Locke and John Stuart Mill in order to reject paternalism. I conclude that while involuntary commitment may be necessary in some cases, it has a plethora of negative consequences which must be further explored.

Introduction

I argue that in a many cases, involuntary commitment is immoral by employing John Stuart Mill's Libertarianism as well as John Locke's theory of natural rights in order to reject paternalism. Paternalism is typically understood as "the interference of a state or an individual with another person, against their will, and defended or motivated by a claim that the person interfered with will be better off or protected from harm[3]." Furthermore, I advocate for a right to self-harm and a right to suicide by utilizing Locke's theory of natural rights. Based on my ethical findings, I make a substantial policy proposal for altering the LPS Act to not allow for self-harm to serve as justification for involuntary commitment. I consider an objection to my use of Locke's theory as well as an objection to my policy proposal and reject both. I conclude that the unethical consequences of involuntary commitment as it is currently practiced demands that we alter the practice.

Current Practice and Policy

The Lanterman-Petris-Short (LPS) Act is the current piece of California legislature regarding involuntary commitment. The LPS Act, entitled after the three political leaders who prepared the bill, was motivated by a concern over the treatment of the mentally ill and concerns over state expenditures. The LPS contains a great deal of information but the most important of this information can be extracted from three main sections: (1) 5150, (2) 5250, and (3) 5350. I will now provide an exposition for each individual section.

This section gives legal power to the government to place any individual into a locked psychiatric facility without their consent provided they meet a minimum of one of three requirements: the individual must be a harm to themselves, others, or be "gravely disabled" (I will expand upon what this means shortly). Under a 5150 hold, the individual who has been involuntarily committed can be placed in a facility for up to 72 hours

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[1] I will provide more information on what qualifies this term in the Current Policy & Practice section.

[2] I contend that other states also must look into the ethical ramifications of involuntary commitment; I, however, will explore California on its own as a resident and a member of the California Center for Ethics and Policy.

[3] From the Stanford Encyclopedia of Philosophy - Gerald Dworkin's entry on paternalism.

(3 consecutive days). The hold is meant to guarantee safety for that person and others around them without infringing upon the rights of the (forced) patient regarding due process. A 5150 hold can be initiated by a variety of individuals in the medical and legal professions. Physicians, registered nurses, physician's assistants, psychiatric facility directors, and police officers are all capable of placing a hold if they interpret an individual to meet any of the aforementioned requirements.

Grave Disablement

The first two mandates regarding being a harm to oneself or others are fairly cut and dry. However, the third, which involves the term "gravely disabled" is a bit more complex to define. In fact, most states differ on what they consider to be "gravely disabled" despite the fairly unified agreement that it is enough to warrant involuntary treatment. Under California's definition for this term one must meet one of the following two requirements:

A. Possess a condition based in mental illness that inhibits one's ability to "provide for his or her personal needs for food, clothing, or shelter" (Mental Illness Policy).
B. Have been deemed 'mentally incompetent' by Section 1370 of the California Penal Code. From this information it is easy to understand the first type of grave disability.

However, the second references an external piece of legislature and deserves further exploration. The label of "mental incompetency" is obtained through due legal process when the following three requirements are all met:

1. The individual is being charged with a felony involving physical harm or death.
2. The case is active (it has not been dismissed).
3. "As a result of mental disorder, the person is unable to understand the nature and purpose of the proceedings taken against him or her and to assist counsel in the conduct of his or her defense in a rational manner" (Mental Illness Policy).

Thus, for one to be "gravely disabled" they must be incapable of providing for themselves as a result of poor mental health or must be a (accused) violent felon in an active case in which they seem incapable of defending themselves due to mental illness.

5250

This section is a mere extension of the prior one. If, during one's evaluation in the 72 hours of the 5150 hold, they are still considered a harm to themselves, others, or deemed 'gravely disabled' then the psychiatric staff must legally seek a 5250 hold. In a 5250 hold, an individual is locked up for an additional 14 days for "further evaluation" (LPS). During this time period individuals can also be transferred to other psychiatric facilities if the one in which they are in finds reason to believe that they will be more successful elsewhere. It is also important to note that in regards to both 5150 and 5250 holds, the time limit is not mandatory. That is, if an individual is discovered to be healthy before 72 hours or 14 days respectively, they should be released. On the other hand, if an individual is assessed for the full 14 days and the psychiatric facility still considers them as a potential threat or 'gravely disabled' then a 5350 hold must be obtained by the professionals with the responsibility of this person's care.

5350

This is the most severe hold that an individual can be placed on - it can literally last a lifetime. For an individual to be placed upon a 5350 hold they must have been recently placed on 5150 and 5250 holds and still be considered threatening or 'gravely disable'. Furthermore, their attending psychiatrist must file the relevant paperwork and obtain signatures from the medical director of the facility in which they are being held and from the Public Guardian Office of the county in which the facility lies. At this point, all consenting powers are taken away from the individual and given to the Public Guardian responsible for them in their county. This type of hold can legally last up to 180 days. However, the process of extending a 5350 hold is fairly simple seeing as consent lies with a public office. An individual can be upgraded from a 'temporary' status to a 'permanent' status at essentially any time during the 180 day hold. The most significant change that results from the status shift is that they can now be held for a full year and that this can be repeatedly renewed if legal justification (physical threat/'grave disablement') is provided. Many individuals who get placed on even one temporary 5350 hold never get taken off and are institutionalized by the state for the bulk of their lives.

Ethical Analysis

Rejecting Paternalism - Applying Mill's Libertarianism

Mill's views on liberty as expressed by his writing indicate his opposition to paternalism. From his perspective, the government only has a right to restrict one of its citizens' liberty in the case that that this liberty is being exercised in a way that is a harm to others[4]. For Mill, it exists within the boundaries of our right liberty that we are granted full autonomy. Until this autonomy is exercised in way that inflicts harm upon others the government should not possess the power to intervene. I contend that Libertarianism provides irrefutable arguments for the rejection of paternalism.

One account of libertarianism rejects paternalism with the justification that liberty calls for a right to noninterference5. I suggest that this view is highly relevant when discussing involuntary commitment, in which many individuals feel that they are experiencing too high of a degree of interference from the government. "An assault on one's lifestyle," as Dr. Elyn Saks put it. Given that consent is taken away from individuals who are deemed to be a harm to themselves, the question must be asked as to whether this violates a natural and Constitutional right. Mill would certainly argue that it does. He writes that:

> ...the only purpose for which power can be rightfully exercised over any member of a civilized community, against his will, is to prevent harm to others. His own good, either physical or moral, is not a sufficient warrant. He cannot rightfully be compelled to do or forbear because it will be better for him to do so, because it will make him happier, because, in the opinion of others, to do so would be wise, or even right (On Liberty 1859).

Here, Mill is noting that self-harm or suicide may indeed sometimes be a poor choice, an irrational choice, or a choice that is entirely anti-utilitarian.

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[4] See Eunseong Oh - Mill on Paternalism from the Journal of Political Inquiry.

[5] See Stanford Encyclopedia of Philosophy - Michael J. Cholbi on Suicide

Still, it is a choice that belongs to an individual to be made, on their own terms. On the Libertarian view, any interference that takes away an individual's right to make this choice is an infringement upon the freedom that must be granted to all of humankind. Dr. Michael Cholbi reveals that for the Libertarian "attempts by the state or by the medical profession to interfere with suicidal behavior are essentially coercive attempts to pathologize morally permissible exercises of individual freedom," (SEP on Suicide).

The right to noninterference warrants the rejection of paternalism. For the clearly paternalistic practice of involuntary commitment, this showcases a flaw in the U.S. legal system. On one hand, the U.S. Declaration guarantees the rights to life, liberty, and the pursuit of happiness; on the other, the LPS Act is depriving individuals of something that should be included in their right to liberty and, presumably, the pursuit of happiness. For some individuals, the decision to commit suicide may be made because they believe it will yield them the most happiness or the least suffering. Libertarianism provides ample support for the rejection of the self-harm stipulation in the LPS Act.

Proving that there is a Right to Self-Harm & Suicide- Applying Locke's Theory of Natural Rights

Locke's theory makes two important contributions to this discussion. First, he argues that "every man has a property in his own person. This nobody has a right to but himself" (25-51). Second, he argues that [hu]mankind is created equal and within this equality lies a right to life, liberty, and property. I defend Locke's views on natural rights and aim to extend them in order to definitely prove that there exists a right to suicide on the grounds of property self-ownership in personhood and the rights to life and liberty.

To elaborate upon Locke's first point I argue that the ownership that every individual has over oneself can be logically extended to include a right to self-harm or commit suicide. In nearly every other case of ownership, an individual has the right to discard or destroy their property as they see fit. Indeed, Cholbi notes that:

> On this view, our relationship to our bodies is like that of our relationship to other items over which we enjoy property rights: Just as our having a right to a wristwatch permits us to use, improve, and dispose of it as we wish, so too does our having a right to our bodies permit us to dispose of them as we see fit.

The salient question is this: why would this not apply to the ownership of one's own body? A government that has greater control over an individual's body than the individual does is a government that is unjust[6]. Locke's assertion that humans possess ownership over their own bodies, and perhaps more importantly, that no other individual can deny them this ownership is a clear indicator that the LPS Act is formulated improperly. I will address this claim more comprehensively in the Proposed Practice & Policy Reform section. First, I will conclude by addressing Locke's claim that there are natural rights to life and liberty.

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[6] This sentence is relevant for discussions on self-harm, suicide, abortion, sex-transition operations, etc.

To elaborate upon Locke's theory of natural rights, I will first make the familiar argument that the right to self-harm and suicide exists within the right to liberty. Furthermore, I will note that the right to suicide exists within the right to life, for death is, irrefutably, an important part of life. Thus the question becomes this: if persons are granted the right to life and liberty - that is, they can construct their life as they choose through their agency - then why does this right not extend to death?

As I have shown via Mill's Libertarianism, there exists the right to suicide as a right of noninterference. However, I believe the right to suicide can be also be logically derived via Locke's theory of natural rights as a liberty right[7]. Under Locke's own view, liberty can not be constrained unless an individual poses a threat of harm to others or has harmed others, in which they have forfeited their right to liberty by infringing upon the liberty of another. In the scope of involuntary commitment, an individual's right to liberty should supercede any power of the government without ethical and legal justification. Instead, many individuals, some who may benefit from involuntary commitment and others who will not, have their consent stripped away by an unethical legal process. This poses what I will coin as an iceberg threat - on the surface, it may be perceived as minor or insignificant, but it contains massive hidden ethical implications and assumptions. Locke himself wrote that "I have no reason to suppose, that he, who would take away my liberty, would not, when he had me in his power, take away everything else," (18).

Regarding the right to life, I will pose the following syllogism:

1. A right to life includes a right to all aspects of life, such as infancy, youth, and adulthood.
2. Within the right to an aspect of life such as adulthood, an individual maintains the right to carry out their adulthood with full autonomy (outside of harming or infringing upon the rights of others).
3. Death is an aspect of life.
4. Within the right to death, an individual maintains the right to carry out their death with full autonomy (outside of harming or infringing upon the rights of others).

I contend that this syllogism showcases the significance of the relationship of life and death: they are not opposites, one is a mere piece of the other. Given that there is a right to life, categorical logic would indicate that the right to death is included.

Additional Concerns & Questions

Besides the aforementioned concerns, I am wary of how directly the conceptualization of "gravely disabled" relates to the United States Constitution. To be 'gravely disabled,' on one account, is to not be able to provide for oneself what is needed when it comes to food, shelter, and belongings such as clothes. But based on this, if an individual is able to provide these things they may be considered to not be in need of care despite other reasons such as paranoia, severe migraines, seizures, etc. On the other hand, if an individual is not able to provide these things, how are we to decide if that is a result of their mental state? For example, I may be incapable of providing myself with one of these three simply due to my own laziness and lack of desire to make money.

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[7] See Stanford Encyclopedia of Philosophy - Michael J. Cholbi on Suicide

Laziness is indeed a mental state and it is directly inhibiting my ability to provide for myself. However, should I be considered 'gravely disabled'? Pulitzer Prize awardee and Los Angeles Times author Thomas Curwen has directed criticism at the term in the past, claiming that those who are in favor of expanding the definition may not realize the financial and practical consequences of doing so, while those who are against expansion may be doing a disservice to the individuals who are "falling through the cracks," (2).

A further concern is that the approach to mental health in the LPS Act is archaic. It is heavily standardized and does not account for subjectivity in the experiences, needs, and interests of varying people. For some people I am confident that involuntary treatment truly made a beneficial impact. However, for many, the opposite holds true. Professor Elyn Saks of the University of Southern California is one such example. She was involuntarily committed during her time as a student and has since dedicated her life to reforming the mental health care industry, claiming that "putting someone away without their consent is a kind of assault on a person's integrity and lifestyle" (USC News).

Proposed Practice & Policy Reform

One potential policy reform that I believe could be made would be to give individuals full legal autonomy over their own body (I think this should also be extended towards things like sex changes and abortions, which still often encounter legal difficulties). Humans consistently serve as a threat to themselves. If I step on my skateboard and ride it down a hill, I am a harm to myself (and perhaps others). But this should not be basis for removing one's ability to consent to treatment, especially when that person may consider that treatment to be an even greater harm. Having done copious research and spoken with individuals who have been involuntarily committed, I can make the honest claim that this sort of treatment is by no means successful for everyone. The United States is indeed one of the countries with the highest populations of mentally ill that leave facilities and return (NAMI).

The ethical implications of involuntary commitment, when taken along with research showcasing the failure of this practice in many cases, should serve as justification to alter the practice. I contend that the government should not possess the power to hold an individual and subject them to medical treatment against their own will. In many cases, this can be seen as an infringement upon one's right to liberty. Therefore the revision that I suggest be made to the LPS Act is that the clause about "being a harm to oneself" be removed. Even though some individuals may believe that there is a moral obligation for the government to protect its citizens, the more fundamental moral obligation is for the government to preserve the rights of its citizens. Mill and Locke have revealed that there should exist a right to self-harm and a right to suicide within our rights to liberty and property in our own person. The logical next step to take would be to adjust the legislation according to this ethical proof and current research. Even many psychiatrists seem to support this proposal - a 2007 survey found that they are aware of the limits of both the definition and the legal basis of involuntary commitment[8].

[8] See Robert A. Brooks - Psychiatrists' opinions about involuntary civil commitment

Objections

(1) Objection to Utilization of Locke

This objection seeks to refute the use of Locke in the debate over the ethics of involuntary commitment, for Locke himself did not even support a right to suicide. Locke made this abundantly clear, writing that " though man in that state have an uncontrollable liberty to dispose of his person or possessions, he has not liberty to destroy himself[9]." Locke's objection to suicide stems from his religious beliefs. Under his view, an individual is the property of God first and foremost, and thus, as Her creation, owe it to not enforce our own death. He believed that humans were "made to last during His, not one another's pleasure[10]." Due to Locke's personal rejection of a right to suicide, proponents of this objection would argue that my use of his theory is poor justification for the exact right that he himself denies.

(2) Objection to Criticism of Standardization

This objection regards one of my concerns about the standardization of mental health care as not being invested enough in the well-being of patients. This objector would likely argue that standardization to some extent is entirely necessary simply due to logistics: California has over 30 millions individuals, of which around 15.4% of adults suffer from mental illness (CHCF). It would be unreasonable to fantasize over legislature that is able to fully comprehend or address the relative and subjective needs of every individual in any capacity, and especially so when it comes to mental health care, because individuals may lack the ability to rationalize about their own needs and interests properly.

Responses

(1) For this objection, I will reply by acknowledging Locke's denial of a right to suicide, but claiming that it is based in ignorance. The theological issue that Locke has regarding suicide is poorly formed and entirely irrelevant for modern America, in which church and state are (supposed to be) separate. For one, if Locke is to view humans as God's creation and thus God's property, then where can one derive the right to harm or destroy other pieces of God's property, such as a plant or an animal? A practice such as farming certainly goes against the will of God, for God intended those plants and animals to live a certain life and instead it has been altered by the practices of humans. Secondly, Locke's subscription to religion should not have bearing on legal decisions or ethical discussions involving his views on politics and philosophy. I contend that the extension of his theory of natural rights to reveal the right to self-harm and suicide is a fair use of his work and an important consideration in the dialogue surrounding involuntary commitment.

(2) To this objector, I would argue that my view should not be characterized as being the view that all individuals will be given full consideration to their subjective needs and desires within the confines of the law. I recognize that there are definite limitations within what the law can address and achieve. However, I believe that my criticism is still entirely fair; the current language of the LPS Act does little to acknowledge current research and views on mental health and the treatment of mental health, such as that institutional treatment may not be optimal for everyone and that it takes drastically different amounts of time for different individuals to recover from varying mental illnesses. The LSP Act was passed in 1972 and

[9] From John Locke's Second Treatise: Chapter II, Section 6

[10] From John Locke's Second Treatise: Chapter II, Section 6

since then there have been nearly five decades of research which should be considered and used to make revisions to the actual policy that informs the practices of the healthcare industry.

Conclusion

To conclude, I argue that there is a clear need for significant reconsideration over the nature of the LSP Act and the practice of involuntary commitment in general. I advocate for other writers, researchers, and professionals to do their part in attempting to develop a critical understanding of involuntary commitment and some of the ethical ramifications. I do not, however, want to make the claim that involuntary commitment should be outright banned. For some individuals it is a necessary step towards recovery. Still, I believe that it is time that this very old bill be given a facelift - I contend that individuals with consenting powers (over 18 and not on alcohol or drugs) have a legal right to their own body, which includes a right to self-harm and a right to suicide. At this point, I believe I have proven that there are a number of unethical consequences that result from the LPS Act as it currently stands.

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