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Additional acknowledgements can be found in the Pandemic Essay forward

A Letter from the Editor

Once upon a time, someone asked me, in all earnestness, “what does it matter if I don’t understand science?”

The last decade, and especially the first few months of 2020, have answered that question better than any Sagan quote ever could. The world is different now. Not in the slow, accumulating sense we all become used to, but in the catastrophic, culture reorganizing sense experienced only every few generations. Tomorrow, whatever it becomes, will not be like yesterday in important ways.

From March until…well, the writing of these words, a plague has demonstrated, in no uncertain terms, that understanding science, mathematics, and history matters. And not understanding it has dire consequences.

COVID-19 is a horrific test of the effects rejecting scientific claims can have on a society, and it is working in real time. Everywhere people reject the best practices for social distancing and the use of masks, and the virus surges.

One could argue that the rejection of bio-anthropological claims that all humans are in every important way the same, and that race is a cultural construct rather than a biological reality, has led to the calls for dismantling our current systems in favor of more truly egalitarian examples.

And of course, the specter of rapid climate change exacerbated, perhaps caused, by mankind’s overproduction of dangerous substances and overharvesting of necessary natural resources, looms omnipresent over everything we do – or don’t do.

To deny or ignore scholarship has become life and death as never before. If we wish to live in a world where suffering is minimized and problems are solved, understanding and accepting what science, history, and the totality of academic research reveals to us is paramount.

To that end, Weber State University encourages and rewards students who choose to take their studies a step further than grades and

ceremonies. To take their growing knowledge and apply it to actual research – planning, applying for grants, conducting experiments, interpreting results, and presenting the findings.

These are not simple tasks when students have classes to attend and often jobs to work. Research is time-intensive to say the least. Imagine adding a lockdown to the mix. Having to maintain collaborations and access to data while confined to your room or home adds a professional level of stress to students who are still learning the tools of their future trade.

It is under circumstances such as these that the students in this volume had to finish their work. This past year has placed pressures on our authors as a group that former authors hadn't faced. It is always a bit miraculous that we can publish a volume of research conducted at Weber State University during any regular academic year. This past year has been anything but regular.

Which is why we truly must honor those who have endured and provided us with the articles that follow. And I want to emphasize this. These students, and the mentors and faculty that helped them, have shown dedication to scholarship in the midst of chaos. That they remained so dedicated should inspire us all. I know it inspires me.

We all need this dedication moving forward if the present is to be tamed, and progress toward solutions to our shared global problems made.

Christopher Sessions

A Letter from the Editor Continued

Addendum

As the deadline for this volume approached, we were given the opportunity to publish papers specifically addressing the Covid-19 crisis of this past year. It seemed not only timely, but greatly appropriate that we include this work, and thus we held off the final edit to accommodate the entries. We hope you will agree this was more than worth the delay. You will find them under their own special section, introduced by Professor Gavin Roberts. Once again, the fine scholarship of our fellow students and staff shines a light on darkened times.

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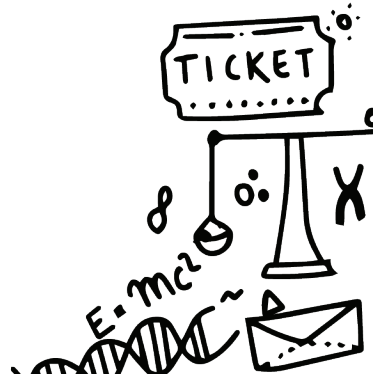

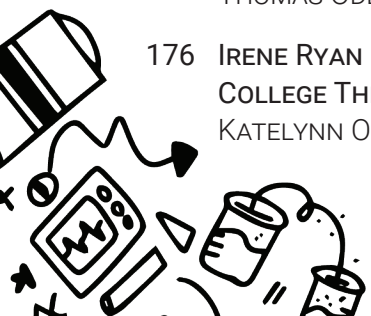

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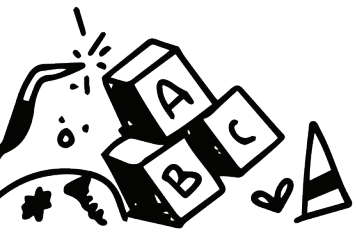


Research Articles

An Analysis of the Decision-Making Process Among Newlyweds

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Mentor: Michael Ault | Department: Communication

Researchers have studied the decision-making process for individuals and small group decision-making extensively. Research into the decision-making process for heterosexual romantic couples is remarkably limited and inconclusive. There is even less information about what this looks like within couples who have been married less than one year. And yet, the value of a greater understanding of how couples make decisions can provide valuable insight into the married relationship dynamic. This knowledge can help married couples make decisions that better fulfill the needs of both people involved, increase the levels of positive and constructive communication, and potentially decrease divorce rates. The researchers have a particular interest in this topic because they themselves are in heterosexual relationships and are interested in improving their communication skills and joint decision-making processes. They understand that within personal relationships certain patterns and experiences could be understood and applied in a general application. This study examines the following questions.

RQ1: What do newlywed couples identify as a big decision?

RQ2: What techniques and strategies do newlywed couples use to make big decisions?

Methods

Participants

Participants range in age from 22 to 28 years old. Both male and female participants were interviewed. The majority of the participants were Caucasian, however, one participant was Samoan and another was a Native Hawaiian. “Newlywed” was defined as having been married to a current spouse for less than one year. Participants were chosen using network sampling. All of the participants are partners in a heterosexual newlywed relationship.

Data Collection

Eight semi-structured interviews were conducted for this study. Interviewers sought to identify basic understanding that the couples have created. Questions inclu de "What does the phrase 'big decision' mean to you?" "Could you provide a few examples of some big decisions you have made with your spouse?" and "How do you handle conflicts that arise when you are making big decisions as a couple?" During the interview, follow-up questions were asked to prompt the sharing of further information and deeper understanding.

Interviews ranged in length from 10 minutes to 22 minutes. In total 120 minutes of interview audio was recorded. Participants were interviewed individually.

Data Analysis

Constant comparative analysis inductively builds theory through a process that involves multiple passes through the data. In the first pass, a method known as data reduction is used (Lindelof & Taylor, 2011). During data reduction, researchers become familiar with the data and exclude any information that is not relevant to answering the research questions. In the second pass, researchers open code the data. During open coding, researchers create a brief description of individual thoughts within the data. The open codes in this project are based on individual units of thought. In the third pass, the open codes are combined into large, more abstract focused codes. In the final pass, the interrelationships among focused codes are analyzed to create one axial code for each research question.

Results

This research seeks to understand the techniques that newlywed couples use to make big decisions. RQ1 considers how newlywed couples decide what will be a "big decision" in their newly-established life together. It was discovered that *newlyweds identify big decisions as choices that enable or constrain future decisions.* These choices that enable or constrain future decisions can be broken down into three categories (1) decisions about lifestyle (2) financial decisions and (3) familial decisions.

Lifestyles. Each research participant when asked to define what they would consider a "big decision" identified decisions about their couple's lifestyle. These lifestyle decisions took a variety of forms; however, they all had in common that these decisions would affect not just one but both party's lifestyles now and in the future.

Lifestyle decisions were used as an opportunity to combine values or interests into a shared lifestyle. Charles, who has been married just over a month explained one big decision he and his wife made saying:

> Where we wanted to live... I wanted to live in [city] so she wouldn't have to drive through the canyon, but she didn't want me to have to wake up super early [to drive to work]. So, we decided to live in [city].

Making this decision about where to live impacts both members of the couple as they attempt to negotiate their lifestyle expectations through the decisions they are making. All of the couples consider the decision to get married, where to live, or any religious decisions to be choices that would establish the lifestyle they will share throughout their marriage.

Financial. Participants in this study especially stressed the factors of finances in determining a big decision. Financial decisions are qualified as any decision requiring a large investment of money in to a task, an object, or an opportunity. Some of the decisions that are identified as financial decisions are buying a house, purchasing burial plots, buying a dog, or even investing in a vacuum.

One financial decision mentioned concerned the choice to invest financially in something that comes with daily responsibilities.

> We got a dog in the summer and he wasn't cheap, so that was a big decision for us. A lot of it came down to, is this going to benefit us in the future? How are we going to take care of this dog? We looked at it more like a financial investment because we knew we would have this dog for seven or 10 years so it's a long-term decision. It's a lot of money now, but he will be with us for a long time.

Making decisions that are more long-term financial investment was something that each participant mentioned. For a lot of these newlywed couples, this is the first time they are making these types of decisions especially with someone else as a stakeholder in the

financial decision.

Familial. The participants felt that the consideration that they put into familial decisions could significantly change their life with their spouse and should be considered a big decision. These decisions include deciding to marry each other as well as decisions regarding having children. Kelly explained "Recently I've been talking about having kids someday. When do we want to have kids? That's a big decision." Another common discussion was that getting married itself was a big decision for many of the couples. Jane echoed this concept as she explained, "We have made big religious decisions however, the biggest choice we've made was deciding to get married. That was a big one for us." These familial decisions are seen as big decisions because they are an investment of emotional, physical, and financial commitment to another person. As these couples navigate the world of social interactions deciding to marry someone or to create their own family there is a lot of pressure to make the right decisions and plan the right time.

Overall these three types of decisions are not surprising. Many couples mentioned that their problems or complications generally come from these three categories: **familial, financial, and lifestyle.** The more noteworthy understanding we gained is that all of the decisions mentioned by participants directly aligned with one of these three categories. There were no decisions that failed to fit within these three dominant categories.

Techniques and Strategies

The second research question that was answered in this constant comparative analysis is "What techniques and strategies do newlywed couples use to make big decisions?" Through this analysis, the overarching answer to this question is *newlywed couples adopt or develop different strategies, either purposefully or unknowingly, that they follow when making big decisions.* There are five strategies that newlywed couples utilize: (1) analyzing positives and negatives, (2) organic or "Go with the flow," (3) open communication policy, (4) assigning roles, and (5) conflict management.

Analyzing positives and negatives. The participants discuss the importance of weighing their options or considering the pros and cons. This is a vital strategy of any decision-making process because

it allows for consideration of all options without judgment of those options. Some of the couples stressed the value of being vulnerable during this strategy as a key to their process. One participant said, "we weigh out our options and we're both very open about how we feel about it." Justin, a newlywed of about 5 months, explained the role of analyzing positives and negatives and its impact in his decision-making process with his wife:

> We weigh the pros and cons and make a decision and then if it doesn't feel right, we swap it out and re-discuss but kind of setting up the decision planning options, weighing the pros and cons and then acting up.

As we can see from this quote, it is important to follow this system as the first strategy of the decision-making process. However, simply having more pros or positive aspects does not mean that it is the right decision and that is where the next strategy comes into play.

Organic or "Go with the flow." Another pertinent strategy in the experiences of the participants is allowing things to happen naturally or just "going with the flow" of the decision-making experience. This seems to become important when these newlywed couples have not experienced a similar type of decision and are hoping to find a routine that is natural for both of them. This "Go with the flow" strategy is used when anxiety or stress potential is less because of a lack of control. Additional times this strategy may be used is due to a lack of emotional involvement or for experiences seen as an opportunity to rely on instinct instead of structure. Some participants identify that decisions are better made when they are allowed to happen at a time or place that is natural for the couple instead of a planned discussion. Sometimes these decisions are based on intuition and feeling rather than on logic or planning. For example, Easton said of this organic strategy:

> Just say yes. Just go with the flow… Even though it's a big or a little simple decision just telling me yes or no and then we can move on from that… I made [a] decision and then hoped that she'd go with the flow, which she did.

Here, Easton expresses that each partner should have the freedom to make a judgment call and make decisions, and their spouse should be trusting enough to accept and go along with it. These decisions

are less emotional and less financial in nature when compared to the other decisions being made. Considering the lessened emotional involvement of these decisions, the 'instinct instead of structure' method allows both partners the freedom of choice without creating an environment that needs to be created. Instead, it creates a decision as well as an environment that happens organically.

Open communication policy. One strategy that became clear throughout the interviews is the use of an open communication policy during the decision-making process. Couples speak their minds about their thoughts and feelings without fear of judgment. Couples made it clear that topics discussed in confidence, stay within the couple. For example, Weston said the following concerning the open communication policy that exists between him and his wife:

> It starts with both of us just voicing our opinions to each other, making sure that whatever our opinions are, we're not saying anything to offend the other to go against what another person wants, but just voicing how we both feel, that's super important. Just to get a better understanding of each other's thought processes and feelings on whatever it is.

The purpose of the open communication policy is to get everything out in the open from the beginning so that spouses can be sensitive to the ideas and desires of their significant other. This makes it easier to proceed in deciding because couples are not forced to guess what their spouse wants.

Assigning roles. Many of the participants throughout the interviews discussed formal or informal role assignments. As some couples establish nonverbal roles as to who would instigate the big decision-making discussion, others verbally address that one person will take the lead during one type of decision depending on their knowledge or involvement. This seemed to relieve some of the pressure on the less involved party to make a decision. Allowing them to take a subordinate role within that process reduces the tension and the time it takes to make a big decision. This "role assigning" process is something that Jane discussed in the following quote:

> So I think there are some decisions that we've decided you just make those decisions and I just make these decisions. They have a bigger effect on me… And like when it comes to his bike

> stuff that does not really affect me… I think when it comes to more, like, financial and purchasing my husband has taken the lead on that and when it comes to like buying cars or making big purchases, he definitely kind of has more say. But when it comes to I believe more emotional and religious decisions, I think I have more say in it because I think I am a little bit more sensitive and especially when it comes to religion, I am a little bit ultra sensitive and so he is always so just accommodating to me with that because he knows that that has a much higher effect on me than it ever will on him.

As Jane addressed, some of these roles are assigned because of more experience or more interest in that type of decision whereas other roles come from the emotional impact they hold for one member of the relationship. It is important to also note that some of the roles that are established are based on gender. Some of the participants discussed that they had roles that were assigned simply because of gender expectations or parental modeling and not always because of the actual qualification of one partner over another.

Conflict management. This is the last technique that is heavily used by the participants of this research project. Conflict management is different from the other techniques in that it is heavily influenced by experience. The participants referenced situations such as parents' conflict management habits, mental health status, past relationships, and personal experiences as determining factors to their conflict management styles. It was even acknowledged that sometimes this is not their ideal technique, but habit beats out the reason when it comes to determining the conflict styles. Kelly explained that her husband's previous marriage contributed extensively to the conflict management styles he uses:

> I think that has also been a huge factor is that he has seen the effects of when people shut down and don't want to talk about the conflicts. He knows the consequences and doesn't want that to ever happen again. So, he forces me to talk about, which is good for me again. I think that's probably the biggest factor of why he's like that as well.

Overall, the conflict management strategies that the participants use contribute extensively to the strategies they use as they make big

decisions as a couple.

Discussion

In summation, the big decisions that newlyweds are making enable or constrain future decisions. These are decisions about (1) lifestyles, (2) familial, and (3) financial decisions. These three types of decisions create opportunities for the couple to create a shared meaning of the magnitude of the decisions at hand. Second, the techniques that newlywed couples use to make big decisions allow them to establish and maintain roles that are used as shortcuts to the responsibility processes the couple must use to make a decision. They also allow the couple to use naturally occurring techniques to perpetuate an "organic" feel during the couple's decision-making process. Open communication policies are important as they allow the couple to express themselves and create a collaborative decision-making process to take place.

Understanding these specific elements of the decision-making process can provide valuable insight into the married relationship dynamic. The findings of this research could help married couples make decisions that better fulfill the needs of both people involved. As these results are applied to newlywed relationships, opportunities to refine and improve the decision-making process for married couples could increase the levels of positive and constructive communication and decrease the rates of divorce and abuse.

Limitations. These findings could be expanded upon in future studies. Researchers that are searching for more explanation of these techniques should interview a larger sample size than this study was able to do so that the findings can be generalized. The researchers also believe this research could be expanded to analyze an organizational decision-making team and the ways their decision-making processes compared to those of in a similar way as the newlywed couples. Exploring if similar strategies are utilized within decisions made with a team or organizational leadership would expand the significance of these findings to many other avenues of life. This research should also be expanded to include couples from non-heterosexual relationships. Expanding this research to members of the LGBTQ+ community further understanding of the patterns used in choice making could be more expansive and inclusive. Limitations

to this study include the sample size as these interviews included only eight interviewees who all come from similar religious and location backgrounds. This limited sample size could limit the generalizability of the data to a larger scale or to people who may be from a different demographic or cultural background.

Conclusion

In conclusion, this constant comparative analysis has answered the two research questions. It has revealed that newlyweds identify big decisions as choices that enable or constrain future decisions, namely choices that are a matter of lifestyle, finances, or family. It has also revealed that newlywed couples adopt five different strategies, either purposefully or unknowingly, when making big decisions. These strategies consist of analyzing positives and negatives, allowing decisions to happen organically, maintaining an open communication policy, assigning roles, and managing conflict. This information would be valuable to any newlywed couple as it has the potential to aid them in their decision-making processes.

References

Keyton, J. (2019). ***Communication research: Asking questions, finding answers*** (5th Ed.). New York, NY: McGraw-Hill.

Appendix

Research Questions:

Grand-tour question: Take me through your typical decision-making process.

Structural question: What does the phrase “big decision” mean to you?
Example question: Could you provide a few examples of some big decisions you have made with your spouse?
Example question: How do you handle conflicts that arise when you are making big decisions as a couple?
Experience question: What do you wish your spouse would do differently regarding making big decisions?
Experience question: What would the ideal decision-making process look like for you?

Investigating the Effects of Ocean Acidification on Adult Oyster (*Crassostrea virginica*) Shells

Dillion Flowers, Crystal Price-Sturgeon, Annie Rollin, Dylan Schmidt, Megan Banford, Cassandra Collard, Malachi Dearden, Sara Deem, Rachel Dubose, Megan Faulker, Sabrina Haney, Karina Hipolito, Heidi Huges, Daniel Hunnel, Hailey Johnson, Kassey Mereer, Catherine Miller, Daniel Moran, Sasha Pressley, Ashley Pytlewski, Geoffery Sorenson, and Austin White

Mentor: Rebecka Brasso | Department: Zoology

Introduction

Anthropogenic activity has led to the increased uptake of the greenhouse gas (CO_2) by the oceans, which consequently lowers oceanic pH potentially causing a host of complications for marine organisms (Hale et al., 2011; Kelly & Hofmann, 2013). Marine organisms are accustomed to environmental fluctuations, but in the past 100 years ocean surface temperature has risen and pH has fallen at accelerated rates (Harley et al, 2006). With warmer temperatures caused by climate change already stressing life in the ocean, it is important to study the effects of lowered pH in conjunction with raised temperature in order to assess what effects they might have on marine organisms, some of which are economically valuable (Wells & Okada, 1997; Goreau, 2005).

Marine animals with calcium carbonate ($CaCO_3$) shells/endoskeletons, such as clams, oysters, snails, and sea urchins, are particularly vulnerable to ocean acidification. As more atmospheric CO_2 dissolves into the ocean it can alter the bioavailability of calcium ions (Ca^{2+}) needed to form $CaCO_3$ used to construct shells. This can lead to reduced calcification rates and the dissolution of $CaCO_3$ shells causing weak, brittle shells as has been seen in coral, coccolithophores and bivalve mollusks (Feely et al., 2008; Findlay et al., 2009). With the weakening of their shells, marine invertebrates have a higher chance of being killed by predators and eventually wiped out of ecosystems all together which would have seriously

negative effects on the ecosystem (Harley et al., 2006).

Previous studies have shown that the acidification of the ocean has changed the physiology, morphology, and behavior of different marine animals (Berge et al., 2006; Kroeker et al., 2010; Bressan et al., 2014; Talmage & Gobler, 2011; Waldbusser, 2015; Nagelkerken & Munday, 2016). A study by Amaral et al. (2012) found that the shells of the Sydney rock oyster, (*Saccostrea glomerate*), and the sea snail, (*Bembicium auratum*), were weakened when raised in an acidified environment, but the shell of the crab, (*Heloecius cordiformis*), showed no difference. This is likely due to the diminished capability by the mollusks to precipitate $CaCO_3$ shells in acidified environments, whereas the shells of crabs are made primarily of chitin which is typically unaffected by acidification. Acidification can also modify behavioral predator-prey interactions between the soft-shelled clams, (*Mya Arenaria*), and blue crabs, (*Callinectes sapidus*). The clams exhibited a delayed response time to the presence of their predators, and the blue crabs had an extended search time for the clams that were their prey under acidified conditions (Glaspie et al, 2017).

Our study was conducted in order to examine the effects of lower pH on adult eastern oyster, *Crassostrea virginica*, shells. We hypothesized that oyster shells placed into tanks at an environmentally relevant lowered pH (7.0) would show significant mass loss relative to oyster shells left in a tank at the ocean's current average pH of (8.2). We also predicted that the oyster shells would lose more mass if we raised the temperature of the water to simulate global warming with the combined effect of the lowered pH.

Methods and Materials

Study Design

The experiment took place in a temperature-controlled lab in Tracy Hall on the campus of Weber State University (Ogden, UT). In total, 120 adult oyster, *C. virginica,* shells were acquired from a local restaurant (Harley and Buck's) in Ogden, Utah. The live oysters themselves were originally sourced from New York. Prior to the experiment the oyster shells were placed in metal cages and mechanically washed in a home dishwasher to remove any remaining tissue. Additional external partials, such as rocks, barnacles, and

miscellaneous organic matter, were then removed by hand as needed. Each shell had its original dry weight (mg) measured and the shells were each numbered with permanent marker before being placed into one of three, 75-liter tanks. The oyster shells were divided equally among the three tanks, having 40 shells in each.

All three tanks had approximately 26 liters of distilled water, Instant Ocean (Spectrum Brands, Blanksburg, VA), HCl, and 0.5 NaOH added to them. Instant Ocean was added to each tank to achieve a salinity of ~14 ppt to mimic estuary conditions that would have been similar to the oyster's natural habitat. Each tank's pH was measured and adjusted for a week prior to the experiment using an electronic probe; drops of 0.5 mol NaOH and HCl were added as needed in order to achieve the desired pH. For the experiment, Tank 1 had a pH of 8.5 ± 0.5 at a room temperature of 20°C (control), Tank 2 had a pH range of 7.0 ± 0.5 at a room temperature of 20°C (acidified), and Tank 3 had a pH of 7.0 ± 0.5 and an elevated temperature of 25°C (acidified and warming). Temperature was adjusted using a common hobbyist aquarium tank heater and the tanks were covered with aluminum foil to minimize evaporation.

Each tank was measured for temperature and pH every day for five weeks. The water was stirred with a wooden spoon (to ensure homogenization and to oxygenate the tanks) before checking the temperature and measuring pH with a pH probe. If the pH was out of range, it was then adjusted using drops of either 0.5 molar NaOH or concentrated HCl. Once every week the shells were taken out, dried using paper towels, and weighed to the thousandth of a gram. At the end of five weeks, the shells had a final wet mass recorded, then left dry for 2d and a final dry mass was recorded.

Statistical Analysis

The dry masses of the oyster shells before and after the experiment from each tank separately using Wilcoxon Signed Rank tests (SPSS) as the data sets were not normally distributed. A one-way ANOVA (SPSS) was then used to test for the effect of treatment (control, acidified, and acidified plus warming) on shell mass among the tanks. Finally, a Tukey's post-hoc multiple comparison test was used to test for significant differences ($P < 0.05$) among treatments. Two outliers from Tank 1 were more than two standard deviations

away from (greater than) the mean. These shells had a much greater change than any others, so they were removed and not included in statistical analysis.

Results

There was a significant difference between the final average dry weight and the beginning average dry weight of the oyster shells in each treatment (Fig. 1). There was a significant decrease in oyster shell dry mass in all three tanks (Tank 1: $p<0.001$; Tank 2: $p < 0.001$; Tank 3: $p < 0.001$). Wet mass did not appear to change weekly over the course of the experiment (Fig. 2). The percent change in mass (± S.D.) over the course of the study was relatively small with changes averaging less than 1.50% (Tank 1: -1.42 ± 0.70%; Tank 2: -1.31 ± 0.44%; Tank 3: -0.59 ± 1.32%; Fig. 3). When the percent mass change among the three tanks was compared, we found a significant effect of treatment ($F_{2,118}=9.96$, $P<0.001$, Fig. 3). Analysis with Tukey's post-hoc comparison showed that the percent mass change in Tanks 1 and 2 were not statistically significant from one another. However, the mass change of oysters in Tanks 1 and 3 were statistically different ($P=0.001$) from one another in which oysters in Tank 3 lost less mass than those in Tank 1. Tanks 2 and 3 also differed from one another in which Tank 3 lost less mass than Tank 1 ($P<0.001$).

Discussion

Overall, oyster shells in all three tanks showed significant loss of mass. However, Tanks (1) and (2) lost significantly more mass than Tank (3). Ultimately, this was counter to our hypothesis as the control oysters (Tank 1) lost more mass than did the oysters in the acidified and warmed treatment (Tank 3). Whereas oyster shells in Tanks (1) and (2) lost a similar amount of mass. With Tank (1) having a significant change in mass we were not able to compare changes in Tanks (2) and (3) to it as it was not functioning as a proper control; therefore, our findings remain inconclusive relative to the effect of acidification on oyster shell mass.

The decrease in shell mass of Tank (1) could have occurred for several reasons. First, the shells in Tank (1), relative to Tanks (2) and (3), could have had some flaws in them making them susceptible to chipping and damage during their handling. While this was not

something assessed directly, it could have made the mass loss an artifact of the shells in that tank themselves, but as our study did not have replicates within each treatment, we were not able to test this hypothesis.

Previous studies conducted on oysters under acidified conditions looked at live oysters and how they were affected by the change environmental conditions. We tested the effects of acidification on only the oyster shell (no living animal present), which is different than most previous studies. This is a likely reason why our results did not match those of other studies. For example, in a study on live oysters in an acidified environment, the researchers found a decrease in the organic periostracum layer of the shell, as well as the inner nacreous layer, which decreased the structural integrity of the shells (Welladsen, et al., 2010). In Welladsen et al. (2010), observations of the decrease in structural components of the shells were made under microscope. This type of assessment of microscopic structural change could be added to a future experiment in order to measure the changes in shell integrity before and after exposure to acidification, rather than just measuring mass alone.

Previous studies examined the impacts of acidification on juvenile oysters and how acidification affected the crucial stages of shell building. One study looked at the effects of oysters under the pressures of predation by invasive snails when raised in both normal pH and lower pH levels. They found that oysters reared under acidified conditions grew at the same rate as oysters under normal conditions, except that their shell mass was lower (Sanford et al., 2014). Subsequently, the thinner shells made the oysters more susceptible to predation (Sanford et al., 2014). Similarly, another study on the growth of bivalves in acidified water showed that animals that form $CaCO_3$ shells are much more vulnerable to degradation when they are forming the shells as juveniles. The fully formed shells of mature oysters make it difficult for acidified water to reach the calcium embedded under the periostracum (Waldbusser et al., 2013), which may explain why we did not find the predicted mass changes in our experiment. By replicating methods of rearing live oysters in acidified conditions, we could directly test the structural integrity and mass differences of shells in a future study in order to make a more direct comparison with previous research. Ultimately, our study suffered

from complications that prevented us from determining the effects of acidification of oyster shells, as a result of the lack of a suitable control. One way that we can adjust this experiment in the future is to have replication of each tank treatment. We had only one tank per treatment, so adding replicates should give us more data allowing more control for unpredictable results in a single tank.

Though our experiment caused us to support our null hypothesis, there are other studies that show, in fact, that not only are global temperatures on the rise (Harley et al., 2006), but these rising temperatures can cause increased acidification in the ocean that can affect the $CaCO_3$ structures of marine fauna (Beniash et al., 2010; Comeau et al., 2010; Kurihara, et al., 2007; Welladsen, et al., 2010). By looking at the organism's ability to adapt on a cellular level, we can observe whether oysters can precipitate adequate amounts of $CaCO_3$ in the face of rising amounts of anthropogenic carbon in the atmosphere and the oceans. Oysters play crucial ecological roles in ecosystems through their filtration of water and the building of reefs with the piling of their shells. Therefore, additional research on the oyster's ability to compensate for the lower pH should be done.

References

Amaral, V. Cabral, HN. Bishop MJ. (2012). Effects of estuarine acidification on predator-prey interactions. *Marine Ecology Progress Series*, 455, 117-127. doi: https://doi.org/10.3354/meps09487

Beniash, E. Ivanina, A. Nicholas, S. Lieb, NS. Kurochkin, I. Sokolova, IM. (2010). Elevated level of carbon dioxide affects metabolism and shell formation in oysters *Crassostrea virginica. Marine Ecology Progress Series*, 419, 95–108. doi: https://doi.org/10.3354/meps08841

Berge, J. Bjerkeng, B. Pettersen, O. Schaanning, M. Øxnevad, S. (2006). Effects of increased sea water concentrations of CO2 on growth of the bivalve *Mytilus edulis* L. *Chemosphere*, 4. 62, 681-687. doi: https://doi.org/10.1016/j.chemosphere.2005.04.111

Bressan, M. Chinellato, A. Munari, M. Matozzo, V. Manci, A. Marčeta, T. Finos, L. Moro, I. Pastore, P. Badocco, D. Marin, M. (2014). Does seawater acidification affect survival, growth and shell integrity in bivalve juveniles. *Marine Environmental Research*, 99, 136-

148. doi:10.1016/j.marenvres.2014.04.009

Comeau, S. Jeffree, R. Teyssie, JL. Gattuso, JP. (2010). Response of the arctic pteropod *Limacina helicina* to projected future environmental conditions. *PLoS ONE*, 5. 6, e11362. doi: https://doi.org/10.1371/journal.pone.0011362

Doney, SC. (2006). The dangers of ocean acidification. *Scientific American*, 294. 3, 58–65. doi: 10.1038/scientificamerican0306-58

Feely, RA. Fabry, VJ. Guinotte, JM. (2008). Ocean acidification of the North Pacific Ocean. *PICES Press*, 1. 16,, 22–26. url: https://www.researchgate.net/profile/John_Guinotte/publication/228354388_Ocean_acidification_of_the_North_Pacific_Ocean/links/54359b5f0cf2dc341db2b444.pdf

Findlay, HS. Kendall, MA. Spicer, JI. Widdicombe, S. (2009). Future high CO2 in the intertidal may comprise adult barnacle *Semibalanus balanoides* survival and embryonic development rate. *Marine Ecology Progress Series*, 389, 193–202. doi: https://doi.org/10.3354/meps08141

Gazeau, F. Parker, LM. Comeau, S. Gattuso, J. O'Connor, WA. Martin, S. Pörtner, H. Ross, PM. (2013). Impact of ocean acidification on marine shelled molluscs. *Marine Biology*, 160, 2207-2245. doi:10.1007/s00227-013-2219-3

Glaspie, CN. Longmire, K. Seitz, RD. (2017). Acidification alters predator-prey interactions of blue crab Callinectes sapidus and soft-shelled clam Mya arenaria. *Journal of Experimental Marine Biology and Ecology*, 489, 58-65. doi: https://doi.org/10.1016/j.jembe.2019.05.011

Goreau, TJ. Hayes, RL. McAllister, D. (2005). Regional patterns of sea surface temperature Rise: Implications for global ocean circulation change and the future of coral reefs and fisheries. *World Resource Review*, 17, 350-374.

Hale, R. Calosi, P. McNeill, L. Mieszkowska, N. Widdicombe, S. (2011). Predicted levels of future ocean acidification and temperature rise could alter community structure and biodiversity in marine benthic communities. *Oikos*, 120, 661-674. doi:10.1111/j.1600-0706.2010.19469.x

Harley, CDG. Hughes, AR. Hultgren, KM. Miner, BG. Sorte, CJB. Thornber, CS. Rodriguez, LF. Tomanek, L. Williams, SL.

(2006). The impacts of climate change in coastal marine systems. *Ecology Letters,* 9, 228-241. doi:10.1111/j.1461-0248.2005.00871.x

Kelly, MW. Hofmann, GE. (2013). Responses to global climate change, adaptation and the physiology of ocean acidification. *Functional Ecology*, 4. 27, 980-990. doi: 10.1111/j.1365-2435.2012.02061.x

Kroeker, K. Kordas, R. Crim, R. Singh, G. (2010). Meta-analysis reveals negative yet variable effects of ocean acidification on marine organisms. *Ecology Letters*, 11. 13, 1419-1434. doi:10.1111/j.1461-0248.2010.01518.x

Kurihara, H. Kato, S. Ishimatsu, A. (2007). Effects of increased seawater pCO_2 on early development of the oyster *Crassostrea gigas*. *Aquatic Biology*, 1, 91–98. doi: 10.3354/ab00009

Nagelkerken, I. Munday, PL. (2016). Animal behavior shapes the ecological effects of ocean acidification and warming: moving from individual to community-level responses. *Global Change Biology,* 3. 22, 974-989. DOI: 10.1111/gcb.13167

Sanford, E. Gaylord, B. Hettinger, A. Lenz, E. Meyer, K. Hill, T. (2014). Ocean acidification increases the vulnerability of native oysters to predation by invasive snails. *The Royal Society*, 1778. 281, 1876-1935. Doi: https://doi.org/10.1098/rspb.2013.2681

Talmage, S. Gobler, C. (2011). Effects of elevated temperature and carbon dioxide on the growth and survival of larvae and juveniles of three species of northwest atlantic bivalves. *PLUS ONE*, 6. 10, 1-12. doi:10.1371/journal.pone.0026941

Walther, K. Sartoris, F. Portner, H. (2011). Impacts of temperature and acidification on larval calcium incorporation of the spider crab Hyas araneus from different latitudes (54° vs. 79°N). *Marine Biology*, 158, 2043-2053. doi:https://doi.org/10.1007/s00227-011-1711-x

Waldbusser, GG. Bunner, EL. Haley, BA. Hales, B. Langdon, CJ. Prahl, FG. (2013). A developmental and energetic basis linking larval oyster shell formation to acidification sensitivity. *Geophysical Research Letters,* 40. 10, 2171-2176. doi: https://doi.org/10.1002/grl.50449

Waldbusser, G. Hales, B. Langdon, C. Haley, B. Schrader, P. Brunner, E. Gray, M. Miller, C. Gimenez, I. (2015). Saturation-state sensitivity of marine bivalve larvae to ocean acidification. *Nature Climate*

Change, 5 273–280. doi: https://doi.org/10.1038/nclimate2479

Welladsen, HM. Southgate, PC. Heimann, K. (2010). The effects of exposure to near-future levels of ocean acidification on shell characteristics of *Pinctada fucata* (Bivalvia: Pteriidae).*Molluscan Research*, 3. 30, 125–130. url: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.363.7237&rep=rep1&type=pdf

Wells, P. Okada, H. (1997). Response of nannoplankton to major changes in sea-surface temperature and movements of hydrological fronts over Site DSDP 594 (south Chatham Rise, southeastern New Zealand), during the last 130 kyr. *Marine Micropaleontology,* 32. (3-4), 341–363. doi: 10.1016/s0377-8398(97)00025-x

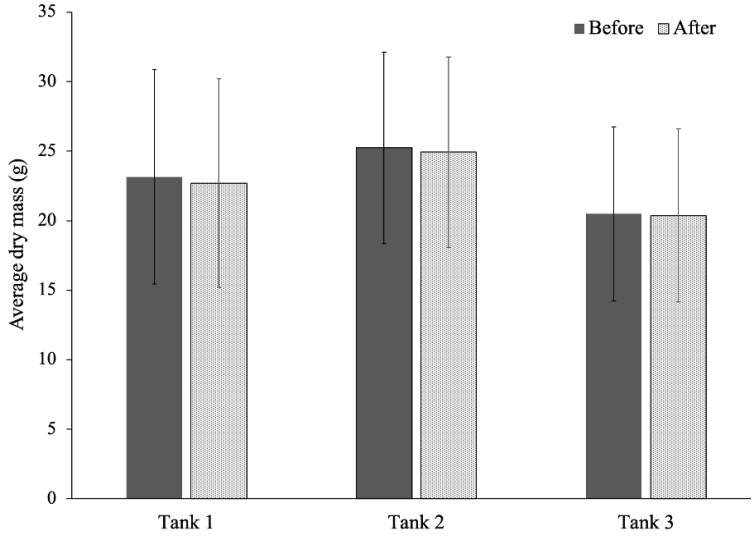

Figure 1. Mean (±SD) dry mass of oyster shells in each tank before the experiment began and after. There was a significant decrease in oyster shell dry mass in all three tanks (Wilcoxon signed rank tests: Tank 1: p<0.001; Tank 2: p < 0.001; Tank 3: p < 0.001)

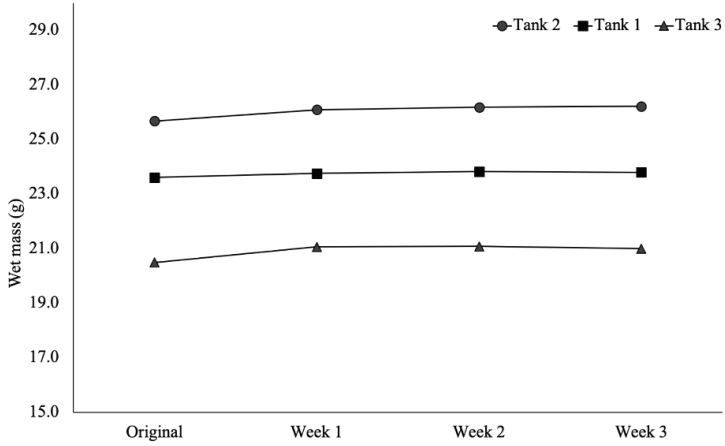

Figure 2: Average wet shell mass (mg) of each tank over four weeks. Each interval does not include beginning and end dry weights. Tank (1) was the control pH and temperature, Tank (2) was the lower pH, and Tank (3) was lower pH and higher temperature

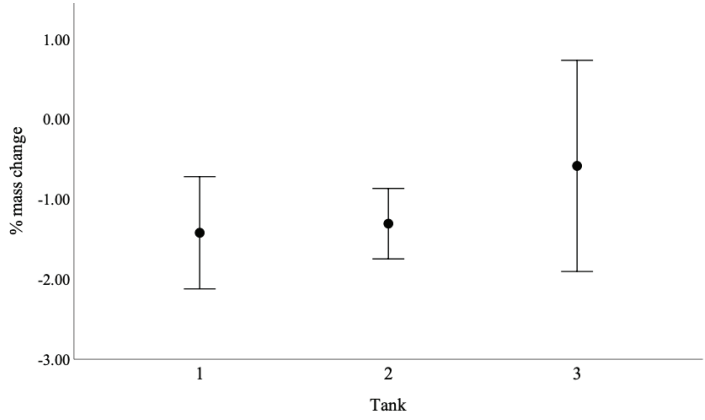

Figure 3: Mean (±SD) percent change in dry mass of oyster shells in all three tanks from the beginning to the end of the experiment. There was a significant effect of treatment ($F_{2,118}$=9.96, P<0.001) in which percent mass change differed between Tanks 1 and 3 and Tanks 2 and 3 (P<0.001 in both cases).

College Coaching Legends

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Executive Summary

Sports play a major form of entertainment in people's lives, whether as a spectator or a participant. Sports as entertainment in general provide us a moment of euphoria, a release of everyday stress, and for some a part of self-identity. Sports comein many different forms and each different sport has its own unique complexity. In this article the sport focused on is US men's college basketball.

The task is to formulate a mathematical model, analyze it and determine a solution to rank the top five men's college basketball coaches based on what sports enthusiasts define as the "best all-time men's college basketball coach."

The best men's college basketball coaches were found by defining a consensus opinion among experts using Rank Aggregation to compile various 'Top 10' lists into a single ranked list of coaches. The results from the Rank Aggregation were used to train a Principal Components Regression model which takes into account a number of easily obtainable statistics of men's college basketball coaches. It was assumed that win percentage, postseason appearances, postseason wins and total number of games coached during their career (for active coaches in this report, up to the date when data was collected) are significant indicators relating to a coach's ranking.

The model was then applied to all men's basketball coaches to give them each a grade by which they could be sorted to obtain a ranked list. The Principal Component Analysis results state that the top five coaches are as follows: John Wooden, Mike Krzyzewski, Dean Smith, Bob Knight, and Adolph Rupp.

Introduction

The culture created by sports includes not only die-hard fans,

crazy-rich owners and players, and fiery, passionate coaches, but also analysts with facts, figures and opinions. One debate that inspires many a passionate exchange among fans and analysts alike is best coaches of all time. The role a coach plays is like a general leading his or her armies to victory, vanquishing foes along the path toward a championship. The leadership that a coach gives can be the defining quality that sets the team apart from mediocre to either a shining model of what it takes to win, or a cautionary tale about wasted time, talents and effort.

At the collegiate level, this debate involves coaches at different levels for each sport. There is Division I, II, III and within these divisions, there are multiple conferences. The Big Dance, also known as March Madness, which is the NCAA Division I Men's Basketball Tournament. The event allows coaches to make an appearance and when expectations are excelled earning them the title of Cinderella Team. Coaches seal their legacy by constructing a team that can become an undefeatable force or upset mainstream teams to make legacies of their own. Deciding who the best coach is in men's basketball is a feat in itself. We have applied two methodologies to attempt this for the collegiate sports listed above: Principal Component Analysis (PCA) and Linear Regression.

Background

We used a principal components regression which is defined as follows:

> "The Principal Components Regression (PCR) approach involves constructing the first M principal components, Z1, . . ., ZM, and then using these components as predictors in a linear regression model that is fit using least squares. The key idea is that often a small number of principal components suffice to explain most of the variability in the data, as well as the relationship with the response. In other words, we assume that the directions in which X1, . . .,Xp show the most variation are the directions that are associated with Y . While this assumption is not guaranteed to be true, it often turns out to be a reasonable enough approximation to give good results. If the assumption underlying PCR holds, then fitting a least squares model to Z1, . . . , ZM will lead to better results than fitting a least squares

model to X1, . . .,Xp, since most or all of the information in the data that relates to the response is contained in Z1, . . ., ZM, and by estimating only M<<p coefficients we can mitigate overfitting." [10]

Restatement of the Problem

Sports enthusiasts are constantly looking for the "best all-time men's college basketball coach" for the previous century. We are given the problem of building a mathematical model that chooses the *best* college coach(es) in men's basketball. We must also see if time is a factor in the analysis to pick coaches from different eras. This model must be applied in general.

Ultimately, "best," like beauty, is in the eye of the beholder, therefore there is no way to remove all subjectivity from this problem. Because of this, we must restate the problem as defining a kind of consensus for who the best coaches are.

First, we will approach this problem as one of Rank Aggregation. However, we also assume that not all experts are going to have perfect knowledge of every coach in existence, so we seek to use the aggregated ranking from experts to create a model which takes into account easily quantifiable measures, and assign a grade to all coaches in the appropriate field, allowing us to establish a ranking of coaches which may include some that slip under some analysts' radars. We will then verify this model on data from other conferences including the Big Sky.

Global Assumptions

In the model we constructed, we needed to make reasonable assumptions in order to make the model as approachable as possible.

We chose not to account the number of years that a given coach has coached, as we determined that the number of games coached will be a more suitable variable as an experience factor, because we assume that a coach will get more experiences through a game coached then the number of years coached. Also, the number of years coached are well-enough related with the number of games coached; for example a coach could have thirty-one games as a result of one season. Of course, the number of games varies by coach, each

season coached, and the sport coached.

We analyzed the amount of post-season appearances and wins, since post-seasons are a nation-wide competition, and not a regional competition. We decided that nation-wide competitions are more prestigious than the regular season games and should be accounted for within our model; because nation-wide competitions are more elite due to the factors that build up the nature of it like fan following, televised games, revenue generated, ad revenue, revenue from game tickets sold by a given institution, and pressure to perform the very best from both the players and coaches because they are representing the institution.

For the purpose of our model we made a major assumption with regards to how players have an overall effect on the team. We figured that since this model is strictly the analysis of the top five coaches, the players are relatively equal to each other in factors like skill, team chemistry, and academic performance off the court. By "relatively equal", we mean players from Division I men's college basketball will perform at certain equal level to another player in the same division. So a Division I player will not be relatively equal to a Division II player. This assumption may prove useful, because there are cases in which good coaches can lead average players towards championship victories, but there are cases in which the opposite is true: where it is the good players that lead an average coach towards victory. We will revisit this major assumption later and see whether it is appropriate to make it or not.

1. College sports that are being analyzed in this study are as follows:
    a. Men's Basketball
2. Coaches are evaluated by the following:
    a. Win percentage
    b. Total number of postseason appearances
    c. Number of wins in the postseason
    d. Total number of games coached in career (as of Nov. 20, 2019)
3. Top ten lists are collected to use for generating the model's top five coaches. (conducted by sports analysts and credible journalists)

Analysis of the Problem and the Model

Part 1. Rank Aggregation

To train a model such as linear regression or Principal Component Regression (PCR), which is essentially linear regression using Principal Components (PCs) from Principal Component Analysis (PCA), you need a response variable to train against. In our case, we want the model to predict the rank of a given coach given certain statistics of the coach, so we need to train it with an initial ranking of some coaches and those coaches associated statistics. It was decided that we'd base that initial ranking on the opinions of sports analysts in the form of their own rankings, using many to help eliminate bias from any one in particular. To combine these different rankings, we employed Rank Aggregation.

We first attempted to use brute force rank aggregation so the potential effects on the sensitivity of our models were small. We accomplished this by introducing more potentially non-optimal algorithms, all with their own trade-offs. However, aggregating via brute force turned out not to be feasible for three lists of top ten, as the spatial complexity grew too large for standard computers, and while we don't know whether the time complexity would've been completely unreasonable if there had been adequate space, it did appear that the time complexity also grew quite rapidly. Therefore, we had to rely on other methods of rank aggregation. We choose the genetic algorithm as our rank aggregation; however, the cost of this computational efficiency is determinism. This method of rank aggregation doesn't necessarily return the same results every time. However, the goal of this project is not to analyze the best rank aggregation methods in general, we simply wanted a relatively well-defined way to aggregate rankings of multiple reasonably reliable sources. No matter the case, the model produced will depend on the input ranking, so it is possible to improve these models by creating stronger training data, possibly based off of additional expert opinions.

We started with collecting data from various articles done by sport specialists on their top ten coaches for each of the sports being evaluated. The data collected was assembled based on the global assumptions.

	1	2	3	4	5	6	7	8	9	10
List 1	Bob Knight	John Wooden	Mike Krzyzewski	Dean Smith	Clair Bee	Adolph Rupp	Hank Iba	Phog Allen	Denny Crum	Al McGuire
List 2	John Wooden	Mike Krzyzewski	Dean Smith	Bob Knight	Roy Williams	Tom Izzo	Adolph Rupp	Jim Boeheim	Jim Calhoun	Jim Valvano
List 3	John Wooden	Mike Krzyzewski	Rick Pitino	Dean Smith	Adolph Rupp	Roy Williams	Bob Knight	Jim Calhoun	Tom Izzo	John Calipari

Coach	W/L%	# of Post Season W's	# of Post Season Appearances	Games Coached	List 1	List 2	List 3
John Wooden	0.804	47	17	826	2	1	1
Mike Krzyzewski	0.767	97	35	1479	3	2	2
Rick Pitino	0.74	54	21	1041			3
Adolph Rupp	0.822	30	20	1066	6	7	5
Roy Williams	0.789	79	29	1107		5	6
Bob Knight	0.706	45	28	1273	1	4	7
Jim Calhoun	0.697	51	23	1259		9	8
Tom Izzo	0.723	52	22	841		6	9
John Calipari	0.78	56	20	964			10
Jim Boeheim	0.731	60	34	1434		8	
Jim Valvano	0.628	15	9	537		10	
Phog Allen	0.735	10	5	978	8		
Denny Crum	0.696	42	23	970	9		
Al McGuire	0.787	20	9	375	10		
Hank Iba	0.693	15	8	1085	7		
Clair Bee	0.826	0	0	499	5		
Dean Smith	0.776	65	27	1133	4	3	4

Table 1: Men's Basketball

Approach

We created our model by simulating it in a computer program using RStudio. The code consists of identified variables and their relationships. When simulating individual sports, new data is entered for the assigned variables and print out the assorted rankings based on weights.

Part 2. Model

$$\mathbf{T} = q_1 * Z_1 + q_2 * Z_2 + q_3 * Z_3 + q_4 * Z_4, \textbf{ where}$$
$$Z_1 = X_1 * a_1 + X_2 * a_2 + X_3 * a_3 + X_4 * a_4$$
$$Z_2 = X_5 * a_1 + X_6 * a_2 + X_7 * a_3 + X_8 * a_4$$
$$Z_3 = X_9 * a_1 + X_{10} * a_2 + X_{11} * a_3 + X_{12} * a_4$$
$$Z_4 = X_{13} * a_1 + X_{14} * a_2 + X_{15} * a_3 + X_{16} * a_4$$
$$\textbf{And where } q_i = \textbf{weighted coefficients}$$

T is the final grade and is comprised of q-weighted coefficients in 4 equations of Z, where X is a component associated with its respective alpha, which is the input from the variable categories such as number of wins, win-loss percentage, etc. After the T-grade

is determined, it is then ranked using a pcr.fit command in RStudio. This gives us our final ranking of the coaches. It is notable that using the PCR approach is effective in determining rankings because PCR is considered to be "unsupervised learning" [11]. In other words, Y's can be determined without being necessary as input for the model to work. The alpha-categories were as follows for all sports: alpha1 was win-loss record as a percentage (career), alpha2 was number of postseason wins, alpha3 was number of postseason appearances and alpha4 was total number of games coached (career).

Part 3. Sensitivity Analysis

After we constructed the model, we began to manipulate the weighted coefficients for each category to see if the rankings would hold. We discovered that all the categories were very sensitive to the weighted coefficients and also to the number of coefficients present.

Men's Basketball			
Category	**Coefficient**	**Intercept**	29.3541938
Win/Loss Rate	-1.2930779		
Number of Post-Season Wins	1.0400105		
Number of Post-Season Appearances	-1.7081955		
Number of Games Coached	0.3215263		

Table 2: Weighted Coefficients

We conclude, that although we have tried to remove any severe subjectivity in our model, it is still very sensitive to the coefficients and number of categories used in addition to which categories are used.

Within our model there are some concerns which we have to address. To begin with, since we chose from selective ranking lists of the all-time best coaches from sports analysts in order to have

some variability in our data, the subjectivity or how a sports analyst ranks a respected coach on their respective list from best to not so best is going to have a different set of criteria for each list. For example, with finding data for our research we chose from three different ranking lists that had differed in criteria and that, according to sports analysts, determined what makes a given coach the best. As mentioned before, the way in which each ranking list is determined is subject to different criteria that a given sports analyst may believe is important. Ergo in our three different lists that we used, one of the criteria for one sports critic was how good a coach maintains team chemistry, while a different sports analyst believed that an important factor for a good coach is how many total games a coach has won. Hence, whose opinions we chose to consider, and what methods we used to create a consensus among those opinions, did affect the ranking we chose to train against.

Another concern to address is how much data is available, by this we mean how much data can we find in regards to how many different response/explanatory variables we may choose. In our case, we chose four response/explanatory variables, because after much discussion we came to the conclusion that win-loss ratio, number of postseason appearances, number of postseason wins, and total games coached were what makes a good coach. What we wanted to address is that the number of response/explanatory variables was not chosen because our four criteria are the ultimate factors as to what determines a good coach; it is clear to see what makes a good coach is more than win-loss ratio, number of postseason appearances, number of postseason wins, and total games coached. But our criteria was limited to four because the four criteria we chose were difficult enough to manipulate to a point in which finding enough data that would suffice completely for the coaches in the sports we considered would have been a very difficult challenge given our resources. Thus, the addition of more criteria (response/explanatory variables) for what makes a good coach, wouldn't have been a difficult challenge if we had a reliable and easily accessible source of these statistics for coaches in all considered sports. It is possible that other statistics may be better predictors/indicators, and that the model would be better if there were a larger number of explanatory variables.

Discussion

To be able to select the best coaches of all time, we need an efficient and effective way to define a coach's abilities. We have recorded data from some of the most well-known coaches in college sports. We then identified the global assumptions such as which sports to review and the characteristics of an "ideal" coach in each of these sports. Once we established the global assumptions, we then researched out various published rankings from sports analyses regarding the definition of what good coaching is and then we used those authors' top ten coaches of all time. We then created a model using our assumptions of good coaching and then put it through a series of tests using R programming in RStudio. We then determined the top five coaches for men's college basketball as follows:

Men's Basketball:

1. John Wooden
2. Mike Krzyzewski
3. Dean Smith
4. Bob Knight
5. Adolph Rupp

A fair question one might ask is whether using PCR modeling is useful to this overall research of top five coaches? The answer may not be obvious. As mentioned before, due to our relatively small amount of response/explanatory variables being used in the PCA to make the model a bit smaller, it may prove to not be beneficial, particularly if you end up using as many components as explanatory variables, which we generally are. It could have been possible that trying it with PCA could have revealed major overlap or interactions between some explanatory variables, resulting in us reducing the total number of components, or possibly eliminating one of the explanatory variables and adding a different one which may contribute more independently of the other explanatory variables. However, we only determined four explanatory variables at this time. Determining and obtaining more would be no simple task for us, and PCA did not reveal a large amount of overlap/interaction between our explanatory variables, so we simply used the four we assembled, and all of the

components, which is essentially the same as using a linear model to begin with. It is possible that simply investigating the explanatory variables via other methods could have revealed that there was not sufficient overlap or interaction between them to warrant doing PCA to reduce the size of the model, and perhaps smoothing the model by getting rid of excess in some components that did not contribute sufficiently to the response variable. Furthermore, data collection proved to be no simple matter. We searched for data in many sports and determined that collecting further data would be time consuming. Had there been a better, standard-based source for our data, our model possibly could have taken into account more explanatory variables, warranting the use of PCR as opposed to just a linear model, and we could have spent more time on the rest of the methodology instead of manual data collection.

We wanted determined with this research whether time period (By "time period" we mean eras like the 1950's or 1980's for example) is a factor in which affects our results for our top five coaches. The approach we took to how we determined the top five coaches doesn't lend itself easily to this part of the model when we determined whether time period affects our analysis. One complicating factor is how sports change over time, as some metrics aren't easily comparable at all points in history, and statistics weren't necessarily gathered and organized as they are currently. Furthermore, our approach first uses rank aggregation to define a kind of consensus among opinions, and those opinions can change over time. Any change to the ranking used to train the model will result in differences in output, so if you were to use the same method to generate a model based on a subset of coaches during any particular time period, and train the model on rankings from that time period will yield different results. In general, we decided to focus on modern rankings on which to base our model and run the model across whatever data is appropriate and accessible.

Recall in the global assumptions we made the assumption that the players are relatively equal to a given division, and since they are relatively equal, we never really accounted for whether a player may influence the rankings, since we tried to completely remove the focus from the players and put the focus on only the coaches. In addition, if one were to determine whether a player creates an effect from our

model; it is clear to see that coaches from Division I had an advantage in regard to our four criteria than other coaches from other given lower Divisions. To some degree the players had an influence on the ranking of coaches in our model. And that influence is due to the fact that Division I players are going to perform at a more elite level then lower Division players, and since Division I players perform at a better level; coaches from Division I are going to be better ranked. But, since we made the assumption of players being relatively equal, it is not possible to determine in our model whether individual players are another factor that affect the rankings of coaches.

We also found that if we looked at the bottom of the list, and inverted it, the list made more sense, however our model predicted these coaches were not the best coaches, for example, Randy Rahe, Weber State's and the Big Sky Conference's all-time leader in coaching victories was not in the top ten. Our Model actually placed him at rank 180 out of 184.

Conclusion

It will be for future researchers to apply the model to other conferences, like the Big Sky, which we have done for Men's Basketball (see appendix) and see if coaches who have not attained any national championships, still get ranked in an order that is agreeable to the experts, the analysts, the fans and perhaps the coaches themselves. Ultimately, coaching legends are determined in the eyes of fans, experts and the consumers of sports culture. Time, while healing all wounds, also solidifies champions, legends and great failures that are woven in our culture's histories and mythologies, for future generations to examine or admire.

References

Basketball, R. (2019). The Greatest College Basketball Coaches of All Time. Ranker. Retrieved Nov, 20, 2019 from https://www.ranker.com/list/best-college-basketball-coaches-of-all-time/ranker-ncaa-basketball.

Goodpaster, M. (2018). The Top 10 College Basketball Coaches of All-Time - The Grueling Truth. *The Grueling Truth.* Retrieved Nov,

ERGO
20, 2019 from https://thegruelingtruth.com/basketball/college-basketball/top10collegebasketballcoachestime/.
James, Gareth, et al. (2017) *An Introduction to Statistical Learning* (8th ed.) pgs 233-234, New York :Springer.
Dr. Julian Chan. (2019). *Math 4400: Statistical Analysis of Big and Small Data.* Personal Collection of Dr. Chan, Weber State University, Ogden, Utah.
Trachtman, S. (2019). All-time top NCAA Tournament coaches. *Yardbarker*. Retrieved Nov, 20, 2019 from https://www.yardbarker.com/college_basketball/articles/all_time_top_ncaa_tournament_coaches/s1__20443381#slide_1.

Appendix

	Coach	wlrate	num-Post-SeasWs	num-Post-SeasAp-pears	numGa-mes-Coached	rankpred
1	Gus O'Conner	1	0	0	2	28.70417
2	C. E. Holway	0.75	0	0	4	29.67049
3	R. A. Fuller	0.667	0	0	6	30.42087
4	Harry Caldwell	0.75	0	0	8	30.9566
5	N. Whitlock	0.167	0	0	6	31.06741
6	Walter Knox	0.889	0	0	9	31.09838
7	George Wyman	0.5	0	0	8	31.27987
8	Clyde Carpenter	0.667	0	0	9	31.38545
9	Royce Long	0.375	0	0	8	31.4415
10	Charles Armstrong	0.6	0	0	10	31.79361

Table 3:BigSky Men's Basketball Results (top ten)

Direct Detection of Slow Growing Pathogens Using Nanopore Sequencing

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Abstract

Mycobacterium is an acid-fast bacilli (AFB) that grows primarily in aerobic conditions. It is the causative agent of pathogenic Tuberculosis, Leprosy, wound infections, and nosocomial infections related to implanted devices. It is a slow growing pathogen that requires 1-2 weeks to identify and must be handled in a specialized biosafety level 2 or higher within a negative pressure room and a biosafety cabinet. This study assessed if the new Nanopore sequencing technology can be used to identify *Mycobacterium smegmatis* ATCC 607 using nanopore sequencing at a lower cost. *Mycobacterium smegmatis* is a biosafety level 1, and it rarely causes human infection, for this reason it was chosen for the research. The MinION is a real-time portable DNA sequencing device that could be utilized in a clinical laboratory setting, and possibly in remote environments. The device can analyze organism from small viruses up to an entire human genome. DNA was extracted from a common normal flora found in sputum samples. The samples were combined into mock sputum samples then DNA was extracted for sequencing using the nanopore technology. This device provided real-time 16S targeted amplification DNA sequencing reaction in a matter of hours. To test sensitivity, various concentrations of organism were achieved through serial dilutions and the minimum detectable limit was measured in the MinION. In regard to true organism identification, the MinION correctly identified the genus 80% of the time on the first run while it dropped to 20% on the second run due to smaller amount of nanopores left available on the flow cell. However, the MinION was inadequate with species identification since it was only able to identify *M. smegmatis* in one sample.

Introduction

Rapid detection of slow growing pathogens like *Mycobacterium* is crucial in healthcare. There are many available testing methods for *Mycobacterium* species. However, these methods are either expensive, lack sensitivity and specificity, or take weeks to culture and test (Votintseva, et al., 2015). In this study, the researchers evaluated a portable fourth generation DNA sequencer called the MinION, which allows rapid real-time DNA sequencing. Evaluation of the device was done in order to determine whether it could allow faster and more affordable testing for any slow growing microbes using low concentrations of microbial DNA alongside nasopharyngeal normal flora like *Staphylococcus*, *Streptococcus*, and *Neisseria* species. This could enable early detection and early treatment of the disease.

Early detection and treatment are important for any disease or infection caused by a slow growing microbe. *Mycobacterium* species causes thousands of infections and deaths worldwide (World Health Organization, n.d). For this reason, the need for an affordable, easy to run, highly specific, and highly sensitive test is relevant. The nanopore is an electrically resistant membrane that enables electrical current to pass through the pores. When a disturbance occurs, the device measures that characteristic disruption in the current. The method used for the DNA is called a strand sequencing method. In the beginning, the DNA strands are mixed with copies of a processive enzyme that catalyzes a reaction without releasing the substrate. As the DNA enzyme combination approaches the nanopore, the single stranded DNA is pulled through the opening gap of the nanopore. The enzyme binds to the single stranded leader at the end of the double stranded DNA temple that uncoils the DNA as it passes through the pores. K-mers located within the innermost part of the pore barrel creates a characteristic disruption in the current that determines the order of the bases on the DNA strand. Through this process, the pore reads both strands of DNA, which could increase accuracy of the data collected. Once the nanopore is done, the process starts again. The nanopore streams data to the cloud using an instrument-based software as soon as the experiment begins. The experiment will continue until sufficient data is collected to determine what organisms are present in the mixture. Optical density was used

to determine the concentration of microbes in each mixture then DNA extraction was performed. After amplification and purification, samples were loaded on the device. The software generated data that identified which samples had *Mycobacterium*.

Methods

Growth Conditions and Bacteria Suspension

Mycobacterium specific culture media 7H10 was used for *M. smegmatis ATCC 607*, grown at 37°C ,1.2% carbon dioxide incubator for 4 days. *Staphylococcus*, *Streptococcus*, and *Neisseria* species were grown at 37°C at 5.0% carbon dioxide incubator. These species were isolated from nasal swabs and identified to the species level using standard biochemical testing.

McFarland Standards were used to standardize the approximate concentration of bacteria in the saline suspension. In a blinded manner one of the researchers prepared the samples that contained Optical Density at 600nm of 0.4, 0.3, 0.2, 0.1, and 0.05 while the status of the samples was unknown to the other researcher running the sequence experiment. Four samples were created for quality controls, two positives and two negatives. The other 8 were spiked with a constant absorbance of 0.1 optical density with normal flora. While *M. smegmatis* was added with different variations of Optical Density to five samples, and the rest were negative for *M. smegmatis*.

DNA Extraction and DNA Quantification

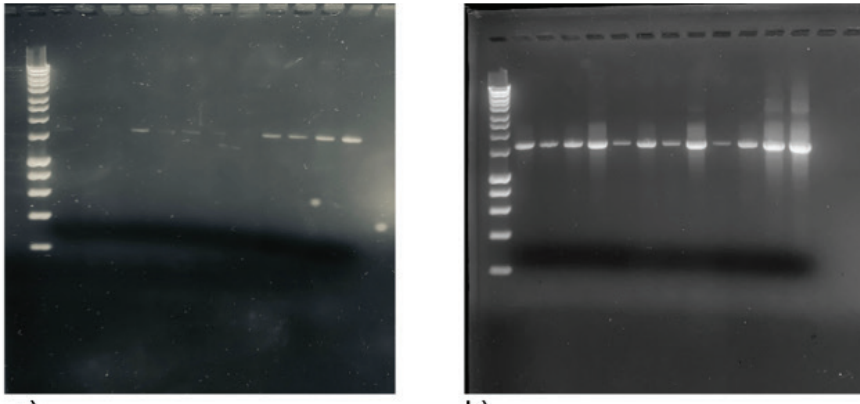
To do mechanical cell disruption before DNA extraction the Freeze-thaw method was performed for all the samples (Padilla, et.al., 2003). 200 uL of the samples were centrifuged at 13,000 X g for 15 minutes, the supernatant was poured off, and the pellet was resuspended with 20 uL of TE buffer. The samples were then placed in a water bath at 95 degrees Celsius for 30 minutes. After being heated samples were placed in the freezer of -20C for 30 minutes. After the samples were thawed 180 uL of sterile saline was added, and researchers continued with the DNA extraction.

For DNA extraction, QIAamp DNA Mini Kit was used. This kit uses the

column method which the sample is lysed, bound to a filter matrix, washed and eluted while changing out the tubes between each step and the extracted DNA will be in the last column. Quantification of DNA and purity was accessed with the EPOCH.

DNA Barcoding

DNA extracted samples were than prepared with the 16s-barcoding kit provided by Oxford Nanopore Technologies. This helps to easily identify the samples due to the fact that all 12 samples are combined into one sample at the end of the sample preparation and sequenced only in one run. To prepare the samples with the barcodes researchers added 14uL of Nuclease-free water, 10 ng of DNA, 1uL of the 16S barcode, and 25uL of LongAmp Taq 2X master mix. After the 12 samples went through PCR cycles. There were two runs which both underwent 95°C for 1 minute. Run one underwent 95°C for 20 seconds, 55°C for 30 seconds, and 65°Cfor 2 minutes repeated 25 cycles. Run two underwent the same process but repeated 35 cycles instead in order to amplify more DNA than run one. Both runs were amplified at about 1500 kb (Figure 1).



a) b)

PCR of 16S ribosomal DNA. Both **a** and **b** underwent 95℃(1 minute). **a** underwent 95℃(20 seconds), 55℃(30 seconds), and 65℃(2 minutes) for 25 cycles while **b** underwent the same process but with 35 cycles in order to amplify more DNA than **a**. Both **a** and **b** were amplified at about 1500kb.

Figure 1.

MinION Sequencing

Flow cells for the MinION had to be prepared and primed with reagents provided by Nanopore technology, 1000uL of the priming reagent was inserted through the priming port. Afterwards 75uL of the prepared DNA was loaded in to the SpotON sample port and the sequencing run started.

While the sample was running researchers could visualize how many nanopores are active, going inactive, and DNA going through them. The quality of the run was shown to the researchers by the Duty Time section (Figure 2), which told researchers that the first run was of better quality due to 1,010 nanopores that were scanned before the run, and since run two only had 210 nanopores it was not a good quality run (Figure 3)

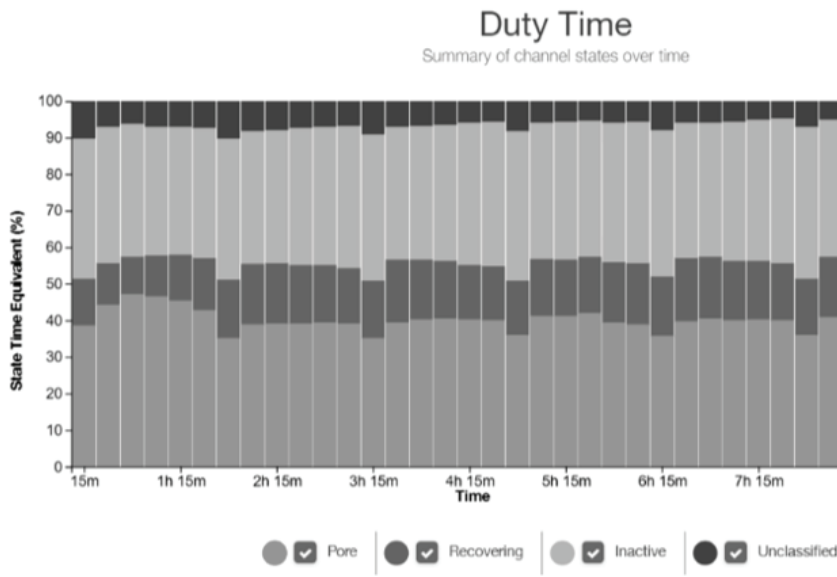


Figure 2. The data represent the first run. This graph shows how many nanopores were being used throughout the eight-hour run, how many were recovered and how many were inactive.

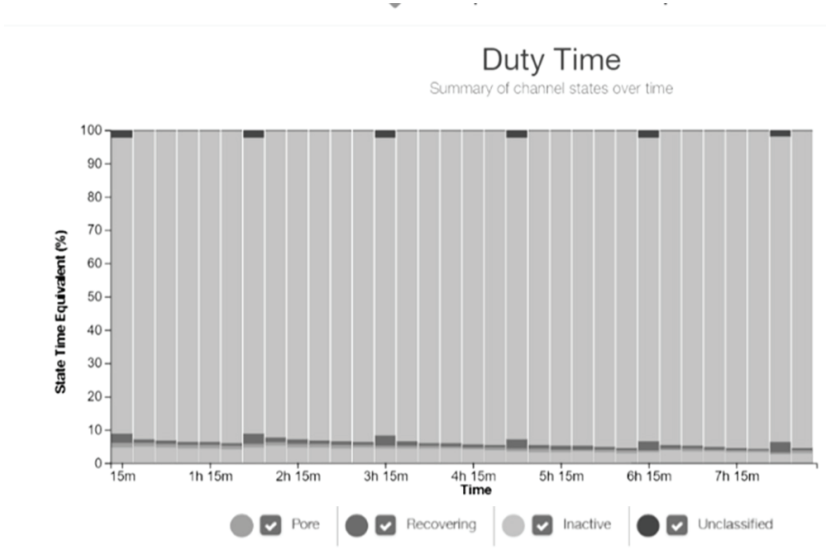


Figure 3. The data represents the second run. Shows that there were a small amount active pores through the eight-hour run, and approximately 90% of the nanopores were inactive during the run.

Analysis

The data was analyzed by a EPI2ME software. Where the data produced by the MinION was downloaded into the software and it was able to go into different data clouds and analyzed the DNA data produced to identify the DNA sequences. After receiving result through the EPI2ME software, researchers did sensitivity, specificity, positive predictive value, and negative predictive value.

Results

Detection

To be able to determine of the nanopore sequencer could detect M. smegmatis, 12 mock sputum samples were spiked. 5 that were positive with M. smegmatis and normal flora and the 7 negative samples. The MinIOn was able to detect *Mycobacterium* in four out of the five samples in the first run. Only one sample detected

M. smegmatis in the first run however identified three other species of *Mycobacterium*. *M. flavescens*, *M. stomatophae*, *M. saskatchewanense*.

In run two, it was only able to detect *Mycobacterium* in one sample out of the five positive samples. In that one positive sample it detected the right genus but the species it detected was *M. flavescens*. As mentioned in the methods for the second run, researchers did 10 more cycles than run 1 and hypothesized that due to more amplification that the minion would be able to detect the *Mycobacterium* in all samples (Figure 5 and Figure 6).

MinION Detection Quality In Run 1, the specificity was 1.00 meaning that 100% of the time the MinION was able to truly identify a negative sample. The sensitivity was 0.80 meaning that the MinION truly identified *Mycobacterium* infected samples 80% of the time. Positive predictive value (PPV) was 1.00, meaning that of the positive *Mycobacterium* samples identified by the MinION 100% of them were truly infected with the organism. The negative predicted value (NPV) was .88, meaning that of the truly uninfected samples of *Mycobacterium* identified by the MinION only 88% of them were truly uninfected by the organism.

In Run 2, the specificity was 1.00. meaning that the MinION truly identified the negative samples 100% of the time. The sensitivity was .20, meaning that the MinION successfully identified *Mycobacterium* infected samples 20% of the time. The PPV was 1.00 meaning that the positive samples identified by the MinION were 100% truly infected by *Mycobacterium*. NPV was .64, meaning that the negative samples identified by the MinION only 64% of them were truly negative samples (Figure 4).

TABLE 1. MINION DETECTION AND PREDICTIVE VALUES

***Mycobacterium smegmatis* (CFU/mL)**	**Run 1**	**Run 2**
$7.45x10^8$	*+	★+
$5.58x10^8$	★+	-
$3.69x10^8$	◆+	-
$1.80x10^8$	-	-
$0.86x10^8$	■+	-
Predictive Values (%)		
Sensitivity	80	20
Specificity	100	100
Positive Predictive Value (PPV)	100	100
Negative Predicted Value (NPV)	88	64

Samples with various concentrations of **M. smegmatis* were analyzed as well as 7 negative samples with A. niger. Run1 identified *Mycobacterium* of different species,★*M. flavescens*,■*M. stomatophae*,◆*M. saskatchewanense*, and **M. smegmatis*. The test started with 1,010 nanopores and ran for eight hours. The specificity was 1.00 meaning that 100% of the time the MinION was able to truly identify a negative sample. The sensitivity was 0.80 meaning that the MinION truly identified *Mycobacterium* infected samples 80% of the time. PPV was 1.00, meaning that of the positive mycobacterium samples identified by the minion 100% of them were truly infected with the organism. The NPV was .88, meaning that of the truly uninfected samples of *Mycobacterium* identified by the MinION only 88% of them were truly uninfected by the organism. In run 2, the MinION was able to identify *M. flavescence* in one sample. The test started with 210 nanopores and ran for eight hours. The specificity was 1.00, meaning that the MinION truly identified the negative samples 100% of the time. The sensitivity was .20, meaning that the MinION successfully identified Mycobacterium infected samples 20% of the time. The PPV was 1.00 meaning that the positive samples identified by the MinION were 100% truly infected by mycobacterium. NPV was .64, meaning that the negative samples identified by the MinION only 64% of them were truly negative samples.

Figure 4

Discussion

The study reviewed a new portable device to see if it could enable early detection and treatment for slow growing pathogens with small concentration of bacterial DNA. Currently, the best method for slow growing pathogen is still the culture method. The result of this experiment supports the idea that the technological world has come a long way when it comes to new innovative ways to make early detection and treatment possible. Although the research concluded that the device is unable to accurately identify up to the species level and the cost per test could range between $50.00 to $100.00 dollars, the device still proves to be promising due to its portability and ability to rapidly identify organisms. This is a step to the future where this technology could improve and potentially be able to identify species more accurately and at a lower cost.

Limitations and challenges were encountered during this research. The first device sent by the manufacturer was broken which delayed data analysis for about a week. Isolated colonies that are usually seen in respiratory samples are used. However, the device detected multiple genera that the researchers were not expecting. This could

be due to the 16s amplification was either insufficient to distinguish species or the amplification itself introduced enough errors to alter the species. This study also noticed that several nanopores become inactive after a couple of days without usage. The data analysis presented by EPI2ME showed additional barcodes that are unexplained by the system.

The researchers also found that the MinION does not have an internal quality control system that double checks the DNA base pairs analyzed by the device and whether it completely and accurately match the specific organism. This could explain the inadequacy of the device to accurately identify to the species level. The addition of quality control system in the device will greatly improve its accuracy. Further testing, more runs, experience using the device alongside an addition of a quality control system are needed in order to determine whether the device could generate more accurate results.


Run1
root
Neisseria
Snodgrassella
Pigmentiphaga
Burkholderia
Ralstonia
Haemophilus
Actinobacillus
Aggregatibacter
Mannheimia
Pasteurella
Rodentibacter
Aeromonas
Pseudoalteromonas
Shewanella
Enterobacter
Pantoea
Tatumella
Xenorhabdus
Pectobacterium
Serratia
Halomonas
Francisella
Photobacterium
Vibrio
Streptococcus
Lactococcus
Enterococcus
Lactobacillus
Bacillus
Staphylococcus
Mycobacterium
Lineage
Taxa - Not Classified
Taxa - Classified

Figure 5

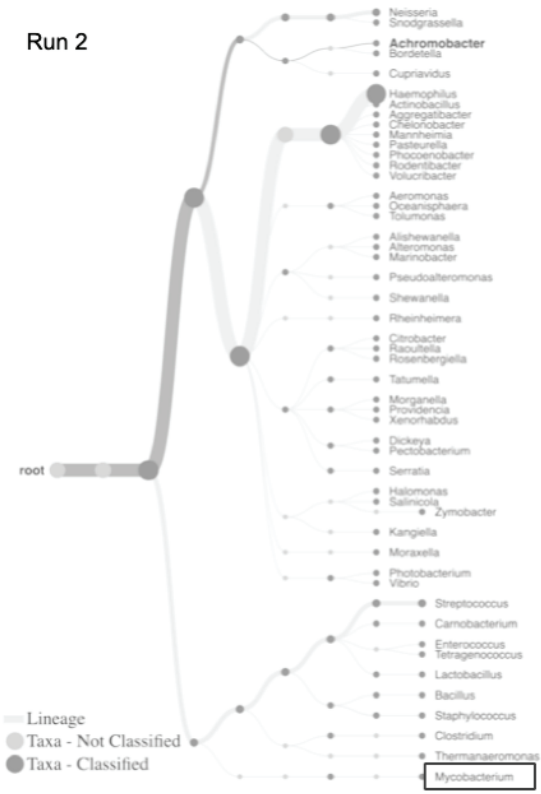


Figure 6

References

Arvanitis, M., Anagnostou, T., Fuchs, B. B., Caliendo, A. M., & Mylonakis, E. (2014). Molecular and nonmolecular diagnostic methods for invasive fungal infections. *Clinical Microbiology Reviews, 27*(3), 490–526. https://doi.org/10.1128/CMR.00091-13

Nanopore DNA sequencing. (n.d.). Retrieved Spring, 2019, from https://nanoporetech.com/applications/dna-nanopore-sequencing

Padilla, E., González, V., Manterola, J. M., Lonca, J., Pérez, A., Matas, L., … Ausina, V. (2003). Evaluation of two different cell lysis methods for releasing mycobacterial nucleic acids in the INNO-LiPA mycobacteria test. *Diagnostic Microbiology and Infectious Disease, 46*(1), 19–23. https://doi.org/10.1016/S0732-8893(03)00010-5

Puri, L., Oghor, C., Denkinger, C. M., & Pai, M. (2016). Xpert MTB/RIF for tuberculosis testing: Access and price in highly privatised health markets. The Lancet Global Health. Elsevier Ltd. https://doi.org/10.1016/S2214-109X(15)00269-7

Sequencing R. (2018). Evaluation of Oxford Nanopore's MinION Sequencing Device for Microbial Whole Genome Applications. *Scientific Reports, 8*(1). https://doi.org/10.1038/s41598-018-29334-5

Votintseva, A. A., Pankhurst, L. J., Anson, L. W., Morgan, M. R., Gascoyne-Binzi, D., Walker, T. M., … Crook, D. W. (2015). Mycobacterial DNA extraction for whole-genome sequencing from early positive liquid (MGIT) cultures. *Journal of Clinical Microbiology, 53*(4), 1137–1143. *https://doi.org/10.1128/JCM.03073-14*

World Health Organization. (n.d.). Retrieved Fall, 2018, from https://www.who.int/

Tyler, A. D., Mataseje, L., Urfano, C. J., Schmidt, L., Antonation, K. S., Mulvey, M. R., & Corbett, C.

Can Automatic Hand Dryers Serve as a Microbial Reservoir for Contamination

Riley Nichols and Hyrum Packard

Mentor: Craig Oberg | Department: Microbiology

Abstract

Our purpose for doing this research was to determine if the hand dryers in public restrooms are antiseptic, or if they are a source of contamination to your hands during drying. The first phase was to determine restroom areas at Weber State University that had a high frequency of foot traffic, making them good locations for sampling. Testing was conducted by swabbing a 5 cm^2 area of the top, middle, and bottom of the hand dryers using a 3M Quickswab. Pour plates using TSA were made to enumerate samples. Testing was done in men's and women's restrooms in three buildings on campus, testing four bathrooms in each building. Plate counts were determined at 48 hours after incubation at 37° C. Results showed that the bottom of the dryers in both the men's and women's restrooms had the most contamination, with an average of 311 cfu/5cm^2 in the men's rooms, and an average of 299 cfu/5cm^2 in the women's room. The middle section was the second most contaminated for both men's and women's restrooms averaging 144 cfu/5cm^2 for men, and 145 cfu/5cm^2 for women. The top was the least contaminated for both men's and women's restrooms averaging 107 cfu/5cm^2 for men, and 51 cfu/5cm^2 for women. Tracy Hall bathrooms had the most organisms of all the men's restrooms, and Union building restrooms had the most growth of all the women's restrooms. Results showed that these dryers serve as a source of contamination following hand washing, and the levels of contamination in the dryer can be correlated with the amount of foot traffic through the restroom, and men (higher levels of CFU) versus women. As a preventative measure, the inside of these dryers should be cleaned on a daily basis to prevent people from contaminating their hands immediately after washing them thus preventing the spread of bacteria.

Introduction

Hand dryers are considered a more environmentally friendly alternative to using paper towels as they reduce paper waste. They also are advertised to be more sanitary than the paper towel dispensers since they eliminate direct contact with the dispenser and towels. With the widespread use of hand dryers, often the only option in restrooms are these hand dryers, and their antimicrobial nature has been put into question. Recent studies have suggested they can be a reservoir for bacteria waiting to be cycled through the air. Our objective in this experiment was to see if there were bacteria on these hand dryers and if hand dryers serve as a reservoir for bacteria that can be reinoculated on a person's hands during drying. As we conducted this experiment, we also decided to compare the number of microorganisms between two different types of hand dryers, and compare men's and women's restrooms.

Methods

Testing Locations

Commercial hand dryers were tested on the campus of Weber State University, located in Ogden, Utah. Three buildings were tested, with four bathrooms selected in each building. The buildings were Tracy Hall, Shepherd Union, and the Stewart Library. The Shepherd Union and the Stewart Library restrooms use Dyson Airblade hand dryers, while Tracy Hall restrooms contain Mediclinics Dualflow Plus hand dryers. Restrooms selected at locations based on foot traffic were in various locations throughout these buildings.

Sampling and Media

Commercial sterile 3M Quickswabs used for collecting bacteria samples from the hand dryers. These swabs contain 1 mL of letheen broth which was then used for the pour plates. Pour plates, used to enumerate the bacteria contained Tryptic Soy Agar (TSA). TSA was utilized because it contains nutrients allowing for propagation of a large variety of bacteria, including organisms that are components of the human microbiota.

Experimental Protocol

Samples were collected using the 3M Quickswabs from three different locations in each hand dryer. One location was at the top of the dryer above the air vents, one location was in the middle beneath the air vents on the internal part of the dryer where hands are moved through following the manufacturers sampling, flowing heated air to facilitate drying, and one location was at the bottom of the dryer. With each swab, a 5 cm^2 area was swabbed by carefully rolling the moistened swab over the surface. The swab was then placed in the 1mL of letheen broth of the Quickswab container, which was vortexed prior to plating to get all bacteria off of the swab. This 1mL was transferred to a sterile petri dish along with approximately 20 mL of sterile molten TSA (50°C), which was cooled in a water bath before pouring. Once poured, the dish was swirled 10 times to dispense the sample. Pour plates were held at room temperature for 3 hours and then placed in a 37°C incubation chamber. Observations of the plates were made after incubating for 48 hours. Each plate was then counted for cfu/5cm^2 and results recorded.

Results

Comparison between Buildings

The average growth of the men's restrooms in the Shepherd Union building were 60 cfu/5cm^2 on the top section, 114 cfu/5cm^2 on the middle section, and greater than 350 cfu/5cm^2 on the bottom section. The average growth of the women's restrooms in the Shepherd Union building were 115 cfu/5cm^2 on the top section, 276 cfu/5cm^2 on the middle section, and greater than 400 cfu/5cm^2 on the bottom section (Tables 1 and 2).

The average growth of the men's restrooms in Tracy Hall were 224 cfu/5cm^2 on the top section, 202 cfu/5cm^2 on the middle section, and greater than 400 cfu/5cm^2 on the bottom. The average growth of the women's restrooms in Tracy Hall were 18 cfu/5cm^2 on the top section, 26 cfu/5cm^2 on the middle section, and 281 cfu/5cm^2 on the bottom section (Tables 1 and 2).

The average growth of the men's restrooms in the Stewart Library were 37 cfu/5cm^2 on the top section, 117 cfu/5cm^2 on the middle

section, and 183 cfu/5cm^2 on the bottom section. The average growth of the women's restrooms in the Library were 22 cfu/5cm^2 on the top section, 134 cfu/5cm^2 on the middle section, and 217 cfu/5cm^2 on the bottom section (Tables 1 and 2).

Sample Location in the Dryer

The average growth of for the Dyson Airblade was 58 cfu/5cm^2 on the top section, 16 cfu/5cm^2 in the middle section, and 287 cfu/5cm^2 on the bottom section. The average growth of the Mediclinics Dualflow Plus was 120 cfu/5cm^2 on the top section, 114 cfu/5cm^2 on the middle section, and 340 cfu/5cm^2 on the bottom section (Tables 1 and 2).

Men's vs. Women's Restrooms Based on Location

The average growth of the men's restrooms in all three buildings were 107 cfu/5cm^2 on the top section, 144 cfu/5 cm^2 on the middle section, and greater than 311 cfu/5cm^2 on the bottom section. The average growth of the women's restrooms in all three buildings were 51 cfu/5cm^2 on the top section, 145 cfu/5cm^2 on the middle section, and greater than 299 cfu/5cm^2 on the bottom section (Tables 1 and 2).

Discussion

These results showed that both types of dryers served as a microbial reservoir containing a high number of bacteria inside the drying chamber. A high microbial load was found in every dryer, both men's and women's, and in every building location, except for two, on all the dryers. Those two locations where no microbial load was found was the top location in the women's Tracy Hall testing center restroom, and the middle location in the women's Tracy Hall fourth floor restroom. This shows that on every dryer, bacterial cells are residing on the surface and that viable bacteria are being cycled through the air contaminating your hands. The bottom of the dryers had the highest levels of contamination, and the top sections have the lowest levels of contamination for both men's and women's restrooms (Tables 1 and 2). More research could be done to determine how long bacteria are viable inside the dryer chamber and which organisms

were present, which we are currently researching by sequencing 16s rRNA.

We were also able to determine that the men's restrooms had a higher average microbial load than the women's restrooms on both the top and bottom sections, but not the middle section (Tables 1 and 2). We hypothesize that the reasoning for this is that females wash their hands more thoroughly than men. More research could be done to determine the reasoning for this.

Lastly, we were able to determine which of the dryers was less susceptible to contamination. The average growth for the Dyson Airblade was substantially less than the average growth for the Mediclinic Dualflow Plus. We believe this is caused by a collecting trough at the bottom of the Mediclinic Dualflow Plus dryers. The Dyson Airblade dryers did not have a trough at the bottom, and were much cleaner because of this.

To counteract the large amounts of contamination in these hand dryers, our recommendation would be that they should be cleaned with anti-microbial cleanser once per day as part of the routine restroom cleaning protocol. This would greatly limit the number of bacteria on the inner surface of these dryers, lessening bacterial contamination on washed hands by the air when hand dryers are used.

References

Gerba, C. P., J. L. Melnick, C. Wallis. 1975. Microbiological hazards of household toilets: Droplet production and the fate of residual organisms. Applied Microbiology. 30(2): 229-237.

Gerba, Charles and Maxwell, S. (2012). Bacterial contamination of shopping carts and approaches to control. Food Protection Trends. 32. 747-749.

Table 1. Microbial Load in Hand Dryers in Men's Restrooms (cfu/5 cm^2)

Shepherd Union Building				
Dryer: Dyson Airblade				
CCEL	**Bowling**	**Ballrooms**	**Food Court**	**Average**
Top – 4*	Top - 212	Top - 1	Top - 24	Top - 60

Middle - 22	Middle - 193	Middle - 121	Middle - 120	Middle - 114
Bottom - >300	Bottom - >300	Bottom - >300	Bottom - >500	Bottom - >350
Tracy Hall				
Dryer: Mediclinics Dualflow Plus				
2nd Floor Chemistry	**2nd Floor Physics**	**4th Floor Micro**	**Testing Center**	**Average**
Top - >500	Top - 223	Top - 90	Top - 81	Top - 224
Middle - >500	Middle - 200	Middle - 4	Middle - 105	Middle - 202
Bottom - >300	Bottom - >300	Bottom - >500	Bottom - >500	Bottom - >400
Stewart Library				
Dryer: Dyson Airblade				
1st Floor South	**Testing Center**	**2nd Floor North**	**2nd Floor South**	**Averge**
Top - 28	Top - 13	Top - 30	Top - 78	Top - 37
Middle - 75	Middle - 46	Middle - >300	Middle - 46	Middle - 117
Bottom - >300	Bottom - 120	Bottom - 12	Bottom - >300	Bottom - 183

**cfu/5cm²*

Table 2. Microbial Load in Hand Dryers in Women's Restrooms (CFU/5 cm)

Shepherd Union Building				
Dryer: Dyson Airblade				
CCEL	**Bowling**	**Ballrooms**	**Food Court**	**Average**
Top – 14*	Top - 127	Top - >300	Top - 18	Top - 115
Middle - 287	Middle - 218	Middle - >300	Middle - >300	Middle - 276
Bottom - >500	Bottom - >500	Bottom - >300	Bottom - >300	Bottom - >400
Tracy Hall				
Dryer: Mediclinics Dualflow Plus				
2nd Floor Chemistry	**2nd Floor Physics**	**4th Floor Micro**	**Testing Center**	**Average**
Top - 12	Top - 60	Top - 1	Top - 0	Top - 18
Middle - 31	Middle - 67	Middle - 0	Middle - 7	Middle - 26
Bottom - >500	Bottom - >300	Bottom - 24	Bottom - >300	Bottom - 281

Stewart Library				
Dryer: Dyson Airblade				
1st Floor South	**Testing Center**	**2nd Floor North**	**2nd Floor South**	**Average**
Top - 63	Top - 15	Top - 4	Top - 4	Top - 22
Middle - >300	Middle - 103	Middle - 80	Middle - 51	Middle - 134
Bottom - >300	Bottom - >300	Bottom - 151	Bottom - 117	Bottom - 217
Men's vs Women's		**Dyson Airblade vs Mediclinics Dualflow Plus**		
Men's Total Average	Women's Total Average	Dyson Total Average	Mediclinics Total Average	
Top - 107	Top - 51	Top - 58	Top - 120	
Middle - 144	Middle - 145	Middle - 16	Middle - 114	
Bottom - >311	Bottom - >299	Bottom - 287	Bottom - 340	

**cfu/5cm²*

Not One Soul To Love Me

Samantha Rust

Mentor: Jenny Kokai | Department: Performing Arts

Abstract:

Edgar Allan Poe is one of the most well-known and highly revered American authors, and although a lot is known about the entirety of his life, it is rarely focused on. Most of the general public know him only for his works, and often for his mysterious death as well. When, on occasion, people do know a third fact about Poe, it is usually that he married his first cousin.

When doing the dramaturgical work for the Theater Department's production of the new musical *The House of Edgar Allan Poe* by Morgan Hollingsworth, I found that the nature of their relationship highly interested me, but I did not have much research to look at from other Poe scholars and historians. Over the course of a year, these are some of the points I have thought much about, partially in relation to the accuracy of the musical, based on a few documents related closest to the subject.

Introduction:

On May 16th, 1836, Edgar Allan Poe and Virginia Clemm Poe were married in their home in Richmond, Virginia. On the marriage certificate, he was twenty-six and she was twenty-one. In reality, she was only thirteen; exactly half his age. The average age of marriage in 1890—the first year the Census tracked the statistic—was twenty-six for men and twenty-two for women (U.S. Census Bureau, 1890). Poe was perfectly average, while Virginia was shockingly below.

To add to their atypical relationship, his father and her mother were siblings, making Edgar and Virginia unfortunate first cousins. They met in 1829 when a twenty-one year-old Edgar came to live with his aunt Maria Clemm and her family, after a particularly bad dispute with his foster father (Hutchisson, 2005). Maria's daughter, Virginia, was only eight at the time, but as the new family provider, Edgar quickly took to helping his cousin in her education.

The two were married for almost eleven years, ending with Virginia's death, caused by tuberculosis, which she suffered from for the last five years of her life. Edgar survived her by two years, almost remarried four times, and ultimately passed away from mysterious circumstances. Although the circumstances of their marriage were strange, it is very difficult to know the exact nature of their marriage, as it is something neither they nor their friends ever wrote about in specifics. The fact that they never had children could allude either to them abstaining from a sexual relationship, or that one or both of them were infertile. That being said, by analyzing some of Poe's works inspired by Virginia, the nature of their marriage could be interpreted as more platonic than sexual.

My Own Sweetest Sissy:

The August before they were married, a very frantic Poe wrote a letter to his aunt. Presumably, Neilson Poe, another one of their cousins, had invited Virginia to stay with him and his wife, Josephine Clemm; Virginia's half-sister. In his letter, Edgar begged Maria to not send her, as in his own irrational words, "It is useless to disguise the truth that when Virginia goes with N. P. that I shall never behold her again" (E. A. Poe, personal communication, August 29, 1835). There is little reason to think that he would never see her again, considering he lived with her mother. Throughout the sporadic letter, Poe insisted that he was making enough money to support Virginia, and had even found a small house for them.

To be fair, in this letter Poe's extreme and manic side shines bright, especially in lines such as "you have driven me to the grave—for love like mine can never be gotten over," and, "What have I *to live for*? Among strangers with *not one soul to love me*." In the moment that he is writing the letter, he sees a bleak future for this Poe boy, where nobody loves him, all because Virginia has not yet accepted his proposal.

Although it is not as evident in this letter, part of Edgar's worry was that Virginia would not be well provided for, intellectually, by anyone other than him. For the entirety of their knowing each other, Edgar made sure she had a decent education, and was well-versed in the arts (Hutchisson, 2005). The letter ends first with Edgar asking Maria, "Ask Virginia. Leave it to her. Let me have, under her own hand, a letter,

bidding me *good bye*—forever—and I may die—my heart will break—but I will say no more." In the postscript, he addresses his cousin directly: "For Virginia, My love, my own sweetest Sissy, my darling little wifey, think well before you break the heart of your Cousin, Eddy."

For all his dramatics, Poe shows well in this letter that his intention to marry Virginia does not come from a sexual need. He is anxious to ensure that she has a bright and safeguarded future, ensured by his own abiding care.

Love Alone:

There is only one surviving letter written from Poe to his wife, about a paragraph in length. In it, Poe, out of town, asks Virginia to "battle with this uncongenial, unsatisfactory and ungrateful life" (E. A. Poe, personal communication, June 12, 1846). At this point in time, she had been diagnosed with tuberculosis for four excruciating years. A few months prior to this letter, Virginia penned her only known poem: "Valentine."

It is an acrostic poem, with the first letter of each line spelling out Edgar's name. In it, Virginia imagines that they could live in a cottage "removed from the world" (V. C. Poe, personal communication, 1846) together, and that "Love alone shall guide us when we are there." By far, the most heart-wrenching line is "Love shall heal my weakened lungs," referencing her illness, and the metaphorical salve Poe's companionship brings.

These two letters, though brief, exemplify the closeness of their relationship, but with everything they say, the only underlying tone is that of friendship. Deep friendship that has been shaped over years and tribulations of course, but friendship all the same.

For Fifteen Years:

One of Poe's lesser-known stories, "Eleonora," pulls heavily from his relationship with Virginia. The narrator tells the story of how he lived with his cousin and aunt; a subject familiar to Poe. Together, the three of them live in a beautiful land full of flowers, where, "Hand in hand about this valley, for fifteen years, roamed I with Eleonora before love entered within our hearts" (Poe, 1841). In the story, the narrator is specifically aged twenty, and Eleonora fifteen. After this quote follows,

"We had drawn the god Eros from that wave; and now we felt that he had enkindled within us the fiery souls of our forefathers."

As Poe directly brings Eros, the Greek god of love and sex, into the story, it can be assumed that this is his way of describing sex. The story continues as Eleonora falls ill, and the narrator promises to never fall in love after she has passed. In his real life, this story was published not long after Virginia was diagnosed with tuberculosis. Most of the practical elements of the story mirror Poe's real life incredibly closely, perhaps making this the most solid evidence of their marriage being sexual.

On the other hand, this is only one of nearly seventy works Poe published, and of the many, only a select few mention anything sexual. Every other one of his works, in the way that he writes of romantic desire with no sexual desire, lend a hand to the idea that Poe may have been asexual. It is difficult to find a singular line to support this, as it is more of a lack of sexual feeling in his works. But this reinforces the idea that Poe and Virginia may not have had a sexual relationship, especially considering the other women he wrote poems for, like Frances Osgood.

It is difficult to give historical figures modern sexual labels, as their own opinion on the matter is usually nonexistent, and the way society views sexuality has changed paramount over time. However—keeping in mind that this is not the focus of the paper and would require much more research to prove on its own—the way that Poe writes about love, especially since his narrators are generally autobiographical, leads one to believe that he viewed his relationship with women, not just his wife, as far more romantic than sexual. This is seen most clearly in "Berenice."

She Had Loved Me Long:

"Berenice and I were cousins, and we grew up together in my paternal halls—Yet differently we grew. I ill of health and buried in gloom—she agile, graceful, and overflowing with energy" (Poe, 1835). "Berenice" was published a year before Edgar and Virginia were married, which shows that marriage to Virginia was already on his mind. Unlike his later narrators, this one was not looking forward to it. "During the brightest days of her unparalleled beauty, most surely I had never loved her," however, "I knew that she had loved me long,

and, in an evil moment, I spoke to her of marriage."

It is certainly a more macabre story, as in the end the narrator, mistakenly thinking that Berenice is dead, blacks out from a mix of opium and generic mental illness, and somehow takes her teeth, which he has become obsessed with. Obviously that never happened in real life, but long before the climax of the story Poe does make it very clear that this narrator has no real sexual or romantic feelings for Berenice. He agrees to marry her because he knows that she loves him, and the idea of their marriage does not seem to get in the way of his studies. Perhaps this mirrored his feelings of marriage to Virginia at the time, and his eagerness in the earlier mentioned letter came purely from a desire to protect Virginia, knowing she loved him.

Conclusion:

The goal of this paper is not to prove that Poe never had a sexual relationship with his wife. That is merely hopeful wishing. Maybe they never had sex, or maybe they had sex often, and maybe they had sex only a few times in the entirety of their marriage. There is no way of knowing for sure. What research and analyzing can show is themes and quotes from surviving literature that show the written feelings they had for each other. This particular research has found that Poe often wrote elements of his stories specifically to excite his audience in order to persuade them to buy more of the many magazines he edited, and so there is no way of really knowing if what he wrote was based on fact.

More than that, this small collection of letters and stories proves that Edgar and Virginia did love each other, regardless of the sexual nature of their marriage. They were close friends who relied on each other for much, and cared deeply about the well-being of the other. One can hope that world-renowned poet Edgar Allan Poe was not in a sexually incestuous relationship with a woman thirteen years younger than him, but it may well be that celebrities, regardless of day or age, are deeply flawed people and not above making mistakes.

"Eleonora," "Berenice," and the three letters show that first and foremost, Poe was a dramatic writer who truly loved his wife. A great many of his stories are about beautiful women who were killed by illness at a young age and the resulting sorrow of the men who loved them. These ones simply have the most practical proof to their

connection to Virginia.

References:

Hutchisson, James M. (2005). *Poe*. Jackson: University Press of Mississippi.

Poe, Edgar A. (1835). Berenice. *Southern Literary Messenger*, no. 7 vol. I, pg. 333-336.

Poe, Edgar A. (1841). Eleonora. *The Gift for 1842*, pg. 154-162.

U.S. Census Bureau (1890). *Median Age At First Marriage*. Retrieved from https://www.census.gov/content/dam/Census/library/visualizations/time-series/demo/families-and-households/ms-2.pdf.

Fermentation of Plant-based Extracts by Dairy Lactic Acid Bacteria

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Abstract

Plant-based fermented foods to replace milk-based fermented foods, such as yogurt and cheese, have become a growing cultural necessity. These products are currently being produced using dairy fermentation cultures and processing equipment. Therefore, it is necessary to determine if dairy derived lactic acid bacteria (LAB) cultures can effectively ferment plant-based milk substitutes. Initially, selected dairy bacterial strains with be profiled for carbohydrate utilization using API CH50 carbohydrate panels to determine if they can ferment the types of sugars available in plant extracts. Three plant-based extracts (almond, coconut, and oat) will then be incubated with specific LAB cultures at three inoculum levels and the pH monitored over 420 minutes of incubation at 37°C. Results showed that fermentation (acid production) is LAB strain dependent based upon the type of plant extract being fermented. Only 2 LAB strains could ferment coconut and almond extracts (YFL01 and YFL02), while most LAB tested could ferment oat extract especially at the lower inoculum levels required for commercial production.

Introduction

Dairy foods cannot be consumed by some individuals due to lactose intolerance or other dietary restrictions. Non-dairy food options that mimic or replace dairy foods, such as plant-based “milks’ and yogurts have become an increasing cultural necessity and an important economic component of many food companies’ product portfolios. According to MarketWatch in 2019, sales of plant-based “milk” were up 9% to $1.6 billion (whereas cow’s milk sales were down 6%) and now comprise 13% of total “milk” sales; sales of plant-based cheese were up 43% to $124 million, and plant-based yogurt sales were

up 55% to $162 million. The Plant-based Foods Association states overall sales of plant-based milk substitutes was up over 6% in 2019 and consumers were willing to pay premium prices, often 2 to 3 times milk price for these products.

One challenge in producing plant-based products that mimic or function like milk-based fermentation products, particularly yogurt and cheese substitutes, is controlling the fermentation process to achieve a product for consumers that has the same organoleptic properties. Since plant-based extracts contain different sugars for microbial fermentation, which could affect the product's functionality, shelf life, and flavor. When milk is fermented by lactic acid bacteria (LAB), the organisms convert the milk sugar, lactose, to lactic acid lowering the pH of the product. Since there is no lactose in plant-based extracts, other sugars must be used by the LAB to produce acid. Currently, most manufacturers are using dairy-derived LAB as the starter culture bacteria for fermenting their plant-based products. In addition, these dairy based products are used as delivery systems for probiotics, which can provide benefits immunologically, nutritionally, and in preventing or treating gastrointestinal disease. For consumers. Unfortunately, a significant number of people are missing the benefits of probiotic-enhanced fermented products because most probiotics are partnered with dairy product delivery systems.

Evaluating the fermentation activity, especially acid production, of various dairy derived LAB cultures as well as LAB combinations in plant-based milk substitutes will provide insights about their effect on the production of yogurt and cheese analogs. Our objective was to determine how dairy-derived LAB starter cultures, traditionally used to ferment milk, will grow, produce acid, and maintain viability during the fermentation process in plant-based fluid extracts.

Methods

Media

De Man, Rogosa and Sharpe agar (MRS) (Hardy Diagnostics) broth and agar was used to propagate most lactic acid bacteria (LAB) used in this study. MRS+cysteine (MRS-C) was made for propagation of

Bifidobacterium strains. For MRS-C, after autoclaving and cooling MRS broth or agar, a filter-sterilized 5% L-cysteine hydrochloride solution was aseptically added to the MRS media to a final concentration of 0.05%. M17 broth and agar were used to propagate *Streptococcus thermophilus* strains used in this study. Bromocresol Purple (BCP) galactose agar was used for differentiation of *Streptococcus thermophilus* from *Lactobacillus bulgaricus* in mixed starter cultures.

Culture Strain Isolation

Commercial lactic acid bacterial culture mixtures YFL02 and Fresh Q, along with individual dairy strains, *Lactobacillus rhamnosus* LGG, *Streptococcus thermophilus* YFL01, *Bifidobacterium* BB12, *Lactobacillus casei* 431, and *Lactobacillus acidophilus* LA-5 (Table 1) were inoculated in appropriate broth, incubated at 37°C for 48 hours. Broth cultures were then plated on appropriate agar plates and incubated anaerobically for 48 hours at 37°C. *Bifidobacterium* BB12 was grown in MRS-C broth, plated on MRS-C agar plates, and incubated anaerobically at 37°C. Individual colonies were isolated from mixed cultures from each respective plate and isolated on additional MRS or MRS-C plates. Once individual organisms were isolated, they were inoculated in MRS broth tubes or MRS-C tubes and stored at 5°C. Fresh samples were made every 7-10 days. Additional samples were preserved in a -70°C freezer in broth or pellet form.

Carbohydrate Fermentation Profiles

Fermentation abilities of individual LAB strains were assayed with API 50 CH panels (bioMérieux Inc.). Each culture was tested using the API 50 CH panels according to the manufacturer's instructions. Results were used to predict if each strain could utilize the fermentable substrates present in each plant-based extract.

Fermentation in Plant-based Extracts

Ninety-nine milliliters of commercial oat, almond, and coconut liquid extracts (often referred to as "milks") were inoculated with either 1 g of the frozen commercial individual LAB strain or 1 ml of a 24-hour MRS broth culture of previously isolated strains and incubated in a water bath at 37°C. The pH was recorded at 0, 60, 120, 240, and

420 minutes. The pH probe was decontaminated with ethanol and distilled water between each reading. All tests were run in duplicate. In addition, different levels of inoculum were tested for their ability to lower the pH of the plant extracts over time. Inoculum of either 0.5%, 1.0%, or 2% (vol/vol) of frozen commercial culture blends (YFLO1 or YFLO2) or individual LAB strains, *Lb. casei* 431 or LGG were added to each plant extract (almond, coconut, or oat).

Based on initial results, the second experiment focused on the use of oat extract. Single, double, and triple combinations of LAB strains were tested for their fermentation capacity in oat beverage. Varied ratios of inoculum; 0.5%, 1.0%, and 2.0% (vol/vol) per 100 ml of oat extract were used. The LAB combinations were 431, 431 plus LGG, and 431 plus LGG plus YFL01. Samples were inoculated with the bacteria and incubated in a 40 °C water bath in triplicate. At 0, 60, 120, and 180 minutes, pH readings were made as described above. Measurements were taken until pH 5 was reached. Samples were then plated on MRS and incubated at 37 °C anaerobically for 48 hours then enumerated.

Results

Carbohydrate Utilization

Determination of which carbohydrates could be utilized by each LAB was evaluated with the API CH 50 tests. Each isolated organism in this study was evaluated. All bacterial strains fermented galactose, glucose, fructose, mannose, esculin, and tagatose. Most isolates could also utilize ribose and sorbitol (with the exception of YFLO1), maltose (with the exception of LGG), amygdalin (with the exception of YFLO2), and N-acetylglucosamine (with the exception of BB12). Results showed *Lactobacillus casei* 431 could only utilize N-acetylglucosamine after 60 hours. Since the most common sugars available for fermentation in plant-based extracts include the disaccharides sucrose and maltose, and monosaccharides fructose, mannose, and glucose, bacterial strains tested for this research appear to have the capacity to utilize common sugars found in plant-based extracts.

Acidification of Plant-based Extracts

All three plant-based extracts had an initial pH of approximately 8 that remained consistent through the incubation period. Most cultures had little effect in lowering the pH of either the almond or coconut plant extracts at the lower inoculum level (0.5%) except for YFL01 (Figures 1-3). When the inoculum level was increased to 2.0% then the YFL02 culture blend showed a marked decrease in pH over 420 minutes. Neither LGG or 431 had any effect of decreasing the pH although when LGG was added as a frozen commercial concentrate it initially lowered the pH at time 0 (presumably due to the low pH of the strain's storage media), but the pH remained constant during the test period (Figures 1-3).

The coconut extract (CM) inoculated with the culture blend YFLO2 lowered the pH 0.88, 1.21, and 1.63 units respectively with 0.5%, 1.0% and 2.0% inoculum over 420 minutes (Figure 2). Almond beverage (AM) inoculated with YFLO2 lowered pH by 2.23, 2.42, and 1.11 units at inoculum levels 0.5%, 1.0%, and 2%, respectively. Almond beverage inoculated with 431 reduced the pH by 0.05, 0.31, 1.32 respectively with the 0.5%, 1.0%, and 2.0% inoculum over 420 minutes (Figure 3).

Of note, is that a more typical fermentation time for commercial production of yogurt from plant-based extracts would be 240 minutes and only YFL01 showed a significant decrease in pH during that period in the coconut extract, especially at the lower inoculum level. In the almond extract, YFL02 was better at lowering the pH than YFL01 at 240 minutes at the 0.5% inoculum level (Figure 3).

All of the test cultures, both blends and single strains, decreased the pH of the oat milk over the test period (Figure 1). As the inoculum concentration increased, the initial pH at time 0 decreased especially at the 2% inoculum. At 240 minutes (4 hours), the pH decreased from 7.70 to pH 6 for all cultures except for 431, while at 1% inoculum concentration YFL01 decreased the pH to 5. At a 2% inoculum, all the cultures were able to decrease the pH to 5.5. At 420 minutes, most cultures could decrease the pH below 5.5.

Based on initial fermentation rates from the first experiment, further testing focused on the oat extract. Oat extract was inoculated with

combinations (or single strains) of 431, LGG, and YFL01. Organisms were inoculated at 0.5 g/mL and 1.0 g/mL in oat extract in triplicate. These inoculations were incubated in a water bath at 37 °C and pH monitored at 300 minutes, then plated on MRS agar plates and incubated anaerobically at 37 °C. All three inocula reduced the pH to pH 5 by 300 minutes (Figure 4). Results also showed that it may be possible to use selected single LAB strains to achieve an acceptable commercial fermentation in 4 hours. Final plate counts were enumerated after 48 hours. Plate counts were made at time zero and after 5 hours to determine if the cultures were activity growing or surviving. At time 5 hours, we found that the isolate and mixture growth activity had declined from the original culture sample (Figure 5).

Discussion

Typical dairy fermentation functions best within a 4-hour time frame, which requires a significant pH drop for successful dairy product fermentation. Measuring pH levels during production is a crucial step in dairy fermentation, particularly yogurt production. In this research, our data showed that oat extract inoculated with most LAB strains yields the greatest pH drop in 4 hours. Coconut extract and almond extract showed much less decrease in pH with little difference between the two.

These commercial dairy derived LAB show promise in plant-based food fermentations. Results show that sufficient acid production in an appropriate commercial production timeframe depends on the individual culture and the type of plant-based extract utilized. Of the three plant-based extracts tested, oat extract had the type and concentration of sugars that allowed most dairy LAB to lower the pH sufficiently in 4 hours. The results will help in determining the production and, thus, self-life stability of these probiotic organisms in dairy alternatives.

References

Aboulfazli, F., Shori, A.B. Salihin Baba, A.S. 2016. Effects of the replacement of cow milk with vegetable milk on probiotics and nutritional profile of fermented ice cream. *Food Science*

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and Technology 70:261-270. lhttps://doi.org/10.1016/j.lwt.2016.02.056.
Bernat N., Cháfer M., Chiralt A., González-Martínez C. 2015. Development of a non-dairy probiotic fermented product based on almond milk and inulin. *Food Science and Technology Int.* 21:440-453. doi: 10.1177/1082013214543705.
MarketWatch, People are willing to pay nearly twice as much for plant-based milk. Published: Nov 16, 2019.
Pramote K., Kumutakan W, Shuji A. (2012). Carbohydrate content and composition of product from subcritical water treatment of coconut meal. *Journal of Industrial and Engineering Chemistry* 18:225-229. *https://doi.org/10.1016/j.jiec.2011.11.010.*
Shori, A. B. (2015). The potential applications of probiotics on dairy and non-dairy foods focusing on viability during storage. *Biocatalysis and Agricultural Biotechnology* 4:423-431.
The Plant-based Foods Association. https://www.marketwatch.com/story/health-conscious-people-are-willing-to-pay-nearly-twice-as-much-for-plant-based-milk-2019-07-17

Strain	Name of Bacteria	Function	Optimal temperature
YF L01	*Streptococcus thermophilus*	Fermentation	37°C
YF L02	non-dairy starter blend	Fermentation	37°C
	Streptococcus thermophilus	Fermentation	37°C
	Lactobacillus bulgaricus	Fermentation	37°C
	Lactobacillus casei 431	Probiotic	35°C
	Lactobacillus acidophilus LA-5	Lactose reduction	37°C
	Bifidobacterium BB12	Probiotic	37°C
LGG	*Lactobacillus rhamnosus*	Probiotic	30°C
BB12	*Bifidobacterium*	Probiotic	37°C
Casei 431	*Lactobacillus casei 431*	Probiotic	35°C
Fresh Q	*Lactobacillus rhamnosus* *Lactobacillus paracasei*	Yeast and mold inhibition	

Table 1. Commercial strains of dairy-derived lactic acid bacteria (LAB) used including their function, optimal temperature and optimal growth conditions.

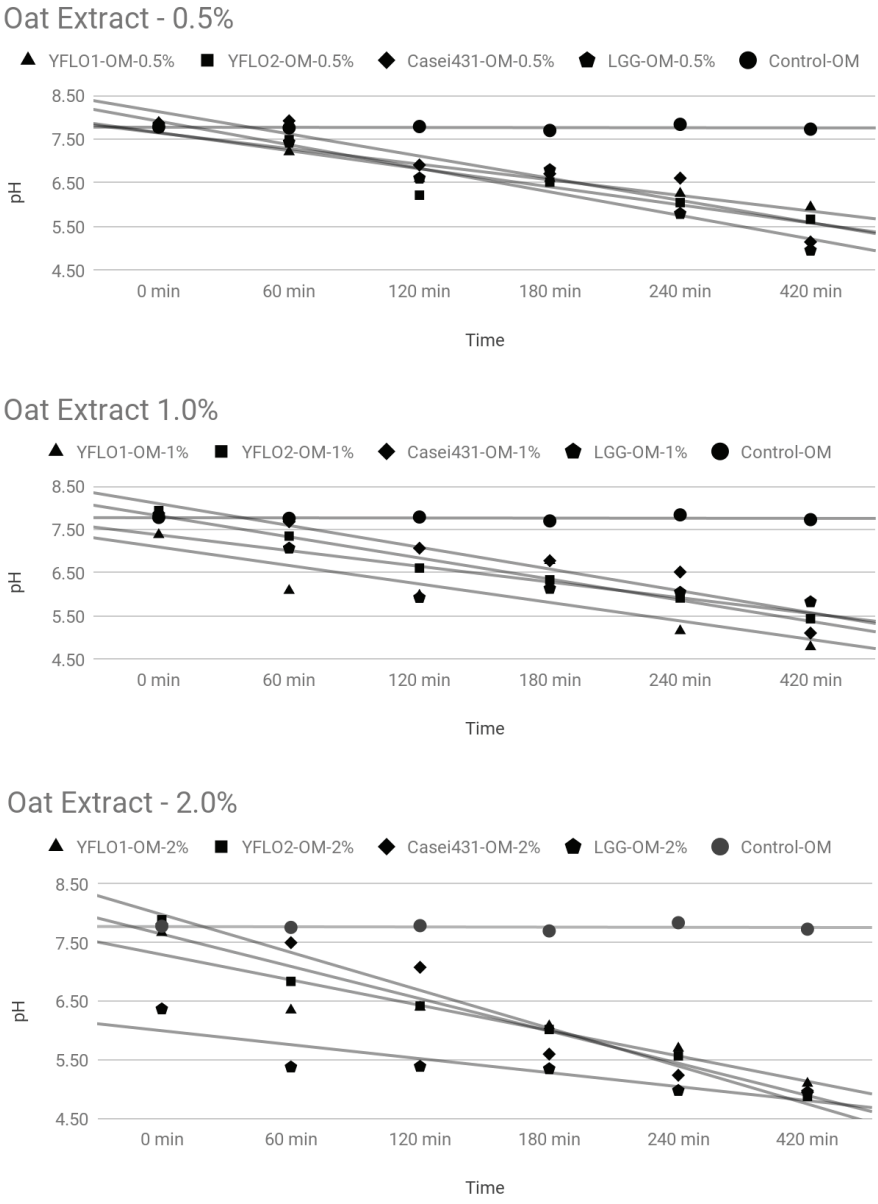

Figure 1. Oat extract pH readings during incubation with LAB cultures over 0, 60, 120, 180, 240, and 420 minutes. Oat extract was inoculated with either 0.5% (top), 1.0% (middle) or 2.0% (bottom)

inoculum (vol/vol).

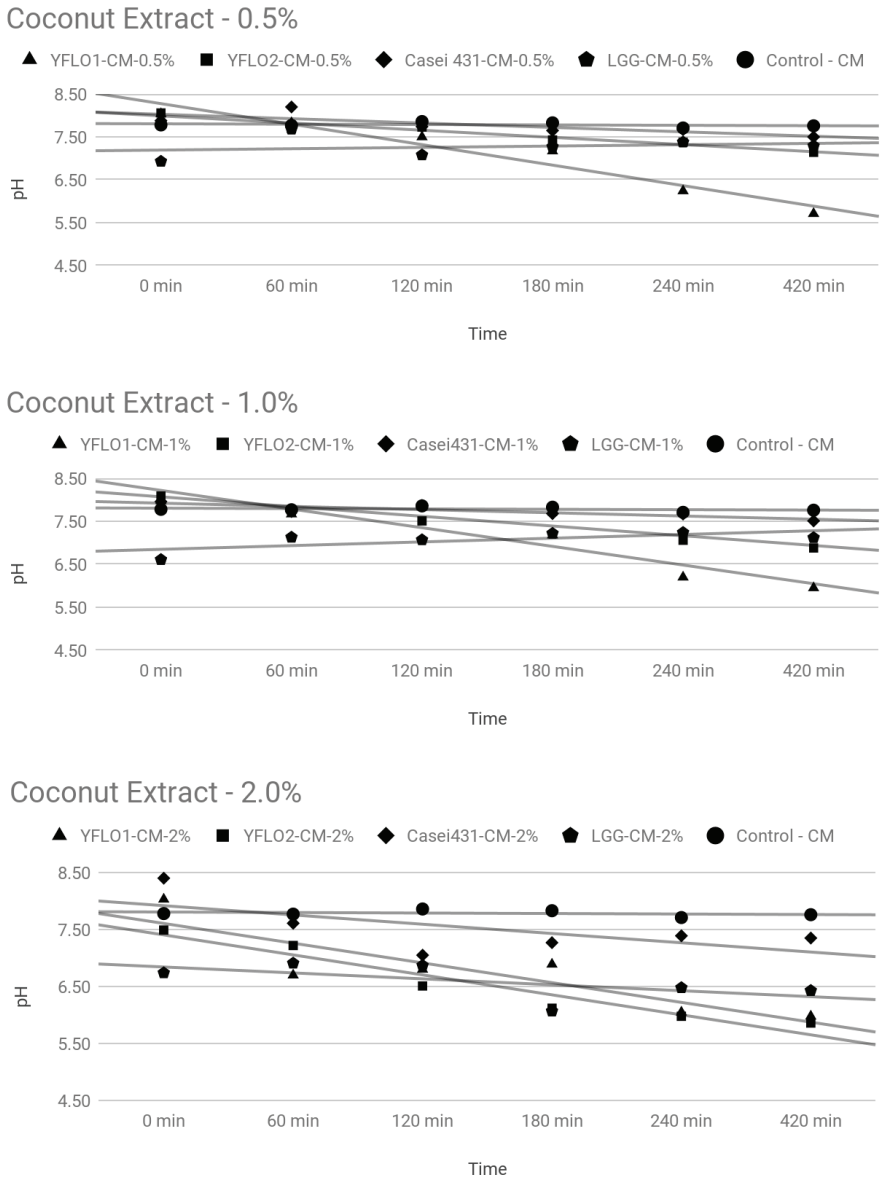

Figure 2. Coconut extract pH readings during incubation with LAB cultures over 0, 60, 120, 180, 240, and 420 minutes. Coconut extract was inoculated with either 0.5% (top), 1.0% (middle) or 2.0% (bottom) inoculum (vol/vol).

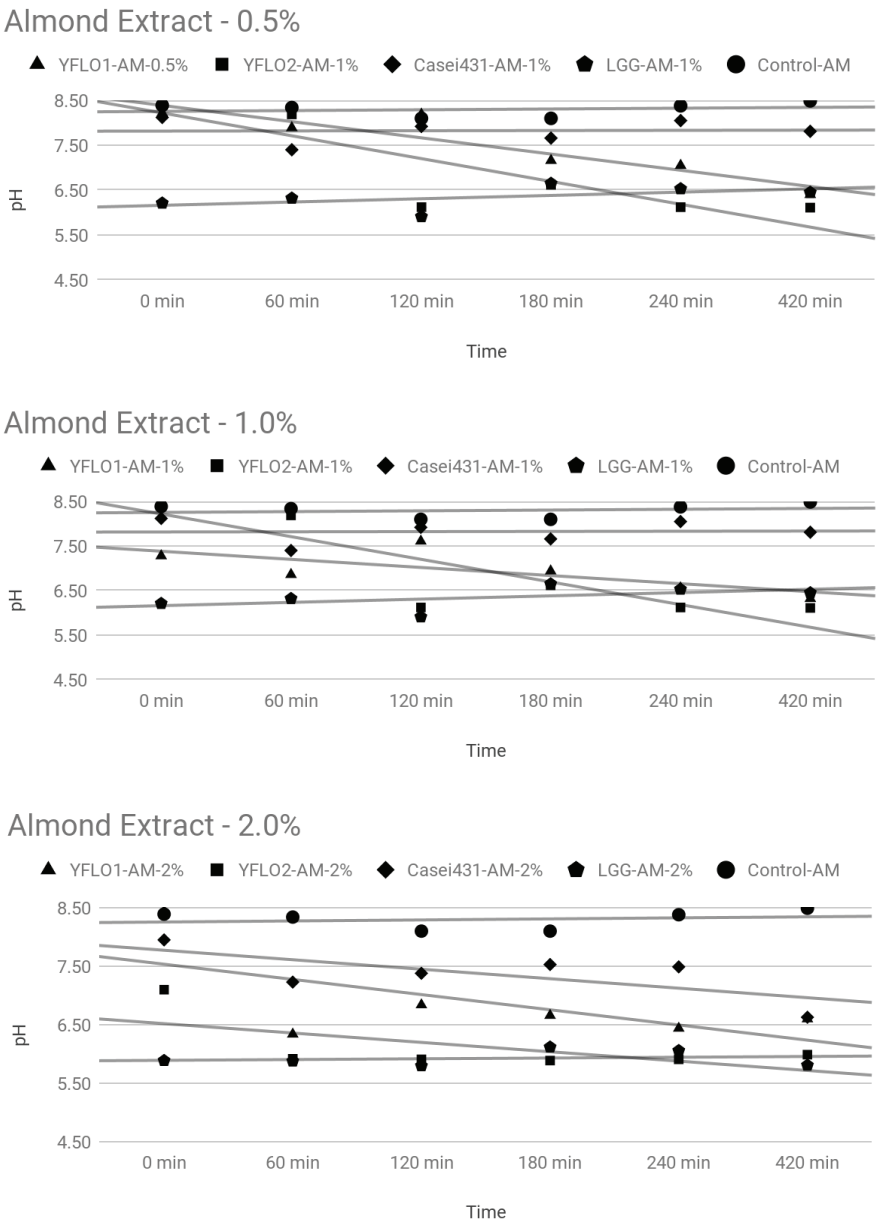

Figure 3. Almond extract pH readings during incubation with LAB cultures over 0, 60, 120, 180, 240, and 420 minutes. Almond extract was inoculated with either 0.5% (top), 1.0% (middle) or 2.0% (bottom) inoculum (vol/vol).

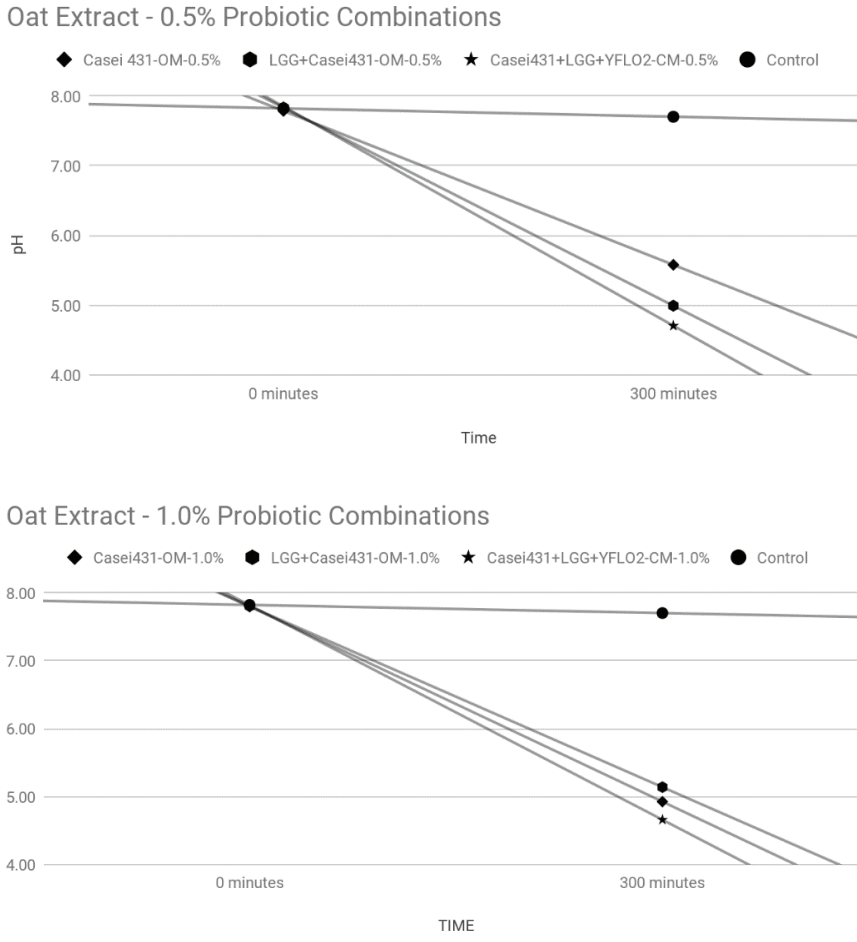

Figure 4. Oat extract (OE) pH readings using probiotic mixed cultures at 0 and 300 minutes. Oat extract was inoculated with a total 1.0% inoculum (vol/vol). Single inoculum (1.0g/99mL OE), double inoculum (0.50g each organism/99 mL OE), and triple inoculum (0.33g each organism/99mL OE).

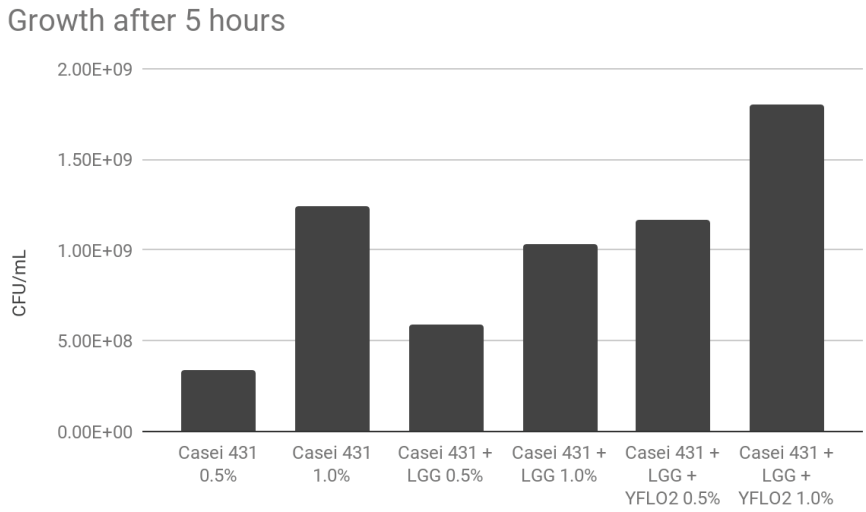

Figure 5. Bacterial counts (CFU per mL) after 5 hours of incubation in oat extract at either 0.5% or 1.0% inoculum (vol/vol) using on MRS agar incubated anaerobically at 37 °C for 48 h.

Gluconate Metabolism by *Lactobacillus wasatchensis* WDC04 Can Be a Cause of Late Gas Defect in Aging Cheese

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Lactobacillus wasatchensis, a nonstarter lactic acid bacteria, can cause late gas production, and splits and cracks in aging cheese when it metabolizes 6-carbon sugars in cheese, particularly galactose, to a 5-carbon sugar, resulting in the release of CO_2. Previous studies have not explained late gas production in aging cheese when no galactose is present. Based on the genome sequence of Lb. wasatchensis WDC04, genes for potential metabolic pathways were mapped using Knowledgebase Predictive Biology software. This metabolic modeling predicted Lb. wasatchensis WDC04 could use gluconate. Gluconate contains 6 carbons and Lb. wasatchensis WDC04 contains genes to convert it to ribose-5-P using phosphogluconate dehydrogenase by a decarboxylating step, producing CO_2 during its metabolism. The goal of this study was to determine if sodium gluconate, often added to cheese to reduce calcium lactate crystal formation, could be metabolized by Lb. wasatchensis WDC04 resulting in gas production. Carbohydrate restricted MRS (CR-MRS) was mixed with varying ratios of ribose, sodium gluconate or D-galactose (total sugar content of 1%). Oxyrase was also used to create an aging cheese environment in selected tubes. Tubes were inoculated with a 4 d culture of Lb. wasatchensis WDCO4 and results recorded over 8 d. When inoculated into CR-MRS containing only sodium gluconate, Lb. wasatchensis WDC04 grew, confirming gluconate utilization. Of the ten ratios used, Lb. wasatchensis WDC04 produced gas in six with the most gas production resulting from the ratio of 100% sodium gluconate with no added ribose or galactose. Results showed that Lb. wasatchensis WDC04 can utilize sodium gluconate to produce CO_2 gas, which could cause late gas formation in aging cheese. The presence of gluconate in cheese thus becomes another risk factor for unwanted gas production,

and formation of splits and cracks.

Introduction

Late gas production during aging of Cheddar cheese is a defect that causes splits and cracks in the cheese. This gas production can cause further problems such as package bloating, and impaired slicing and shredding of the product. Late gas defect occurs during the aging process as the result of *Lactobacillus wasatchensis* growth, a hetero-fermentative nonstarter lactic acid bacteria (NSLAB) (Oberg et al., 2016a). Previous studies showed galactose could be metabolized to produce gas by *Lb. wasatchensis*, but they did not explain the carbon source for late gas production in cheese when no galactose was present (Orakci, et al. 2015a and 2015b).

A study examined possible energy sources for various species of NSLAB, including 11 *Lactobacillus* species (Williams et al., 2000). These energy sources included galactose, lactose, N-acetyl-glucosamine, and other sugars that could potentially be metabolized during the aging process of cheese. Cheese manufacturers often add in other compounds to improve the quality of their product. Sodium gluconate is one such compound, added to reduce the likelihood of calcium lactate crystal development during cheese aging. As a 6-carbon molecule, sodium gluconate could be a potential energy source for NSLAB, including *Lb. wasatchensis,* and thus a potential cause of late-gas defect.

This experiment dealt with understanding more about the metabolism *Lb. wasatchensis*. The first goal of this research was to determine possible pathways *Lb. wasatchensis* could utilize for energy production. To do this, the complete *Lb. wasatchensis* genome sequence was analyzed using a metabolic modeling program, and growth curves used to confirm suspected specific sugar metabolism pathways. The second goal was to evaluate whether sodium gluconate could be used as an energy source by *Lb. wasatchensis* and if its use resulted in CO_2 production.

Methods

Culture

Lactobacillus wasatchensis WDCO4 was originally isolated from aged Cheddar cheese produced at Utah State University Western Dairy Center and maintained in MRS broth.

Media

DeMan, Rogosa, and Sharpe broth (MRS) with 1% ribose was used to grow *Lb. wasatchensis*. MRS-Carbyhydrate Restricted (MRS-CR) was used in the experiment: Per liter, 10g protease peptone, 10g beef extract, 5g yeast extract, 1.0g Tween-80, 2.0g ammonium citrate, 2.0g dipotassium phosphate, 5.0g sodium acetate, 0.1g magnesium sulfate, and 0.05g manganese sulfate were combined with dH2O. The sugars added to the MRS-CR were varying ratios of ribose, D-galactose, and gluconate where the total sugar equaled 1%. Each sugar was prepared in a 10% solution, filter sterilized, and then added to the sterile MRS-CR broth. Oxyrase was also added to induce a more anaerobic environment in selected tubes. Ratios of the and oxyrase in MRS-CR broth are found in Table 1.

Bioinformatics

The *Lb. wasatchensis* WDC04 genome sequence was obtained from GenBank (https://www.ncbi.nlm.nih.gov). The WDC04 genome was annotated using RAST and analyzed using the Biology Knowledgebase (KBase) metabolic modeling program.

Growth Curves

A Tecan Infinite 200 plate reader was used to measure the optical density of *Lactobacillus wasatchensis* WDCO4 in a sterile 48-well plate over a 72 hour period while incubated at 30°C. Growth curves were obtained from the Magellan program, which plotted optical density at 600 nm over time.

Gas Production

Test tubes were prepared with durham tubes placed on 61mm

capillary tubes. Triplicate tubes of each carbohydrate ratio were pipetted and autoclaved at 121°C for 15 min. Fifty microliters of a 4 day culture of *L. wasatchensis* WDC04 was inoculated into each of the tubes and incubated at 30°C. The tubes were checked every 24 hours for gas production over 8 days. Data was gathered by measuring the length and diameter of CO_2 bubbles and then calculating the volume.

Results

Data output from KBase flux balance analysis (FBA) showed *Lb. wasatchensis* WDC04 to contain all the genes coding for the enzymes needed for a pentose phosphate pathway (PPP). Pathways for glycolysis, TCA, and galactose metabolism, however, were incomplete (Figure 1). Growth curve analysis showed significant metabolic use of only gluconate and ribose.

The average gas production is depicted in Figure 2. The negative control (100% ribose) did not produce gas. The positive control (30% ribose/70% galactose) showed gas production. Each of the tubes with carbohydrate ratios containing sodium gluconate were also positive for gas production. The amount of gas produced increased as sodium gluconate was increased in the carbohydrate ratio, with the highest gas produced in tubes solely containing sodium gluconate as the carbohydrate without any ribose or galactose (Figure 3).

Conclusion and Discussion

The data output from flux balance analysis showed *Lactobacillus wasatchensis* has a complete pentose phosphate pathway (PPP), while pathways for glycolysis, TCA, and galactose metabolism are incomplete. Growth curve results confirmed the metabolic modeling data from KBase, showing *Lb. wasatchensis* does use the PPP to metabolize ribose and gluconate but cannot effectively metabolize galactose, gluconic acid, lactose, lactate, NAG, α-ketoglutarate, or xylose. KBase metabolic modeling predicted that the 6-carbon sugar, gluconate, would fit the predicted genome pathway model for both gas production and utilization by PPP. KBase indicated gluconate is converted to ribose-5-P using phosphogluconate dehydrogenase by a decarboxylating step, producing the CO_2 gas that causes splits in aging cheese.

Lb. wasatchensis produced gas in MRS-CR broth when supplemented with various ratios of gluconate. The amount of sodium gluconate added correlated to the amount of gas produced, and produced gas in greater quantities than that of the positive control containing 30% ribose and 70% galactose. This result has significance in the cheese industry because some manufacturers currently add sodium gluconate to the milk during cheesemaking, which may increase the likelihood of late gas defect occurring during the aging process. Further investigation, by measuring the amount of gas output when WDC04 is added to Cheddar cheese supplemented with sodium gluconate, may confirm this observation, and provide a greater understanding of this organism's metabolism as well as suggest possible solutions to reduce late gas production by *Lb. wasatchensis* in aging cheese.

References

Arkin AP, Cottingham RW, Henry CS, Harris NL, Stevens RL, Maslov S, et al. 2018. KBase: The United States Department of Energy Systems Biology Knowledgebase. Nature Biotechnology. 36:566. doi:10.1038/nbt.4163

Oberg, C. J., Culumber, M. D., Allen, T., Villalba, B., & McMahon, D. J. 2016a. Characterization of *Lactobacillus wasatchensis* from aged cheeses showing late-gas defects. Journal of Animal Science Supplement 5, 94:261. doi:10.2527/jam2016-0546

Oberg, C. J., Bowen, I., Culumber, M. D., & McMahon, D. J. 2016b. Determination of treatments to reduce late gassy defect in cheese due to *Lactobacillus wasatchensis* WDC04 contamination. Journal of Animal Science Supplement 5, 94:261-262. doi:10.2527/jam2016-0548

Oberg, C. J., Broadbent, J. R., Oberg, T. S., McMahon, D. J., Ortakci, F., & Culumber, M. D. 2016c. *Lactobacillus wasatchensis* sp. nov., a non-starter lactic acid bacteria isolated from aged Cheddar cheese. International Journal of Systematic and Evolutionary Microbiology 66:158-164. doi:10.1099/ijsem.0.000689

Ortakci, F., Broadbent, J. R., Oberg, C. J., & McMahon, D. J. 2015a. Late blowing of Cheddar cheese induced by accelerated ripening and ribose and galactose supplementation in presence of a novel obligatory heterofermentative nonstarter *Lactobacillus*

wasatchensis. Journal of Dairy Science 98:7460-7472. doi:10.3168/jds.2015-9468

Orakci F., Broadbent, J. R., Oberg, C. J., McMahon, D. J. 2015b. Growth and gas formation by *Lactobacillus wasatchensis*, a novel obligatory heterofermentative nonstarter lactic acid bacterium, in Cheddar-style cheese made using a *Streptococcus thermophilus* starter. Journal of Dairy Science. 98:7473-7482.

Williams, A. G., Withers, S. E., & Banks, J. M. 2000. Energy sources of non-starter lactic acid bacteria isolated from Cheddar cheese. International Dairy Journal 10:17-23. doi:10.1016/s0958-6946(00)00027-3

Sugar Ratio	Ribose (%)	NaGluconate (%)	D-galactose (%)	Oxyrase (%)
100Ribose	1	0	0	1.8
30R/70gal	0.3	0	0.7	1.8
50R/50g	0.5	0.5	0	1.8
30R/70g	0.3	0.7	0	1.8
100g	0	1	0	1.8

Table 1. *The ratios of ribose (R), sodium gluconate (g), D-galactose (gal), and oxyrase used in the experiment. The total volume of media in each tube equaled 11 mL.*

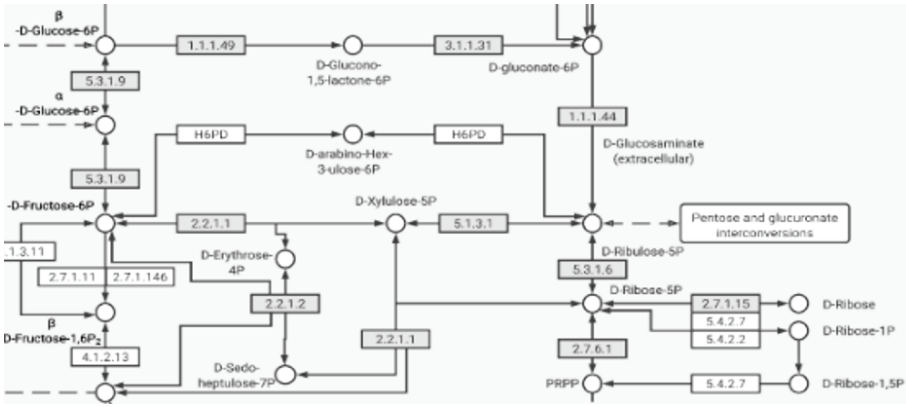

Figure 1. *WDCO4 complete pentose phosphate pathway created from KBase FBA data. Genes for the enzymes present are highlighted in blue.*

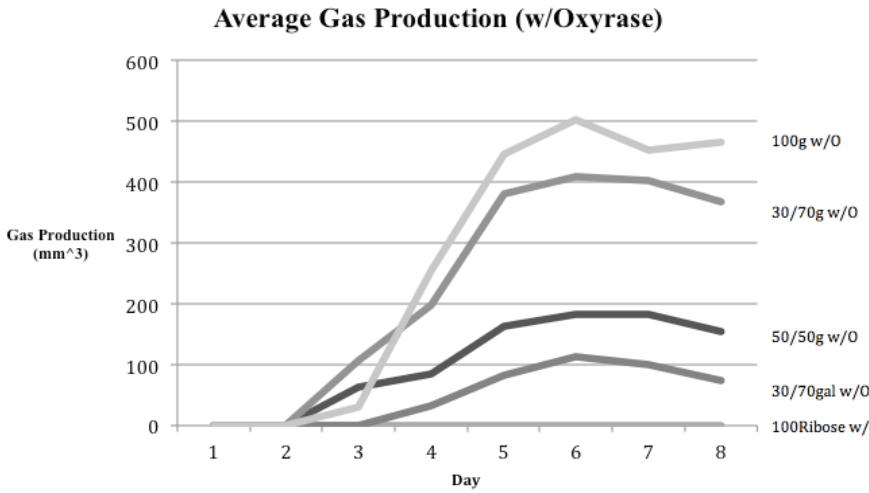

Figure 2. *The average gas production of the tubes with various sugar ratios and oxyrase (O). The highest amount of gas seen in the durham tubes occurred on day 6. The first number in the ratio is the ribose concentration (R) while either gal (galactose) or g (gluconate) are the second number in the ratio.*

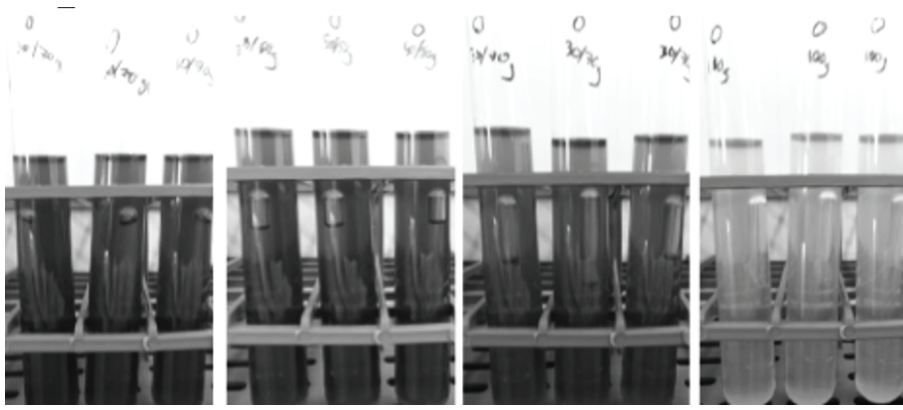

Figure 3. *Carbon dioxide (CO_2) gas captured in durham tubes on day 6. Each set was run in triplicate From left to right: 30% ribose/70% galactose; 50% ribose/50% gluconate; 30% ribose/70% gluconate; and 0% ribose/100% gluconate.*

Medical Marijuana Legalization and Crime: A National Examination

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Abstract

To date, 33 including DC have legalized medical marijuana. This paper examines the effects of medical marijuana legalization (MML) on crime using an economics of crime approach. Using data from 1983 to 2014 across all 50 states plus DC, I employ a difference-in-differences (DID) approach to estimate the treatment effect. After controlling for state specific factors, I find a statistically significant decrease in nearly every category of crime after MML implementation. My results contribute to a new understanding as to why MML decreases crime, potentially leading to more efficient public policy.

Introduction

If there is a demand for a good, and it cannot be legally obtained, a black market will develop to supply that demand. Profits made from the illicit drug trade create large-scale criminal organizations, and since the only method of recourse in an illegal market is vigilantism, crime increases as well (Gray, 2001; Kopp, 2004). Although medical marijuana legalization (MML) does not imply total legalization, MML represents a movement away from prohibition. To date, 33 states and DC have enacted MML (ncsl.org). Since the most serious social costs of illegal drugs are often the violence involved in their distribution (Kopp, 2004; Becker, et al., 2006), my research measures the effects of MML across the United States. I find that MML produces statistically significant reductions in crime.

Background and Literature Review

The modern framework of American drug legislation was enacted on October 27th, 1970 with the Drug Abuse Prevention and Control Act. Title II of the act classifies drugs within five categories according to their potential for abuse and whether they have medicinal value

(Frydl, 2013). Since the inception of the act, the DEA continues to classify marijuana as a Schedule I narcotic alongside heroin and cocaine, which are narcotics with no currently accepted medical use and a high potential for abuse (dea.gov). However, while marijuana in any form remains illegal at the federal level, an increasing tolerance among the public and changing demographics coupled with greater scientific understanding of the medicinal benefits of marijuana have led to changes in state drug policies.

Research suggests that crime resulting from the illicit drug trade can be reduced through MML. Gavrilova, et al. (2017), examining the impacts of MML on violent crime among U.S. states that border Mexico, argue that the legal status of marijuana is the factor contributing to violent crime rates; since MML affects the profits of drug trafficking organizations. Using a series of fixed-effects regression analyses and a DID methodology, the authors conclude that MML do decrease the violent crime rate in border states by approximately 12 percent.

Corroborating the research conducted by Gavrilova, et al. (2017), Shepard and Blackley (2016) hypothesize that there would be a positive relationship between MML and crime rates, but found a substantial drop in crime rates in states that have adopted MML.

Further evidence that MML reduces crime is demonstrated when comparing the effects of legalization versus depenalization. Huber III, et al. (2016) analyzed state panel data on non-drug crime from 1970 through 2012. Using a linear regression analysis and controlling for time-varying variables that impact crime rates, the authors conclude that the results show a largeand significant relationship between MML and a decrease in non-drug crime, but depenalization has no effect on non-drug crime.

There remains, however, mixed and conflicting data outcomes in the field of MML research. Chu and Townsend (2018), recognizing the mixed results of MML on crime rates, set about measuring the effects of MML on violent and property crime rates at the city, state, and national levels. Using a DID method, complemented with a synthetic control method, the authors conclude that MML has no statistically significant effect on violent or property crime rates, except in California, Washington, and Oregon, where the authors find a 20 percent decrease in both crime rates. Chu and Townsend (2018)

further believe that the reduction in violent crime rates due to MML that Gavrilova, et al. (2017) examined are due to a sampling bias (only three states were treated).

If the type of MML affects how crime interacts with medical marijuana, as Pacula, et al. (2014) suggests, then ease of access and the presence of dispensaries may alone reduce crime rates. Using evidence from a Los Angeles interim ordinance that forced the closure of many marijuana dispensaries in 2010, Chang and Jacobson (2017) find a large increase in both violent and property crime rates in neighborhoods surrounding the closed dispensaries.; however, their results are only marginally significant. This study extends credibility to the theory that the mere presence of a dispensary can reduce crime through increased security – the "eyes on the street" approach to crime reduction (Chang & Jacobson, 2017).

Expanding on the theory that marijuana legalization leads to crime reduction, Dragone, et al. (2018) examine the relationship between recreational marijuana legalization and crimes along the Washington and Oregon State border. They find that recreational marijuana legalization leads to a significant decrease in crime.

The growing body of literature evincing a relationship between MML and crime rates corroborates some fundamental research into the economics of crime. Becker, et al. (2006) demonstrate that the marginal social costs of interdiction efforts aimed at illegal drugs exceed the marginal benefit when demand is inelastic. Interdiction efforts only increase the costs to suppliers and consumers, but do little to affect quantity demanded. However, excise taxes do not have this problem, and in a legalized drug market, enforcement objectives only need to be aimed at ensuring underground production cost exceeds the tax (Becker, et al., 2006). This analysis potentially explains why a preponderance of research into marijuana legalization's effects on crime rates has largely shown a statistically significant decrease in overall crime.

Data

Crime data was collected from the FBI's Uniform Crime Report (UCR) for the years 1983 – 2014 and are measured by occurrences per 100,000 people. These are the dependent variables of interest. Medical marijuana statistics were collected from the National

Conference of State Legislators (ncsl.org). To control for the economy of each state, state GDP and GDP per capita data were obtained from the U.S. Bureau of Economic Analysis (BEA). State unemployment rates (seasonally adjusted) were collected from the Federal Reserve Economic Database (FRED), and, because population density is a contributing factor to crime rates (Oliveira, et al. 2017), population density data has been gathered from the 2010 U.S. Census data. Since U.S. Census data is only available decennially, I employ an algorithm to average out the increases or decreases in population density in-between census years. Table 1 presents summary statistics for these variables. The categories of Violent Crime and Property Crime are aggregate totals of all violent crimes (murder, rape, robbery, and aggravated assault) and all property crimes (burglary, theft, and vehicle theft). Large variations in every category indicates that crime is widely dispersed. Such wide dispersions indicate that no single factor can explain crime.

Table 1

Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Murder	1,632	6.327	6.793	0.200	3.000	7.700	80.600
Rape	1,632	34.951	13.197	7.300	26.000	41.800	101.500
Robbery	1,632	136.641	137.412	6.400	66.400	164.125	1,266.400
Aggravated Assault	1,632	291.328	170.841	31.300	168.725	380.000	1,557.600
Violent Crime	1,632	469.955	298.164	47.000	276.050	599.650	2,921.800
Burglary	1,632	872.687	365.424	257.200	592.000	1,073.850	2,294.300
Theft	1,632	2,613.713	754.543	1,160.800	2,054.975	3,014.225	5,833.800
Vehicle Theft	1,632	367.040	232.333	38.900	199.125	465.750	1,839.900
Property Crime	1,632	3,858.881	1,215.448	1,524.400	2,908.825	4,558.575	9,512.100
State GDP	1,632	214,509.900	287,969.800	9,129.600	51,598.120	263,932.900	2,309,928.000
Per Capita GDP	1,632	39,116.550	19,564.420	14,045.000	25,015.000	47,680.000	183,971.000
Unemployment	1,632	5.958	2.041	2.300	4.490	7.122	17.790
Population Density	1,628	368.483	1,357.626	0.700	38.538	205.845	10,456.200

Econometric Method and Results

My preferred specification is the DID model, because a DID controls for unobserved extraneous factors by considering the average effects within the treated groups relative to crime rate trends in the control group (states that have never enacted MML during the sample period).

The estimating equation for the DID model may be expressed as follows:

$$(1) \qquad Y_{cit} = \beta X_{it} + \delta_1 MML_{it} + \alpha_i + \sigma_t + \varepsilon_{it}$$

where Y_{cit} is the measurement of crime rate in crime category c in state i in state t, X is a vector of control variables, MML_{it} is equal to 1 if medical marijuana is legal in state i during year t, α_i and σ_t are state and year fixed effects, respectively, and ε_{it} is the idiosyncratic error term. With regards to violent crime rates, overall violent crime decreases by 48.741 incidents per 100,000, or 10.3 percent, and overall property crime exhibits a decrease of 546.951 incidents per 100,000, or 14.17 percent. Aside from the statistically insignificant decrease in vehicle thefts, all violent and property crime results are statistically significant at the 1 percent level, indicating that there is a strong causal relationship between MML and crime rates. These results are in-line with my hypothesis. Table 2 displays the primary results of MML on crime rates from my model.

Table 2

Primary Results

	Dependent Variable:								
	Murder	Rape	Robbery	Aggravated Assault	Violent Crime	Burglary	Theft	Vehicle Theft	Property Crime
MML (DID)	-0.877***	-3.642***	-23.669***	-20.758***	-48.741***	-157.082***	-377.817***	-0.580	-546.951***
	(0.265)	(0.658)	(4.045)	(6.036)	(8.969)	(13.237)	(28.898)	(10.020)	(42.478)

Note: *p<0.1; **p<0.05; ***p<0.01

Conclusion

My research has demonstrated that the economics of crime is a determining factor driving the reduction of crime rates through the legalization of medical marijuana. My results support the economic theory that, where there is an inexorable supply and demand for a good, by increasing the marginal cost and decreasing the marginal benefit to engage in criminal activities to supply and procure that good, it is possible to lower crime rates. In particular, MML decreased the marginal benefit of participating in the illegal marijuana market by creating a close substitute for illegal marijuana, namely medical marijuana. However, this substitution effect is largely dependent on the type of MML that is enacted. Future research should seek to analyze differences in effects across states with differing access to MML participation.

Works Cited

Becker, G., Murphy, K., & Grossman, M. (2006). The market for illegal goods: The case of drugs. *Journal of Political Economy*, 114(1), 38-60. doi:10.1086/498918

Chang, T. Y., & Jacobson, M. (2017). Going to pot? the impact of dispensary closures on crime. J*ournal of Urban Economics*, 100, 120-136. doi:10.1016/j.jue.2017.04.001

Chu, Y. L., & Townsend, W. (2018). Joint culpability: The effects of medical marijuana laws on crime. *Journal of Economic Behavior & Organization*, doi:10.1016/j.jebo.2018.07.003

Dragone, D., Prarolo, G., Vanin, P., & Zanella, G. (2018). Crime and the legalization of recreational marijuana. *Journal of Economic Behavior & Organization*, doi:10.1016/j.jebo.2018.02.005

Federal Reserve Bank of St. Louis. (2019). State unemployment rates. Available from https://fred.stlouisfed.org/

Frydl, K. (2013). *The drug wars in america*, 1940-1973. Cambridge; NY: Cambridge University Press.

Gavrilova, E., Kamada, T., & Zoutman, F. (2017). Is legal pot crippling mexican drug trafficking organisations? The effect of medical marijuana laws on US crime. *The Economic Journal*, doi:10.1111/ecoj.12521

Gray, J. P. (2001). *Why our drug laws have failed and what we can do about it: A judicial indictment of the war on drugs.* Philadelphia, PA: Temple University Press.

Huber III, A., Newman, R., LaFave, D., (2016). Cannabis control and crime: Medicinal use, depenalization and the war on drugs. B.E. J*ournal of Economic Analysis and Policy* 16(4), 1-34. https://doi.org/10.1515/bejeap-2015-0167

Kopp, P. (2004). *Political economy of illegal drugs*. New York, NY: Routledge.

National Conference of State Legislators (2019). State medical marijuana laws. Retrieved from http://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx

Oliveira, M., Bastos-Filho, C., & Menezes, R. (2017). The scaling of crime concentration in cities. *PloS One*, 12(8), e0183110. doi:10.1371/journal.pone.0183110

Pacula, R. L., Boustead, A. E., & Hunt, P. (2014). Words can be deceiving: A review of variation among legally effective medical marijuana laws in the united states. *Journal of Drug Policy Analysis*, 7(1), 1-19. doi:10.1515/jdpa-2014-0001

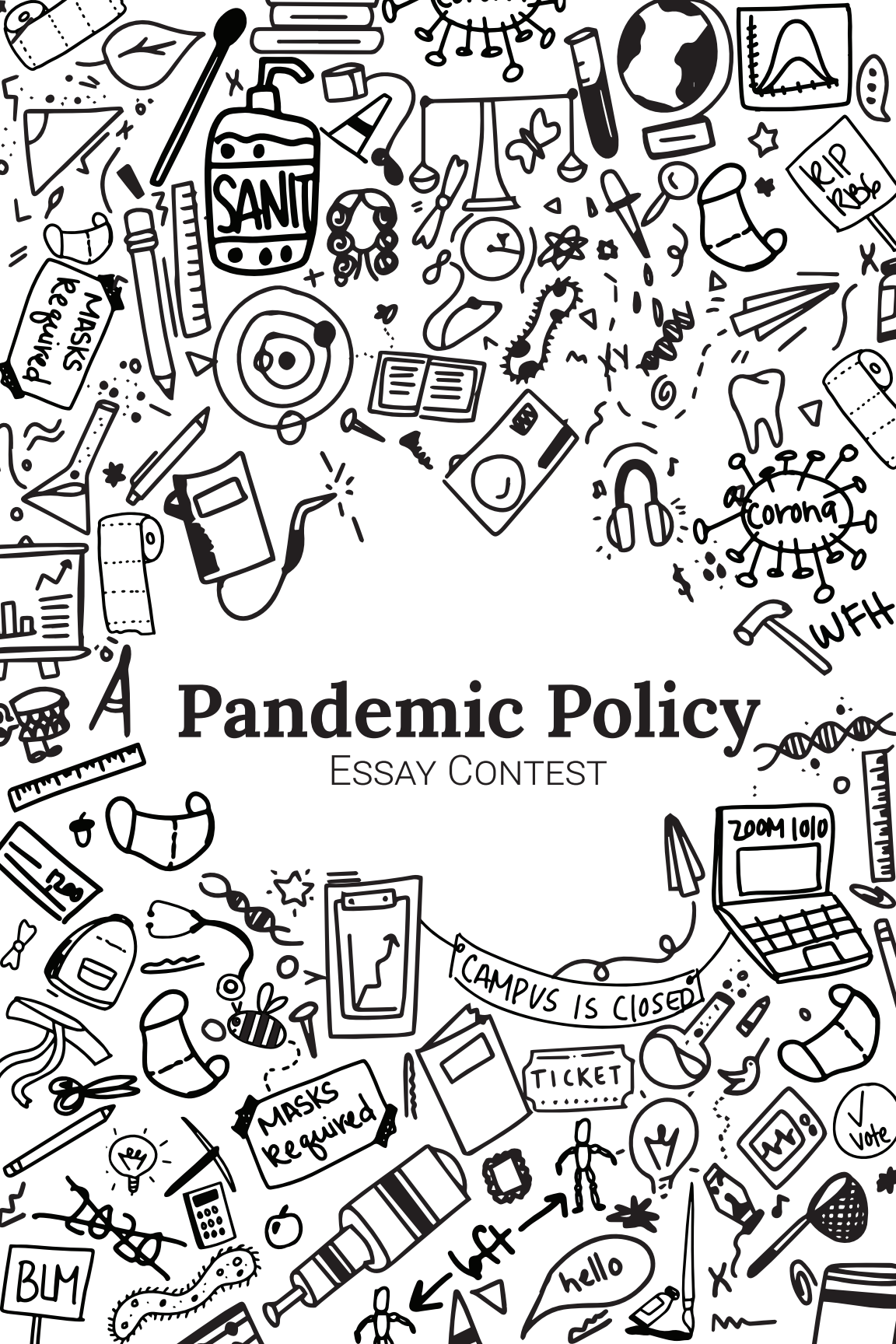
Shepard, E. M., & Blackley, P. R. (2016). Medical marijuana and crime: Further evidence from the western states. *Journal of Drug Issues*, 46(2), 122-134. doi:10.1177/0022042615623983

United States Bureau of Economic Analysis (BEA). 1983-2014. Per Capita Real GDP by State (*Chained 1997 Dollars*). Available from https://www.bea.gov/tools/

United States Bureau of Economic Analysis (BEA). 1983-2014. *Real GDP by State: All Industry Total (Millions of chained 1997 Dollars)*. Available from https://www.bea.gov/tools/

United States Census Bureau (2019). *2010 U.S. Population Density Data*. Available from https://census.gov/

Uniform Crime Reporting Statistics (UCR). 1983-2014. *State-By-State and National Crime Estimates Multiple Years*. Washington DC: United States Department of Justice, Federal Bureau of Investigation. Available from https://ucrdatatool.gov/Search/Crime/State/StateCrime.cfm



A Pandemic Policy

Essay Contest

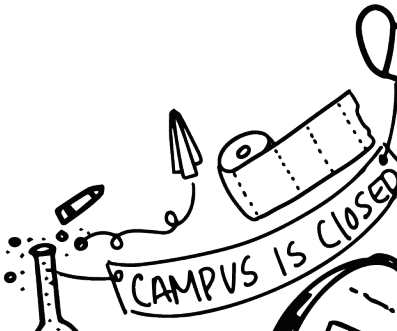
Foreword

I recall ignorantly reassuring myself that emergent pandemics always seem to fizzle out abroad sometime in Spring 2020. As of this writing less than a year later, more than 400,000 have died of Coronavirus Disease in the United States and upwards of two million have died globally. The sudden and explosive emergence of the COVID-19 pandemic led to a dramatic human response. Millions of people across the globe shifted to remote work while millions more found themselves unemployed and/or returning to farm from city. Fear of contagion collided with fear of economic catastrophe and the dust is yet to begin to settle as we hope our most recent peak in cases and deaths is not another false summit. These remarkable events led to a rush to respond individually and collectively.

We challenged Weber State University students to critically examine policies and social phenomena related to pandemics by launching the Pandemic Policy Essay Contest just as the first wave of the COVID-19 pandemic was cresting. Despite facing a time of unprecedented uncertainty and personal challenge related to the pandemic, our students answered that challenge by producing many outstanding essays. This special section of ERGO contains six of those essays. These essays provide diverse viewpoints on a broad set of pandemic-related topics ranging from the special and heroic role played by public health workers during COVID-19 outcomes to virtual contagion in World of Warcraft. I learned a great deal from each essay, and I hope you enjoy reading them as much as I have. They show that our students are prepared to think critically about the complex issues related to pandemics.

Gavin Roberts

Assistant Professor | Department of Economics



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Marketing

Niki Tonks
Goddard School of Business and Economics

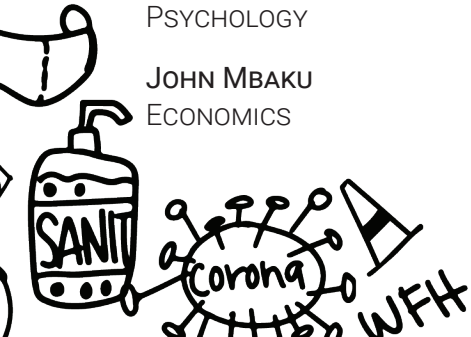
Essay Judges

Rebekah Cumpsty
English

Francois Giraud-Carrier
Supply Chain Management

Sarah Herrmann
Psychology

John Mbaku
Economics



COVID-19: The Illumination of an Unjust Society

Najite Achebo

The year of 2020 has been an exceptionally difficult year for all. With unemployment rates approaching the magnitude of The Great Depression and a nationwide uncertainty as to what the following months will look like, Covid-19 has certainly brought tensions and emotions to an all time high. We are all living in a time where it is more important than ever to take a critical look at the state of our country, and ask ourselves what we can do to help. Adding to the hysteria of this country was the recent murder of George Floyd, an innocent black man that was victim to the systemic monstrosity of this country that is racism. His untimely end has thrown coal in the flames of civil rights, a fire that has been blazing righteously for decades. People of color have been continually failed by this nation and Covid-19 has magnified those failures. While all people of color are being affected by this pandemic, I would like to specifically focus on African Americans and how this pandemic has brightened the spotlight of the injustices that we have endured since the birth of this country. In this essay, we'll explore African Americans' predisposition to disease and what it means during this pandemic, how African American's treatment by the country affects us, past and present, and how Covid-19 is affecting African Americans in urban communities.

African Americans are disproportionately affected by a wide array of diseases and conditions, much more often than their causcasion counterparts. Doctors are finding many illnesses that typically affect elderly populations of other races in African Americans at a more frequent rate. Not only that, but they are seeing these diseases in African Americans at much younger ages (Sowemimo, 2020). One may assume this is because African Americans may have lifestyle traits that lead to these diseases. The true culprit, however, is actually a multifaceted web of events and circumstances that span years and years back. This topic could be an essay on its own, but to give a little insight: lifestyle certainly plays a part, but limited access to healthcare and genes passed down from generations of mistreated African Americans from the era of slavery are also pieces of the

puzzle. Compounding on top of that, African Americans oftentimes live in what is known as a food desert. A food desert is defined as an urban area in which it is difficult to buy affordable or good quality fresh foods. In these environments, it is no wonder why individuals are suffering from more health complications; it is a struggle in and of itself to find fresh produce to nourish themselves and their families. For instance, in a food desert, it may be very difficult to get fresh greens like spinach or affordable nuts like almonds. Both of these foods are a very nutrient dense source of Vitamin E and potassium. These nutrients help regulate your brain's communication with your muscles, and lacking them can cause serious complications. Without access to foods like this it makes sustaining one's health much more difficult. Due to factors such as these, African Americans are more likely to suffer from: asthma, heart disease, high blood pressure, diabetes, various cancers, peripheral artery disease, and other diseases (Sowemimo, 2020). This is especially problematic during this global pandemic because coronavirus is most threatening to those who are elderly and those who have preexisting health conditions. To help illustrate this problem, the American Heart Association reports that the death rate from cardiovascular disease is 33% higher for African Americans than for the overall population(Carnethon et al., 2017). Furthermore, they report that African Americans are twice as likely to have a first stroke and are more likely to die from one than their caucasion counterparts. To make matters more dire, African American communities are having higher Covid-19 related statistics for reasons that I will detail later in the essay. Not only are African Americans getting the coronavirus at higher rates, they also tend to have a worse prognosis from the disease. According to the Center of Disease Control: African Americans are contracting Covid-19 2.6 times more often; are being hospitalized 4.7 times more often; and have died from Covid 2.1 times more often than the caucasion population (Center of Disease Control, 2020). After exploring these topics it is clear that Covid-19 is negatively impacting African Americans' significantly more than the rest of the average population.

The health of African Americans is certainly intriguing, and when we look at the reasons why these factors exist, the story unfolds. The impact of slavery has had tremendous lasting effects on our society

and we are still feeling the ripples from its widespread atrocities. To grasp this idea, a history lesson is required. In 1865, the 13th Amendment was signed, which formally abolished the possession and use of slaves in the United States. Although, one clause in the 13th amendment states, “Neither slaver nor involuntary servitude, except as a punishment for crime whereof the party shall have been duly convicted, shall exist within the United States”(U.S. Const. amend. XIII). This abhorrent section of the constitution is currently being exploited, legally allowing prisons to use their incarcerated inmates as modern-day slaves. Anyway, slavery was removed from the law of the land, but this did not mean that the pain and suffering was over. Succeeding slavery were laws called Black Codes. These laws were a collection of discriminatory measures intended to keep the ideals of white supremacy alive in the U.S. They seized African Americans’ right to vote, to serve on a jury, and in some states they were not even allowed to own land (History.com Editors, 2010). These events caused a large number of African Americans to move from the south, many of which arrived in urban environments like Chicago or New York. Following these codes were the Jim Crow laws: another nationwide measure to keep African Americans oppressed and under their control. Their purpose was to make sure that all elements of everyday life of African Americans were as separate as possible from caucasions (History.com Editors, 2018). Fast forward to 1964 when president Lyndon B. Johnson signs the Civil Rights Act which finally puts an end to legal segregation. This historical event filled many hearts with joy during this time, however it short lived, as it was followed by a catastrophic incident: President Richard Nixon’s declaration of The War on Drugs. The public purpose of The War on Drugs was to curtail the apparent rising drug use in America, however it’s true agenda is lesser known. In 1968, one of President Richard Nixon’s key advisors said in an interview, “we couldn’t make it illegal to be black, but by getting the public to associate blacks with heroin, and then criminalizing it heavily, we could disrupt those communities. We could arrest their leaders, raid their homes, break up their meetings, and vilify them night after night on the evening news. Did we know we were lying about the drugs? Of course we did”(LoBianco, 2016). What ensued was the mass incarceration of African Americans to the point where in 2020 one out of every three black men can expect to go to

prison at one point in their lives (Knafo, 2013). As mentioned earlier, the 13th amendment legally allows prisons to treat their inmates as cogs in the capitalistic machine of America. African Americans are apprehended under the pretenses of justice, then are forced to do the same amount of labor that their ancestors were doing back during times of slavery.

This exposition is required to illustrate that times are not so different from the way they were back then. Over the course of history, African Americans have experienced an overarching lack of opportunities. We have been ushered out of where we grew up, whether it be from segregation or continual gentrification of our neighborhoods; we have been starved of vital foods and produce that are needed to live a healthy life; and we have been explicitly targeted by the law enforcement agencies for decades. These issues have been plaguing us since the 1800s, and now with the arrival of Covid-19, matters have only gotten worse.

African Americans have been extensively pursued by zealots of supremacy, which caused a large number of the population to reside in urban areas. Unfortunately, life in areas like this is not necessarily easier, especially during this covid 19 pandemic. In April 2020, it was reported that 72% of those who died in Chicago due to covid were African American, despite the fact that Chicago's population is only about 33% African American (Perrett, 2020). There are several factors that go into explaining the sad reality of this situation. One reason that African Americans are being disproportionately affected by Covid-19 in urban environments is their living situations. Many African Americans (especially those in poverty) are living with several family members in very close quarters such as apartment complexes, making social distancing quite the difficult task. Another reason that explains this is that many African Americans work essential jobs that are not in healthcare such as working as a bus/subway driver, working in grocery stores, construction, etc. Furthermore, those who live in these environments often rely on public transportation to get where we need to be, which also increases their exposure. All that being said, the most critical reason why African Americans are being hit harder by Covid-19 is the scarce availability of affordable healthcare. In many urban communities across the country, individuals who may be having symptoms may not have life insurance, and are afraid of

the financial repercussions that may ensue after seeking treatment. The lack of affordable healthcare is something that affects the entire nation, but in times of critical medical need, communities that have such large populations without insurance are experiencing unfortunate consequences. These statistics are glaring examples of the injustices that have been inherited by African Americans.

At this time it is clear that many African Americans are living in a world where so many factors are stacked against them, and this Covid-19 pandemic has made so many of the challenges that we face so much harder. We've explored how the health of African Americans has a complicated history, how African Americans have been failed since we were first given our "rights", and how we're being failed everyday by the systems that are intended to sustain and protect us. All this being said, African Americans continue to hold their heads high with strong resolve and passion, just as our ancestors did long ago. We refuse to be resigned to the fate of being misfortune souls. This pandemic is testing the strength of us all, but we do not intend to be knocked down easily, and we never have. Injustice is not something that can be solved overnight, it cannot even be solved over the course of a few years. Be that as it may, it will never be corrected until the whole nation acknowledges these injustices with true empathy and honesty. Only then can we band together as a nation and tackle these problems. We have a long way to go before we can say that we've reached a semblance of equality, but our hope always stands tall.

References

Carnethon, M. R., Pu, J., Howard, G., Albert, M. A., Anderson, C. A., Bertoni, A. G., . . . Yancy, C. W. (2017). Cardiovascular Health in African Americans: A Scientific Statement From the American Heart Association. *Circulation*, 136(21). doi:10.1161/cir.0000000000000534

Center of Disease Control. (2020, August 10). COVID-19 Hospitalization and Death by Race/Ethnicity. Retrieved August 20, 2020, from https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-race-ethnicity.html

History.com Editors. (2010, June 01). Black Codes. Retrieved August 20, 2020, from *https://www.history.com/topics/black-history/black-codes*

History.com Editors. (2018, February 28). Jim Crow Laws. Retrieved August 20, 2020, from https://www.history.com/topics/early-20th-century-us/jim-crow-laws

Knafo, S. (2013, October 04). 1 In 3 Black Males Will Go To Prison In Their Lifetime, Report Warns. Retrieved August 20, 2020, from https://www.huffpost.com/entry/racial-disparities-criminal-justice_n_4045144

LoBianco, T. (2016, March 24). Report: Nixon's war on drugs targeted black people. Retrieved August 20, 2020, from https://www.cnn.com/2016/03/23/politics/john-ehrlichman-richard-nixon-drug-war-blacks-hippie/index.html

Perrett, C. (2020, April 12). Black people account for 72% of COVID-19 deaths in Chicago while making up less than a third of city's population, mayor says. Retrieved August 20, 2020, from https://www.businessinsider.com/covid-19-chicago-72-percent-black-mayor-says-2020-4

Sowemimo, F., Dr. (2020, February 27). 7 Common Health Concerns African Americans Should Monitor. Retrieved August 20, 2020, from https://www.centrastate.com/blog/7-common-health-concerns-african-americans-should-monitor/

Pandemic Policy Essay

Alyssa Casselman

On September 13, 2005, a plague known as The Corrupted Blood Incident infected millions of virtual players due to a coding error in the massively multiplayer online role-playing game (MMORPG), *World of Warcraft*. Though this unintentional plague occurred on a virtual platform, it has been researched as an epidemiological human response model relative to real-life pandemics.

In September of 2005, *World of Warcraft* game developers released a new quest in the area of Zul'Gurub, where one must battle Hakkar the Soulflayer, a dragon-like figure who drains the blood of virtual players to replenish his own amid combat. In a desperate attempt to defeat Hakkar, one must intentionally poison their own blood with a dangerous and highly contagious disease. This infection, known as "Corrupted Blood", slowly depletes the player of their health, and unless healed, they will die. As players attempted this new quest, an unintentional glitch in the system occurred allowing one's pet companion to become infected with the disease if summoned at point of contact, thus originating the spread of the contagion.

Succeeding battle, players often return to highly populated cities to heal, to interact with others and level-up one's character. For many, what was intended to be a peaceful encounter in the city, quickly became a deadly one as diseased pet companions were summoned, infecting anyone in close proximity. Curiously, non-player characters displayed no indication of infection, becoming asymptomatic and thus furthering the uncontrollable spread of the disease. Mass outbreaks soon occurred, revealing the immediate human reaction to the virtual pandemic from those behind the screen.

Upon realization, some players reacted by evading cities, others with healing powers urgently tried to help those around them, curiously, a few players even went to the extreme measures of intentionally infecting others. Game administrators quickly responded by announcing to players they could participate in a voluntary quarantine by fleeing to rural areas of the game where they would avoid coming in contact with others. Unfortunately, these efforts among players and game administrators failed, as some chose not

to participate in the optional quarantine in addition to the highly contagious nature of the disease which caused it to spread quickly, infecting healers, and soon it had wiped out entire populations.

It took nearly a month for game developers to come up with a solution regarding the Corrupted Blood Incident. Options for addressing the issue included checking every pet in the entire game for infection or examining each pet upon summation, both requiring a timely execution, which would result in an inefficiency in containing the disease (Messner, 2019). Eventually, developers created an update that made infection of pet companions impossible, containing the once rapid and uncontrollable spread of Corrupted Blood.

Blizzard Entertainment's *World of Warcraft* had an estimated 4 million subscribers at the time of the incident and epidemiologists argue that the initial reactions to this unprecedented virtual plague could in fact be authentic human behavior in comparison to real-life pandemics.

Epidemiologists Eric Lofgren and Dr. Nina Fefferman studied the Corrupted Blood Incident as it occurred, being World of Warcraft subscribers themselves. The pair published a research paper in September of 2007 drawing the potential for experimentation between the virtual and real world, to support their argument the article states:

> Players in World of Warcraft can become highly involved in the game, investing not only their monthly fee but also hours of time within the game. Some challenges in the game require players to set aside several hours on 3 or 4 days of the week. Friendships are formed within the game…Research into the behavioural and emotional involvement of game players, and their relationship with their virtual selves has shown that reactions to events in the game world can have serious, emotional repercussions (Lofrgren, 2007).

Evaluating the Corrupted Blood Incident, the parallels between what happened in the virtual world of 2005 and what is happening in the real world today amid the COVID-19 pandemic are staggering. A voluntary quarantine suggested by leaders that some chose to participate in, while others disregarded it. Healers risked their own lives to aid those around them at the possibility of exposure in addition to a lack of testing available to contain the disease, even

those who thought it would be humorous to infect others around them. Finally, the pandemic was not contained until the creation of some sort of immunity, or vaccine, was administered to those infected. Lofgren has recently revisited the topic as the COVID-19 pandemic continues to reign throughout the world:

> For me, it was a good illustration of how important it is to understand people's behaviors… it's a virus that's spreading between people, and how people interact and behave and comply with authority figures, or don't, those are all very important things… You can't really predict 'oh yeah, everyone will quarantine. It'll be fine.' No, they won't… People aren't intentionally getting people sick…but willfully ignoring your potential to get people sick is pretty close to that. You start to see people like 'oh this isn't a big deal, I'm not going to change my behavior. I'm going to the concert and then going to see my elderly grandma anyway.'…Epidemics are a social problem (Fenlon, 2020).

The virtual Corrupted Blood Incident that occurred back in September of 2005 seemed to hauntingly foreshadow the current world of the COVID-19 pandemic. Though based off an online platform, it has been studied by epidemiologists as a potential representation of human response to a life-threatening and uncontrollable contagion. It seems that the common theme between both pandemics is the interaction between human beings, and how they initiate response to infectious disease. To reiterate what Eric Lofgren stated, "Epidemics are a social problem" (Fenlon, 2020) and it is the community's responsibility to respond appropriately.

References

Fenlon, W. (2020, March 13). T*he researchers who once studied WoW's Corrupted Blood plague are now fighting the coronavirus.* PC Gamer. https://www.pcgamer.com/the-researchers- who-once-studied-wows-corrupted-blood-plague-are-now-fighting-the-coronavirus/

Lofgren, E.T., & Fefferman, N.H. (2007). The untapped potential of virtual game worlds to shed light on real world epidemics. *The Lancet: Infectious Diseases*, 7(9). https://doi.org/10.1016/

S1473-3099(07)70212-8

Messner, S. (2019, August 26). *How Blizzard coped with World of Warcraft's blood plague and other early disasters.* PC Gamer. https://www.pcgamer.com/how-blizzard-coped-with- world-of-warcrafts-blood-plague-and-other-early-disasters/

Olivetti, J. (2018, March 17). T*he game archaelologist: World of Warcraft's corrupted blood pandemic.* Massively Overpowered. https://massivelyop.com/2018/03/17/the-game- archaeologist-world-of-warcrafts-corrupted-blood-pandemic/

Rear, J. (2020, February 13). Corrupted Blood and coronavirus: what World of Warcraft can tell us about the spread of disease. *Telegraph.Co.Uk.* Retreived April 24, 2020 from https://search-proquest-com.hal.weber.edu/docview/2354573217?pq-origsite=summon

Sydell, L. (2005, October 5). *'Virtual' virus sheds light on real-world behavior*. [Audio podcast]. NPR. Retrieved from https://www.npr.org/transcripts/4946772

ERGO

The Pandemic Paradox

Nathan Hole

As cities ground to a halt and nations were brought to their knees by an unseen threat, the Earth appeared to stand still. As the natural world adapted to our sudden absence, headlines sprung up from around the globe with scenes depicting how "nature is healing" and wildlife had begun reclaiming cities in lockdown: dolphins swimming in Venetian canals;[1] drunk elephants sleeping in a tea garden.[2] From the worldwide silence a new refrain quickly became familiar: "*We are the virus*." The hashtag spread rapidly, racking up millions of clicks and posts across all social media platforms in extraordinarily little time cataloguing stories around the world of how nature was shaking off the shackles that humanity had imprisoned her with. These stories occupied our quarantined lives and filled us with hope of a better tomorrow. A "new normal" where humanity recognized our faults and learned to live in greater harmony with nature. However, most of those stories were sadly not true.

If those stories were spreading little more than false hope, what was happening to the Earth and where were they all coming from? For starters, the Earth was truly undergoing a period the likes of which had not been seen since the pandemic of 1918, and this change was likely even greater due to the technological era we now find ourselves in. Noise pollution, which degrades health and productivity,[3] decreased significantly around the world including up

1 Yahoo, "Venice's Canals Are Beautifully Clear and Dolphins Are Swimming Through Its Ports As Italy's Coronavirus Lockdown Cuts Down on Water Traffic." Yahoo. March 18, 2020. https://www.yahoo.com/lifestyle/venices-canals-beautifully-clear-dolphins-213945552.html

2 James Crowley, "These Drunk Elephants Are Wreaking Adorable Havoc and Living Their Best Lives." Newsweek. March 19, 2020. https://www.newsweek.com/drunk-elephants-twitter-reddit-photo-1493235

3 Nathaniel Mead, "Noise Pollution: The Sound Behind Heart Effects." Environmental Health Perspectives. Environews. November, 2007. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2072857/

to 90% in parts of Paris.[4] Even CO_2 emissions fell between 17-26%[5] along with improvements in air quality around the world,[6] helping clear the air in the most polluted cities. As for the Venetian dolphins and tea garden elephants? The dolphins were filmed hundreds of miles away while the elephants never actually did have that nice, drunken slumber.[7] Our sudden at-home isolation fed a frenzy of misinformation and misleading narratives as we dove into the rabbit hole of social media; grasping for something to bring us hope in an world suddenly upended. For decades, media has thrived from the sensationalized. The "new normal" fueled that thirst even more as the battle for clicks, likes, and views intensified. In an information age where the internet more closely resembles the Wild West than modernity and proven facts are often replaced with the "alternative," this battle culminated in a narrative that nature was taking advantage of our absence and "healing" in every place we seemed to have contributed to the damage. However, a few examples of "fake news" cannot discredit the whole. Closer inspection is needed to validate the authenticity of natural rebound from The Great Indoor Migration.

The allure of the untamed and the Westerner's intrigue of a safari fueled the multimillion-dollar[8] tourism industry in Kenya and many other parts of African savannah. What would be more awe-inspiring than seeing the same wildlife we grew accustomed to in

4 Phys.org, "Taking the measure of noise pollution during COVID lockdown." Phys.org. July 3, 2020. https://phys.org/news/2020-07-noise-pollution-covid-lockdown.html

5 Corinne Quéré et al, "Temporary reduction in daily global CO_2 emissions during the COVID-19 forced confinement." Nature Climate Change. May 19, 2020. https://www.nature.com/articles/s41558-020-0797-x

6 Marco Hernandez, "This is the effect coronavirus has had on air pollution around the world." World Economic Forum. April 21, 2020. https://www.weforum.org/agenda/2020/04/coronavirus-covid19-air-pollution-enviroment-nature-lockdown

7 Natasha Daly, "Fake animal news abounds on social media as coronavirus upends life." National Geographic. March 20, 2020. https://www.nationalgeographic.com/animals/2020/03/coronavirus-pandemic-fake-animal-viral-social-media-posts/

8 World Tourism Organization, "Towards Measuring the Economic Value of Wildlife Watching in Africa." United Nations. 2015. 34. https://sustainabledevelopment.un.org/content/documents/1882unwtowildlifepaper.pdf

zoos in their natural habitats, demonstrating a complete display of the circle of life? Safaris not only support local conservation efforts of species as well as economies, but also act as protection for those species.[9] With the combined presence of ecotourists and armed patrols, poachers were often less inclined to hunt. When the tourists quit coming, many were worried that poaching would increase; however, the patrols were deemed essential and the feared spike has been largely avoided. Other regions were not so lucky. In Asia, where patrols and tourism are not as widespread, the story played out a bit differently. As the lockdowns began many workers lost their jobs and were forced to move back to their villages where few opportunities for income remain. They quickly became desperate, accepting money to help poachers and even poaching themselves out of need for food.[10] This ultimately led to significant increases in illegal wildlife killings which increases the interactions humans have with wildlife.

Across the oceans, activists and advocates have been fighting for the Amazon, the "Lungs of the Planet." Following the election of President Bolsonaro, they seemed to be fighting an uphill battle as he sought to dismantle key environmental protections in much the same way we have seen recently in the United States. At the onset of the COVID-19 pandemic, they were hoping to gain ground as industry shutdowns would avert the rise of deforestation in one of the most important ecosystems on Earth. Unfortunately, Brazil's handling of the pandemic caused the opposite to happen. Legal logging companies shut down, thus handing a win to criminal groups that increased their presence. Rather than decreasing, deforestation in the sensitive Amazon region rose dramatically even surpassing previous rates.[11] Similar to what we saw in Asia, workers from rural areas needed a replacement for their lost income and criminal groups often held the

9 Dina Fine Maron, "Poaching threats loom as wildlife safaris put on hold due to COVID-19." National Geographic. April 10, 2020. https://www.nationalgeographic.com/animals/2020/04/wildlife-safaris-halted-for-covid-boost-poaching-threat/

10 Aniruddha Ghosal and Michael Casey, "Coronavirus lockdowns increase poaching in Asia, Africa." Associated Press. June 21, 2020. https://apnews.com/9df0cc21045578ad86696bc05721c706

11 DW, "WWF: Rainforest deforestation more than doubled under cover of coronavirus." DW. May 21, 2020. https://www.dw.com/en/wwf-rainforest-deforestation-more-than-doubled-under-cover-of-coronavirus/a-53526064

answer. With decreased enforcement came increased opportunities and Brazil saw a 55% increase in deforestation. Other countries saw deforestation more than quadruple as a direct result of the pandemic as reported by the World Wildlife Fund (WWF).[12] None of these issues are new. Deforestation and poaching have occurred throughout history with regulation having varying degrees of success. So why is now any different? One reason is that we are beginning to understand that these activities that are rising due to our reactions to pandemics, risk creating a paradox that increases the chances of another pandemic. This paradox could be the most significant and overlooked product of the pandemic should we ignore it and attempt to continue business as usual. To understand what we are looking at we must first look to the past. After all, history repeats itself, does it not?

In the First Century CE Rome was reaching its golden age of growth: expanding to the horizons, conquering and taming the land wherever it went. As it grew, so did demands for resources and food. This led to large swathes of forest being converted to agricultural land. Due to the poor understanding of the cross sections between nature and civilization, predictable consequences were instead seen as punishment by the gods. While deforestation became more widespread, the ecology of the land beneath them began to change. Water tables increased, flooding worsened, and standing water became more prevalent which in turn were perfect breeding ground for mosquitos. These little pests became pervasive, spreading disease that appeared more and more rampantly.[13] Yet it was not the punishment from the gods many believed it to be, but a consequence of their own actions that contributed to their downfall. Rome was not the only great civilization that helped bring about their own demise by ecological destruction. Research indicates that many others around the world traveled the same path, from Asia to South America, including the ancient Maya.[14] Many fell victim to the foleys of thinking

12 Susanne Winter, "Mehr Wald geht durch Corona verloren." World Wildlife Fund. May 21, 2020. https://blog.wwf.de/wald-corona/

13 Lara O'Sullivan et al, "Deforestation, Mosquitoes, and Ancient Rome: Lessons for Today." *Bioscience* 58, 8 (2008): 756-760, https://doi.org/10.1641/B580812

14 Robert J. Oglesby et al, "Collapse of the Maya: Could Deforestation Have Contributed?" *Journal of Geophysical Research Atmospheres* 115, D12 (2010), https://doi.org/10.1029/2009JD011942

that nature could be tamed.

The Zika virus which was spread by mosquitos and infamous for causing birth defects throughout South America in the 2010s is another good example of this. It thrives in the heat and humidity of Brazil. As deforestation increased, so did drought. This led to more openly-stored water which increased mosquito populations and led to a higher occurrence of mosquito-human interaction which allowed the disease to spread.[15] The same thing is being investigated in Africa as well with deforestation being linked to almost 30 outbreaks of Ebola in the past 30 years.[16] The Centers for Disease Control and Prevention found in Brazil that areas with high rates of deforestation were associated with a 48% increase in malaria cases,[17] while another study found that mosquitos bit 278 times more frequently in similar areas.[18]

Turning our attention to our own dilemma and temporary "downfall" at the hands of COVID-19, it's becoming more and more likely that one of many reasons coronavirus became a zoonosis (a disease transferred from animals to humans), is due to habitats being destroyed throughout China. As more land was cleared for agriculture and development humanity began encroaching more frequently into these areas where the disease was naturally found, and the chances of a transmission grew. As with Rome, it was not the mosquitos' fault that they carried the virus, but our fault for encroaching and creating the habitat that helped them breed most easily. Scientists are finding that this more common in terms of major disease outbreaks throughout history. It is becoming apparent that our actions have

15 Jim Morrison, "Did Deforestation Contribute to Zika's Spread?" Smithsonian Magazine. June 8, 2016. https://www.smithsonianmag.com/science-nature/did-deforestation-contribute-zikas-spread-180959305/

16 Jésus Olivero et al, "Recent loss of closed forests is associated with Ebola virus disease outbreaks." *Scientific Reports* 7, 14291 (2017). https://www.nature.com/articles/s41598-017-14727-9

17 Sarah H. Olsen et al, "Deforestation and Malaria in Mancio Lima County, Brazil." *Emerging Infectious Diseases* 16, 7 (2010). https://wwwnc.cdc.gov/eid/article/16/7/09-1785_article

18 Amy Y. Vittor et al, "The effect of deforestation on the human-biting rate of Anopholis darlingi, the primary vector of Falciparum malaria in the Peruvian Amazon." *The American Journal of Tropical Medicine and Hygiene* 74, 1 (2006): 3-11. https://pubmed.ncbi.nlm.nih.gov/16407338/

contributed to our current situation and certainly have the potential to worsen it, as well as repeat it in the future.

Enter the paradox. As was briefly mentioned earlier, it is highly possible for diseases like COVID-19 to cross to us through increased human-animal interactions because of poaching, deforestation, and other destruction of habitats. This has led to lockdowns that have increased the rate of these activities around the world, sometimes dramatically, and especially where policy fails to address the problem. In turn, more deforestation and poaching increase the likelihood of encounters with wildlife carrying a disease which is then passed to humans, resulting in yet another pandemic of epic proportions. We are, therefore, fueling a positive feedback loop of our own creation, a system in which the product of a reaction leads to a greater reaction. If we continue down this path, then another pandemic is almost a certainty as humans and animals increasingly share the same spaces.[19] For many years, our methodology has been to react to the spread of diseases, only attempting to do something about them after they have appeared. Whether that reaction was mitigation, vaccination, or medicine to treat the diseases that could not easily be inoculated. There is, however, another route. A path in which we decrease wanton ecological destruction, lowering our chances of another pandemic. Rather than mere reaction, this approach would require prevention, all the while working to maintain the fragile balance in the ecosystems of which we are a part. By ramping up research into virus-containing regions we can also find diseases before they become problematic.[20] Furthermore, with policies that protect the world around us and enshrine the rights of nature we protect the economic benefits these habitats inherently have by preventing and protecting us from disease and other natural disasters. However, the biggest change of all may be a paradigm shift.

Imagine for just a moment, that the accusations being

19 Stanford University, "Forest loss could make diseases like COVID-19 more likely, according to study." World Economic Forum. April 15, 2020. https://www.weforum.org/agenda/2020/04/forest-loss-diseases-covid19-coronavirus-deforestation-health

20 Jim Robbins, "How Forest Loss Is Leading to a Rise in Human Disease." Yale School of the Environment. February 23, 2016. https://e360.yale.edu/features/how_forest_loss_is_leading_to_a_rise_in_human_disease_malaria_zika_climate_change

leveled by the media were not as far off as we initially thought. Global population is on the rise, and with it demand for land to feed and support countless people all over the world. Most of this growth will occur in regions that are most susceptible to deforestation and habitat degradation. When coupled with climate change, this land use change means novel diseases are not only a possibility, but an inevitability. We often treated the tree as simply an obstacle to be moved, when it is, in fact, a buffer to our own health and security. Without that extra buffer, a virus, something so small as to appear seemingly invisible, can cause societies of even the most powerful nations and civilizations to run aground all because of our lack of understanding of the interconnections of the planet and the consequences of our actions. Throughout much of modern history we have seen ourselves as separate from nature; a greater force whose mandate was to enslave the land.

Judging by how we are now seeing the consequences of many years of complacency, it would not be difficult to come to the same conclusion the media came to. *We ARE the virus.* Why, then, did all of us so adamantly cling to these stories of hope and restoration if we caused the problems in the first place? Maybe it is because we felt obligated to discover a vaccine to inoculate the environment against the biggest threat of all, humanity. What is this vaccine? Our relationship with the natural world. Despite contrary belief, we are not separate from nature any more than Earth is separate from the Universe. We evolved together. One entity with many branches. John Muir once said, "When one tugs at a single thing in nature, he finds it attached to the rest of the world." So too are we attached to nature, our destinies intertwined. This shift in our mindset is potentially the most important preventative tool we have, and with it, the key to preventing the pandemic paradox.

Xenophobia is Not the Answer

Erica A. Lande

Helping non compatriots is seen as charity rather than justice. Harassing people is excused rather than exposed. Within the United States and around the world everyone is struggling to cope with COVID-19 as it affects friends and families. But, some people are also trying to cope with facing others in the streets in fear of getting harassed, instead of catching symptoms of COVID-19. As the coronavirus spread from China so has the spread of anti-asian xenophobia in many communities. Xenophobia is prejudice towards people from other countries. Xenophobia negatively impacts its victims as well as its perpetrator. Nonetheless, it affects everyone and is unwarranted at all times, including during a pandemic. COVID-19 is not the "Chinese virus" nor is it some conspiracy theory. In previous epidemics, such as the spanish flu nearly one hundred years ago, xenophobia re-emerged amongst the masses without awareness. Xenophobia during pandemics leaves a breadcrumb trail of further implications on the economy and social order.

The 1918 Spanish Flu's name shows the causal relationship between foreign populations and the spread of the disease (Hoppe, 2018). For centuries, there has been an irrational and ingrained sense that foreigners carry diseases. As A. David Napier, a professor of medical anthropology and director of the Science, Medicine, and Society Network at University College London, argues that there is an "urgent need to rethink the relationship between epidemics and xenophobia, and to ask how new knowledge might dampen, if not completely reverse, the human tendency to take bad meaning over no meaning, as Nietzsche so aptly put it, reverting to scapegoat narratives that should have no place or register in the multicultural settings that world populations increasingly inhabit" in the wake of new epidemics (Napier, 2017). Moreover, according to Trevor Hoppe, a researcher at the University of North Carolina at Greensboro who a has studied the history of disease names, states that "casting an epidemic as foreign can have potentially diametrically opposed effects: it can be a rhetorical strategy for promoting fear or for reassuring the public of safety" (Hoppe, 2018). Despite whether or

not the name of the virus only promotes a sense of safety, it actually creates a disillusionment of what is going wrong. For instance, during the cholera and typhus outbreaks in 1892, Jewish immigrants were used as a scapegoat for spreading the disease. In accordance to people's xenophobic misunderstanding, "New York City officials selectively quarantined Jewish immigrants, whereas Italians arriving on the same boat were detained for only a brief time" (Hoppe, 2018). Thus, police officers associated the disease with a set of people based on ethnicity rather than potential hosts of the disease from their previous encounters. The name of the disease is not the only blame for xenophobic responses, but also the fixated idea that the origin of the disease's people are responsible. When, this is undoubtedly a fabricated sense of reality.

There are a series of regulations on healthcare representatives from foreign countries that bridge the line between frugality and fairness. During an epidemic or pandemic there are not only implications during the outbreak, but also there are implications that arise years after. In the United States, for example, during the COVID-19 outbreak, there has been a concern for a shortage in healthcare professionals. So, they have considered loosening regulations on qualifications for doctors to practice. This would open up jobs to doctors who had gotten their training outside of the United States. Yet, why has not this come to question prior to a world-wide pandemic? Dr. Arianne Shahvisi studied Natural Sciences at the University of Cambridge, where she also completed an MSc in Astrophysics. She then received her second masters in Philosophy of Physics at Oxford, before returning to Cambridge to begin a PhD in philosophy. In her article, "Austerity or Xenophobia? The Causes and Costs of the "Hostile Environment" in the NHS," she states, "By examining the available data and adjudicating various moral arguments, I cast doubt on the claim that the current charging regulations are cost-effective and fair, and instead show that the government has deliberately and pragmatically produced a "hostile environment" for migrants, despite this very likely generating economic losses" (2019). A "hostile environment" fosters a continuation of legislation with xenophobic underpinnings. For instance, in London in 2010 there were immagration restrictions on "non-EU migrants to 24,100 [people] per year" that later caused

understaffing by nearly 400 doctors in 2018 because of visa restrictions (Siddique, 2010). Dr. Arianne Shahvisi's connection to migration restrictions, out that xenophobia, is interconnected in healthcare and society. In which, this leads to less medical workers per patient and leads to serious problems, especially in the modern day pandemic.

To work towards fighting xenophobia, cosmopolitanism is a good role model. Cosmopolitanism is that every person has the same stature no matter where they are from and therefore is entitled to equal respect under citizenship laws and all statutes (Brock, 2015, p.112). For instance, cosmopolitanism is commonly associated with cities. Cities are more diverse, so cosmopolitanism implies accepting diversity. In "Global Justice, Cosmopolitan Duties and Duties to Compatriots: The Case of Healthcare" by Gillian Brock, the head of the Philosophy Department at the University of Auckland in New Zealand, proposes "Cosmopolitans highlight the responsibilities we have to those whom we do not know, but whose lives should be a concern to us" (Brock, 2015, p.112). In other words, diversity not only is morally better, but it also benefits others. This relates to understaffing in hospitals, because if officials would have shown more compassion and less regulations, they would have had more relief for their health care system. During the COVID-19 crises hospitals have been overwhelmed in the United States. However, like the National Health Service of London, the U.S. has their own restrictions on foriegn medical doctors. In recent events, understaffing is trying to be addressed world wide. Retired doctors and nurses have been called back to the front lines, but what about immigrant doctors with up to date degrees? The emergency has promoted xenophobia as well as xenophilia. The United States Secretary of Health and Human Services, Alex Azar, called on US governors on March 24 stating, "to take immediate action, under applicable state laws, to waive restrictions on licensure, scope of practice, certification, and recertification/relicensure consistent with the changes announced for federal programs" (Chen, 2020). His call for help may be a turning point in healthcare legislation to open up doors to new health care officials from other countries. However, the healthcare system in the U.S. may not have intentionally restricted foreigners based on xenophobia, but their restrictions promoted xenophobia in the United

States.

Xenophobia harms its victims in the short term, and harms its perpetrators in the long term. COVID-19 has spurred a misunderstanding of biodeterminism; xenophobia has spread because of ignorance. Because a massive amount of people revert to scapegoats as the easy answer, the pandemic's limited understanding has shown the intercorrelation between epidemics and xenophobia. Diseases throughout history have labeled sects of people to blame. Even though people have the capability of being informed instantaneously by the media, fellow classmates are being sprayed with Lysol in the face. Fighting harassment and updating restrictions on foreigners will help cure xenophobia.

References

Brock, G. (2015). Global justice, cosmopolitan duties and duties to compatriots: The case of healthcare. *Public Health Ethics,* 8(2), 110–120. https://doi-org.hal.weber.edu/10.1093/phe/phu039

Chen, N. (2020). These immigrant doctors want to help the US fight coronavirus, but they're stuck on the sidelines. *CNN*.

Hoppe, T. (2018). "Spanish flu": When infectious disease names blur origins and stigmatize those infected. *American Journal of Public Health,* 108(11), 1462–1464. https://doi-org.hal.weber.edu/10.2105/AJPH.2018.304645

Napier, A. D. (2017). Epidemics and xenophobia, or, why xenophilia matters. *Social Research: An International Quarterly*, 84(1), 59-81.

Shahvisi, A. (2019). Austerity or xenophobia? The causes and costs of the "hostile environment" in the NHS. *Health Care Analysis*, 27, 202–219. https://doi.org/10.1007/s10728-019-00374-w

Siddique, H. (2010). Agencies. Theresa May: immigration cap will not harm UK economy. *The Guardian*. https://www.theguardian.com/uk/2010/jun/28/theresa-may-immigration-cap-economy

COVID-19 and Systemic American Racism: Disparate Impacts of an Unfeeling Enemy

Caden Schweitzer

The United States is a nation whose history holds the merit of representation in government to be of paramount importance. In a republic with strong democratic underpinnings, public policy should serve as a reflection of the nation's priorities and value sets. Partisanship aside, one would expect to see the commonly held American principles of liberty, freedom, and justice, advanced by the actors Americans freely elect to represent them. Pandemics, such as COVID-19, are often described as an assault. They attack the American way of life by threatening the state of our routines, our economic activity, and our health. President Trump and other officials have often referred to the novel coronavirus as being an "invisible enemy". While these categorizations may be perfectly accurate, they are also incomplete. Pandemics certainly function as assaulting enemy, engaging the United States and her most vulnerable citizens in a slow-going slog for supremacy in which the prize is life and the penalty is death. However, pandemics also function as a light, illuminating structural concerns in government functionality and resource allocation in the way that only a crisis can.

At the time this paper was written, nearly 5.3 million Americans have tested positive for COVID-19 and 167,546 of those diagnosed have passed away (CDC, 2020). This virus could potentially present a serious threat to all Americans, even those in groups at the lowest end of the risk spectrum. With that said, the impacts of this disease have been disproportionally felt by Americans of color, and the clearest disparities in terms of the ratio of deaths to population count have been seen in the black community and the Latinx community (CDC, 2020). Black Americans are 2.4 times more likely to die from COVID-19 than white Americans (Covid Tracking Project, 2020). As with any serious crisis or disaster, those who are most strongly affected are citizens who have already been moving through life without the necessary resources to thrive. Those who lack access to education, high quality healthcare, safe residential communities, political influence, certain workplace protections, and white collar

career pathways even in times of relative national prosperity, inevitably face greater tumult during chaotic times because they have not been afforded the level of privilege necessary to form the bulwark to offer insulation from such instability.

Before delving further into the conditions of inequality responsible for highly disparate levels of COVID-related risk faced by minority groups, it is necessary to briefly explore the conditions which brought us here. There is a prevalent tendency of members of the American public to make the good-faith assumption that because they themselves and their immediate inner circle bear no racial animus, the structures responsible for promulgating racial injustice have already been phased out. This assumption is reinforced by the fact that the overwhelmingly popular desire to end racial discrimination has long been formally codified by the Civil Rights Act of 1964.

Unfortunately, in the United States, there has been a history of discrimination toward Black and Latinx Americans that has led to disparate outcomes. First, there is racial patterning evident in the United States workforce, a symptom of unequal access to opportunities for career advancement. About 25 percent of black and Latinx Americans work in service industry jobs, whereas, only about 16 percent of white Americans work in similar jobs (CDC, 2020). Being employed in the service industry during the COVID-19 pandemic has put families between a rock and a hard place because there are far fewer opportunities to work remotely or socially distance. If essential service workers want to feed their families, then they are forced to choose between a paycheck and their family's health. The workforce is not the only area where black and brown Americans have seen blatant discrimination. Redlining and other discriminatory housing practices used in the past were created to designate areas where the population was minority dense as "hazardous", so new businesses, investors, and real estate developers stayed far away. This led to a lack of access to opportunities for employment and housing that other largely white areas were able to experience during the era. Although redlining and other discriminatory housing practices were banned in 1968 by the Fair Housing Act, nearly 66 percent of the neighborhoods that were deemed "hazardous" by prejudicial surveys are still inhabited by mostly minority residents (Washington Post, 2018). Although the official practice of redlining may have been

blocked by statute, communities have been unwilling to invest the resources necessary to reverse these damages and end the cycle which has allowed generations of Americans of color to grow up in crowded, substandard, and unsafe living conditions.

Our country's clear history of discrimination toward minorities has caused long-lasting economic harm to generations of black Americans that continues to limit their ability to weather a pandemic-like crisis which disrupts normal employment. In a 2016 study done by the Brookings Institute, researchers found that the average white family in the United States has a net worth of about $171,000. By contrast, the average black family in the U.S. has a net worth of $17,150 (Brookings, 2016). Lack of savings and sellable assets means the same stint of unemployment that would incite stress in the average white family can easily lead to food insecurity or homelessness in the average black family. The American dream is that in our land of freedom and opportunity, anyone willing to work hard can rise above the circumstances they were born into to achieve a higher level of material prosperity. As Americans, we should feel disheartened when a significant group among us is consistently falling short of reaching that dream and earnestly seek to identify the barriers which are obstructing their progress.

In addition to the factors of unequal access to employment and housing, another risk factor that has put black Americans at an unequal level of danger during the pandemic is that of lacking access to high-quality healthcare. Khiara Bridges, professor of law and anthropology, has explored the causes of the lower life spans and poorer health outcomes for black Americans and found telling evidence of implicit bias by healthcare providers "can account for inferior health care" and thus "can account for racial disparities in health" (Bridges, 2018). According to the 2005 study conducted by the National Academy of Medicine, "Minorities receive lower-quality care even when insurance, income, age, and conditions are equal" (Bridges, 2018). Bridges and others assert such studies as compelling proof that poverty alone cannot account for the fact that black Americans are more likely be afflicted with chronic illnesses and suffer shorter lifespans. The impacts of unequal treatment by healthcare providers is currently playing out in real time as black Americans are far more likely to die after contracting the COVID-19 virus.

As mentioned earlier in this paper, the national COVID-19 death rate is much higher for minority groups than for white Americans. When comparing deaths per 100,000 people, black Americans die at a rate 2.4 times higher than whites, while the death rates are 1.5 times higher for American Indians and Hispanics (Covid Tracking Project, 2020). However, these disparities tend to be far more shocking in localized urban populations where black Americans are largely confined to more ghettoized neighborhoods. For example, Sherita Golden, a physician writing in the Hopkins Medicine report states, "…in Milwaukee County, Wisconsin, African Americans make up 70% of deaths due to the coronavirus, but just 26% of the county's population" (Golden, 2020). In Chicago, over 75% of all those diagnosed with COVID were either black or Latinx (Johnson, 2020). African Americans are not the only minority group that is being infected at disproportional rates, but the Latinx and Native American communities' uptick in infections as well as deaths are less disparate than the gap between white and black Americans. There are some common risk factors for people of color that Golden outlines, such as: living in crowded conditions, working in essential fields, inconsistent access to healthcare, chronic health conditions, and stress and immunity. The aforementioned redlining and housing discrimination have led to crowded living conditions which makes it nearly impossible to quarantine oneself when living in such close quarters. As I have already stated, minorities in America are also significantly more likely than white Americans to be working in essential and service industry jobs.

I initially made the claim that the COVID-19 pandemic could be a light to offer insight into the often-overlooked problems of racial inequality in the structures of American society. The necessary follow-up question becomes: where do we go from here and what can be done with this information? Bridgette Brawner, professor of nursing at the University of Pennsylvania, has highlighted the importance of acknowledging the predominant role that racism plays in health inequality. Public discourse must emphasize the need for compassion and restorative actions for underserved minority communities, or the pandemic could actually exacerbate inequality. Brawner fears that the issue could be overlooked in the near future, and those communities will continue to suffer while more well-off groups lose interest, instead

choosing to resume life as normal (Johnson, 2020).

With regard to more immediate, substantive policy solutions, there are options to help protect minority communities. Courtney Boen, a professor of sociology whose work focuses on redress of health inequality, has noted the value which diverting public funding towards basic personal protective equipment and free testing could offer (Johnson, 2020). While more ambitious, laws aiming to require that even service industry jobs offer paid sick-leave could be important tools to offer sick employees the fundamental ability to avoid spreading illness to others without facing retributive consequences from their employers.

Most importantly, we must not allow this issue to be forgotten. Injustice tends to gain attention in times when it is most obvious, but it thrives in the shadows. Each of us has a role to play in striving to include all Americans in the bargain of the American dream. To varying degrees, large portions of the American public have been complicit in allowing racial inequality to continue to fester. This complicity is largely not a result of malice, but simply derives from ignorance of living in the sorts of privileged spaces that do not allow someone to see the strife of their fellow man. Addressing issues created by large systems of inequality will require a broad, unified, and motivated coalition. We must aspire to bring others into the fold and as such should not hatefully condemn them for their lack of understanding but engage in open dialogue for the purpose of illuminating the size and scope of the issues that many of us would never dream are still plaguing communities of color. As best explained by Martin Luther King Jr., "Darkness cannot drive out darkness; only light can do that. Hate cannot drive out hate; only love can do that".

Work Cited

"The COVID Racial Data Tracker." *The COVID Tracking Project*, The Atlantic, 2020, covidtracking.com/race.

Bridges, Khiara M. *Implicit Bias and Racial Disparities in Health Care*. 2018, www.americanbar.org/groups/crsj/publications/human_rights_magazine_home/the-state-of-healthcare-in-the-united-states/racial-disparities-in-health-care/.

Credits Greg Johnson Writer , et al. "COVID-19's Assault on Black

and Brown Communities." *Penn Today*, 1 Jan. 1970, https://penntoday.upenn.edu/news/covid-19s-assault-black-and-brown-communities

Golden, Sherita. "Coronavirus in African Americans and Other People of Color." *Coronavirus in African Americans and Other People of Color | Johns Hopkins Medicine,* 20 Apr. 2020, www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/covid19-racial-disparities.

Health Equity Considerations and Racial and Ethnic Minority Groups. 24 July 2020, www.cdc.gov/coronavirus/2019-ncov/community/health-equity/race-ethnicity.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fneed-extra-precautions%2Fracial-ethnic-minorities.html.

Jan, Tracy. "Analysis | Redlining Was Banned 50 Years Ago. It's Still Hurting Minorities Today." *The Washington Post*, WP Company, 28 Mar. 2018, www.washingtonpost.com/news/wonk/wp/2018/03/28/redlining-was-banned-50-years-ago-its-still-hurting-minorities-today/.

McIntosh, Kriston, et al. Examining the Black-White Wealth Gap. 27 Feb. 2020, www.brookings.edu/blog/up-front/2020/02/27/examining-the-black-white-wealth-gap/

Rogers, Tiana N., et al. "Racial Disparities in COVID-19 Mortality Among Essential Workers in the United States." *World Medical & Health Policy*. https://doi.org/10.1002/wmh3.358

Novel Coronavirus (COVID-19): The role and impact of public health professionals during the pandemic.

Lucas Venegas

Through the eyes of an international student, the present pandemic has made a personal mark in many ways. Academically, I (and all students) was thrust into a new educational system. It required quick adjustment and the ability to navigate a rush of online information. Daily routines and processes became obsolete. Distancing from the outside environment and social interactions meant creating a new way of life to maintain or establish good health. Mentally, isolation and loss of identity have stricken our community members, including students like myself. An underlying issue of community mental health emerged to the surface with a new voice.

As a result of my experience, and that of many other students and non-academics in our communities, I found myself motivated to look for explanations to the pandemic and the cascade of events that have followed. The purpose of this essay is to offer an informed opinion toward a more thorough understanding of the pandemic, primarily from the point view of the foundation public health entities that have played a major, yet under-represented, role in response to COVID-19. The present paper provides an initial overview of the background on the role and importance of public health in preventing population-based illness. Secondly, using the present pandemic of Coronavirus, current public health policies and the interaction with governmental actions will be discussed. Finally, the present paper will discuss the stakeholders involved in the response to a pandemic. Among them, federal and state governments, local communities, families and individuals.

The current global health crisis caused by the novel coronavirus, known as COVID-19, has generated significant changes in the perception of everyday life. Limited human interaction resulting from stay-at home orders, social distancing and mask wearing in public, coupled with the unknown and uncertain nature of COVID-19 have altered the daily reality of citizens throughout the world. This infectious disease is bringing the most powerful economies to their

knees, breaking health-care systems, filling hospitals, emptying public spaces, and disrupting all types of normal-life in ways not witnessed by previous generations. However, despite all the chaos created, heartwarming acts of resilience, cohesion, and collaboration have been manifest. Modern-day, real-life heroes exist in every sector, and on all fronts, including professionals working to provide treatment and care such as doctors, nurses and respiratory therapists. Other individuals providing essential goods to the population – such as grocery store employees, farmers, transportation and food suppliers – performing key tasks to keep societies and economies running worldwide. It is also worth mentioning those professionals whose contributions and knowledge provide hope and the possibility of defeating an unpredictable and powerful enemy like COVID-19. Professionals whose main role is the protection and well-being of communities and society. Workers, whose objective and central purpose is public health. I refer specifically to the applied task force of scientists, guided by epidemiology, biomedical science, statistics, and social and behavioral science, the research areas which provide a framework for fighting this pandemic. These professionals are public health workers, a fundamental part of a relentless task force, largely invisible, and unnoticed by many, that has been essential and critical to protecting the health of entire communities, cities, and countries from the devastating effects of COVID-19.

Public Health's definition and role is varied and multidisciplinary. Considered by many experts to be both science and art, public health specializes in preventing disease, prolonging life, and promoting health and well-being. The Constitution of the World Health Organization (WHO) identifies health as a state of being where complete physical, mental and social well-being are all valued and important; stating that health is not merely the absence of disease or infirmity (World Health Organization, 2020). The WHO´s holistic approach to health emphasizes the importance of the entire system (all levels of stakeholders) and refers to the core objectives of public health.

One way to better understand the role of public health is to compare and contrast its field with that of medical practice. Public health, like medical practice, is based on science, but what makes the latter special is that its scientific foundation is a coalition of

disciplines, united by the same objectives: disease prevention and health promotion. While medicine focuses on individual patients, public health regards the community as its patient, trying to improve the overall health of the population. The world of medicine focuses on healing and treatment of patients who are ill, whereas public health focuses on preventing illness at community level (Scheider, 2017). It's important to note that the value of this field of knowledge has led to the collaboration between medicine and public health. Medical providers are being trained to identify risk factors to disease and provide counseling and/or referral to other public health services to treat patients in the area of health behavior; disease and injury prevention. Treating those affected with the virus is important, but given the contagious nature of COVID-19, stopping a pandemic requires more than healing the sick; it requires prevention at the community level (Qualls, Levitt, Kanade, et al., 2017). It requires public health.

Epidemiology, often considered the primary science of public health, is a discipline focused on the study of diseases in human populations (Schneider, 2017). The successful study of any disease, COVID-19 included, is accomplished by tracking and monitoring illness, identifying risk factors by conducting observational studies, and performing outbreak investigation – with the ever important objective of identifying ways to limit the spread of disease (Bartlett & Judge, 1997). Because these latter functions typically occur behind the scenes, public health's role during this pandemic can be associated with the role of an "invisible detective." The public health methods, whether behind the scenes, or on center stage, are especially valuable during an outbreak of an infectious disease, like coronavirus. Epidemiologist play an important role in establishing public health policies to prevent illness and injury. The work they perform has led to the development of vaccinations, including polio. Epidemiologist are now working aggressively to understand the coronavirus to protect the population. In the meantime, practices of social distancing, hand washing, disinfecting of spaces, and wearing of masks in public have been publicly enforced.

Tracking down the source of the outbreak is one of the major roles of epidemiology, and public health during any pandemic. In 2002, when the Severe Acute Respiratory Syndrome (SARS) coronavirus

hit the world, public health was there to help identify the source (Heymann & Rodier, 2004). Public health was also there in 2012 to help identify the source of the coronavirus outbreak known as the Middle East Respiratory Syndrome (MERS) (Mckay & Arden, 2015). Likewise, in 2019 and 2020, public health professionals have been instrumental in identifying the source and mode of transmission of COVID-19 (CDC, 2020).

Since the early days of this pandemic, public health research has suggested that the source of COVID-19 has been attributed to a local sea market in the city of Wuhan, where presumably this virus jumped from animals to humans. At the time of the first news of the outbreak in China, the nature and cause of the virus were unknown. Through epidemiological research, COVID-19 was determined to be an infectious, airborne disease with an incubation period of 2-14 days, which can be transmitted by symptomatic and asymptomatic individuals alike, through respiratory droplets or as the product of sneezing and coughing (CDC, 2020). Knowing the source of an outbreak and method of transmission helps provide public health professionals with information that not only helps prevent additional cases, but also lays the foundation to prevent or limit the spread of future outbreaks (Reingold, 1998).

Since March 11, 2020, the WHO, officially declared the coronavirus a pandemic. From that moment, the role of public health-epidemiology has been a combination of efforts focused on both containment and mitigation measures. Containment involves strategies such as, contact tracing, which has been helpful to detect and stop chains of transmission by isolating individuals and quarantining positive cases. Mitigation goes hand in hand with containment, and involves strategies such as social distancing, the use of protective masks, hand washing, avoidance of large gatherings, stay-at-home orders, isolation, and sanitization and disinfection practices, among others. Based on the collection of data and proceeding analysis of information provided by these measures, it has been possible for public health officials to create and implement the strategy known worldwide as “flattening the curve,” - a concept that was popularized during the early months of the pandemic, created to save thousands of lives and prevent a potential collapse of the health care system.

Epidemiology, thus public health, has relied on statistics to

prevent catastrophic scenarios during this global health crisis. The compilation, analysis and interpretation of statistical information has been relevant to predict death, mortality, morbidity, infection, and hospitalization rates during this pandemic. However, this discipline not only has been important to assess and diagnose the population, but it has also been important to guide actions and policies to improve health during the pandemic. Such actions have been taken at all levels of the community including reorganization of hospital infrastructures to support the volume of patients requiring medical intervention due to COVID-19. Likewise, predictable models that rely on statistics to predict outcomes, have been fundamental in preparing the health care systems for this pandemic. Predictive models that assess and quantify the need of personal protective equipment, testing kits, mechanical ventilators and intensive care unit beds, have been part of an exhaustive analysis of data that public health experts have performed behind the front lines.

To control and gain understanding of an infectious disease like COVID-19, public health has also relied widely on biomedical sciences. Throughout the course of this pandemic, biomedical research has provided evidence regarding this disease, a virus of zoonotic origin, similar to previous coronaviruses (SARS & MERS) spread by air droplets, causing mild to severe symptoms but potentially deadly to individuals with pre-existing conditions.

Biomedical science has also contributed to controlling the spread of the virus using common strategies designed for the general public. Most of these strategies have now become routine, such as wearing protective masks, washing hands, and keep physical distance; all of which have been critical in stopping the chain of transmission of this infectious pathogen. Consider, if you will the phrase "social distancing." In recent months this phrase has gone from being an obscure term, known by few, to a phrase that is understood and used daily, in nearly every household worldwide. The concept of social distancing – one phrase, two words – has spread across the globe simultaneously with the virus that launched the phrase to global popularity, the novel coronavirus, known as COVID-19. It is interesting to note, this new vocabulary, that was unusual a few months ago, is actually not new at all. The phrase was first coined by public health professionals in 2002, the year the world was subject to the

first epidemic of the new millennium, the severe acute respiratory syndrome (SARS). In an article written by David Bell and colleagues (2004) from the WHO, SARS provides a modern example how nonmedical, public health interventions (i.e., social distancing) can contain outbreaks. Nearly twenty years later, after SARS has been forgotten by many, the world is again relying on the role, science, and impact of biomedical science, public health professionals, and social distancing to help win the fight against COVID-19.

COVID-19 has also highlighted the complexity of accessing health care and other economic and social disparities, such as low income, lack of education, work settings (where social distancing or teleworking is not possible, like meat and poultry processing and construction), cultural barriers, and in some cases, even migratory status. Such disparities have negatively impacted some members of racial and ethnic minority groups, making them more vulnerable to contracting the virus or experiencing severe illness, regardless of age. In the United States, African American, Latino and American Indian ethnicities, have shown higher rates of hospitalization or death from COVID-19 compared to non-Hispanic white persons (CDC, 2020). Without social and behavioral sciences, another important science of public health, these findings would be unperceived, creating even more disparities among the population. Social and behavioral sciences make public health a diverse and inclusive discipline that protects and gives voice to those who need it the most. The many sectors of public health and the people involved, have enabled our nation, states, and communities to respond to the pandemic. While much of what is reported in the news is of actions taking place, it is the behind the scenes role of public health that allows us to gain ground on the fight against the virus, saving lives, and restarting the economy.

The above perspective on the pandemic – that of cultural and societal shaping of opportunities of survival – raises ethical issues and questions styles of governing. Political views on the importance of state funded health care for all, regardless of income, or family dynamics are being closely watched. However, the main argument is gaps between public health policy and the desire to restart the economy. Government is caught in the middle, with roles on both sides of the argument. Actions taken on one side, or the other, seem

to further widened the gap due to a lack of public policy and the absolute reliance on government to step in and address inequalities. Effectively addressing these issues requires stakeholders at every level. Should a consistent public policy finally arise to face the effects of COVID 19, it is putting it in practice nationwide which will prove the most complex operation, and of uncertain success when such a myriad of diverse interests are involved. Coherent public health policies involve many actors, different and multiple networks of action to be really effective. With some degree of dismay, and in light of the decades of crucial work of public health sectors to protect citizens, there is no single solution. When administrative and resource management capabilities are weak and act without supervision and unity, even a well-designed public health policy can fail, especially in the public sector.

Personally, as an international student from Colombia, I've observed and been exposed to the disarray we are currently experiencing with the pandemic. My experience growing up in Colombia and time spent in the U.S., has educated me on the necessity of collaboration between government and public health entities. Likewise, I have learned that collective action and well-being should be prioritized over selfish behavior, and polarization and politicization of the pandemic needs to be minimized, so as not to undermine science-based policymaking. It is not a matter of respecting the role of other agencies but working together to develop public policies and enforcement of such to protect and care for human life. Egos and political divide complicate such goals.

Lastly, we as a planet must determine if the management of public health by a particular government can be considered effective without concern for its cost in terms of fatality rates is the right thing to do. Or if decisions made on the bases of reaching herd immunity and reactivating the economy versus protecting lives can be considered politically wise during times of elections or else, a crass crime against humanity. Most public policies regarding health give room for winners and losers, in times of social injustice. There is not much point in economic reactivation if the losses in human life make recovery impossible and its scars unforgiveable. In the absence of public policies, the impact will likely extend far beyond that of gaining control over the spread of the virus. There is much to reflect on, during this

challenging time, about the present and future of our care of others.

Public health has a long history of improving health and quality of life for people all across the world. Public health policies have shaped our environments. The present time is no different and as described in this essay, powerfully impacting the course of the pandemic. Conflicting sectors of the government have presented challenges that continue to divide stakeholders on either side. A pandemic is the highest level of public health threat, affecting people across the world. It requires the highest level of collaboration. We all have a responsibility.

REFERENCES

Bartlett PC, Judge LJ. (1997). The role of epidemiology in public health. *Revue Scientifique et Technique*. (2):231-6. DOI: 10.20506/rst.16.2.1020.

Bell, DM., World Health Organization working group on prevention of International and community transmission of SARS. Public Health Interventions and SARS spread, 2003. (2004). *Emergency Infectious Diseases*. 10(11): 1900–1906. DOI: 10.3201/eid1011.040729.

Centers for Disease Control and Prevention. (2020, July 7). Clinical questions about COVID-19: Questions and answers. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/hcp/faq.html#:~:text=Based%20on%20existing%20literature%2C,2%E2%80%9314%20days.

Centers for Disease Control and Prevention. (2020, June 25). COVID-19 in Racial and Ethnic Minority Groups. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/racial-ethnic-minorities.html.

Centers for Disease Control and Prevention. (2020, July 1). Identifying the source of the outbreak. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/about-epidemiology/identifying-source-outbreak.html.

Heymann DL, Rodier G. (2004) SARS: Lessons from a new disease. *National Institutes of Health*. National Academies Press. ISBN-

10: 0-309-09154-3.

Mackay, I.M., Arden, K.E. (2015). MERS coronavirus: diagnostics, epidemiology and transmission. Virology Journal 12**,** 222. https://doi.org/10.1186/s12985-015-04395.

Qualls N, Levitt A, Kanade N, Wright-Jegede N, Dopson S, Biggerstaff M, Reed C, Uzicanin A. (2017). Community mitigation guidelines to prevent Pandemic Influenza- United States, 2017. Centers for disease control and prevention. *Recommendations and Prevention.* 66(1);1-34. DOI: http://dx.doi.org/10.15585/mmwr.rr6601a1

Reingold, A. L. (1998). Outbreak Investigations—A Perspective. *Emerging Infectious Diseases*. Centers for Disease Control and Prevention. Emerging Infectious Diseases (1), 21-27. https://dx.doi.org/10.3201/eid0401.980104.

Schneider, MJ. (2017). *Introduction to Public Health (5th ed.)*. Jones and Bartlett Learning.

World Health Organization (2019, May 31). *Basic Documents*. Retrieved from https://apps.who.int/gb/bd/pdf_files/BD_49th-en.pdf#page=7.

Travel Abstracts

Civics Education in K-12

Myla Andersen
Mentor: Leah Murray | Department: Political Science and Philosophy

2019 Civic Learning and Democratic Engagement Meeting
Fort Lauderdale, Florida

Abstract

This program showcases the various types of teaching interventions for civic learning and examines the outcomes. Problem solving curriculum and a voter simulation were two of the high-impact teaching practices implemented in an elementary school. The problem-solving curriculum taught students to develop a reflective cognitive disposition, and the voter simulation demonstrated the election process. Lastly, a more traditional teaching practice was used in high schools to engage students in local elections.

Seeking Funding to Present at the 9th International Conference on Nemertean Biology in Sylt, Germany

Arusa Ashfaq
Mentor: Brian Chung | Department: Zoology

9th International Conference on Nemertean Biology
Sylt, Germany

Abstract

One can determine the original reason for the existence and interesting variations of biology as life evolved. An interesting evolutionary question is the origin of pain. By tracing the evolutionary origins of physiological and biochemical mechanisms, one can determine the original reason for its existence. In vertebrates, pain is sensed by a pain receptor when a damaged cell releases a neurotransmitter called Substance Pain. Tachykinin receptors (TKRs) are an important family of signaling proteins, under which these Substance Pain receptors can be categorized. The various receptors that fall under this category all share similar genetic sequences, hence their similarity and why they all fall under the same umbrella of TKRs. While these receptors are similar, they are not all the same--TKRs not only convey pain, but also control various other body functions such as regulation of blood pressure and intestinal peristalsis. A majority of our understand on TKRs is focused on their role in pain and stress response in vertebrates, however, little is known of their evolutionary lineage, or if these receptors are found in other phyla of life such as invertebrates. We intend to use nucleotide alignment published TKR genetic sequences in order to determine if the invertebrate *Paranemertes peregrina* contains a TKR within its genome, and what this TKR is utilized for. As an invertebrate, this animal represents a significant evolutionary distance from vertebrates which presents an important milestone in the evolution of the TKR family.

Proving People Wrong: Effects of Perspective and Presentation Modality on Overcoming Misconceptions

Sabrina Badali
Mentor: Shannon McGillivray | Department: Psychology

Society for the Teaching of Psychology's 17th Annual Conference on Teaching
Phoenix, Arizona

Abstract

Misconceptions about psychology are prevalent among the public, and while taking a psychology course is associated with a significant decrease in overall misconception endorsement, some misconceptions appear to be resistant to change (Bensley et al., 2015). However, if asked to think from a more scientific perspective, endorsement rate of some misconceptions may decrease (Amsel et al., 2009). Additionally, it has been found that teaching methods that activate a student's misconception before providing the correct alternative, known as refutational teaching methods, are more effective in dispelling misconceptions than standard teaching methods (Kowalski & Taylor, 2009). The current study investigated the effectiveness of refutational videos versus refutational texts, and a perspective taking condition on overcoming misconceptions in psychology. For each of the four common misconceptions that were chosen, a refutational video and a text-based presentation was created. At pretest, participants completed a misconception questionnaire assessing their belief in misconceptions. Participants were then given their perspective-taking instructions and presented with the refutational lessons. Two weeks later, participants completed the misconception questionnaire again. Results showed that refutational lessons were effective in dispelling misconceptions. Additionally, perspective taking condition had an impact on misconception endorsement. The student-perspective condition was associated with greater reduction in misconception endorsement than the professor-perspective condition. Presentation modality did not affect degree of final misconception

endorsement for participants in the professor-perspective condition. However, in the student-perspective condition, videos were more effective in correcting misconceptions than texts. Results suggest that refutational teaching methods are effective in reducing misconceptions, but the degree of effectiveness can be modified based on the perspective that a student takes while viewing the material.

MyPlate Food Group Consumption Predicts Metabolic Parameters Involved in Chronic Disease

Adam Baker
Mentor: David Aguilar-Alvarez | Department: Athletic Training and Nutrition

Nutrition 2019
Baltimore, Maryland

Abstract

PURPOSE/HYPOTHESIS: We investigated the influence of USDA MyPlate food group consumption on Metabolic Syndrome (MetS) parameters in Weber State students. We hypothesize that variation in the consumption amount and the percentage of daily calorie goals for each of the five food groups (grains, fruits, vegetables, dairy, protein and empty calories) will significantly modulate MetS in the study participants. METHODOLOGY: MetS parameters were measured in 236 Weber State University student participants, ages 18-59 years. Two-day diet records for each participant were collected and analyzed using Diet and Wellness Plus. Multiple linear regression (MLR) analysis was conducted to determine influences of food groups on the MetS parameters. RESULTS/PREDICTED RESULTS: According to the MLR analysis conducted using MetS and food groups as predictors; we found that for every ounce increase of grain, SBP increased by 0.67239 mm/Hg (p =.001). For every one cup increase of dairy, DBP decreased by 0.87999 mm/Hg (p=.001448). For every one cup increase of fruit, Glucose increased by 0.96578 mg/dL (p =.029). For every percentage increase of empty calorie percentage, HDL-C increased by 0.018054 mg/dL (p =.001). Similarly, for every percentage increase of empty calorie percentage, LDL-C increased by 0.014072 mg/dL (p =.005). CONCLUSION Specific food groups accounted for some of the variability of multiple parameters. Among the food groups studied; Grain consumption was the best predictor for systolic blood pressure. Dairy was the most influential for diastolic blood pressure. Glucose was influenced by fruit amount consumption. Empty calorie

consumption was the most important predictor of HDL-C and LDL-C. Finally, details on specific food components within the food groups may help to enhance the models to predict these metabolic parameters.

Novel and Economical Shoulder Model for Bursae Injections

Graeme Beatie
Mentor: Brian Chung | Department: Zoology

Human Anatomy & Physiology Society Annual Conference
Portland, Oregon

Abstract

The numerous synovial joints and bursae of the shoulder are the site of many sports injuries and often require specialized training to diagnose and inject. An injection into any of the bursae of the glenohumeral joint can cause permanent damage if performed incorrectly. Teaching models for shoulder injections are expensive and can be inaccessible for small programs. Our goal was to create an ultrasound compatible, cost-effective shoulder model to be used for demonstration and teaching purposes. We gathered qualitative data from licensed instructors to analyze the usefulness of our model in practice.

Environmental Stewardship and High School Recruitment

Marvin Beck
Mentor: Mike Moon |Department: Student Involvement and Leadership

Alternative Spring Break - Environmental Stewardship
Oahu, Hawaii

Abstract

"As a humanitarian trip, we will engage in projects every day to serve the people of Hawaii throughout the island. The places we will serve include the Hawaii Nature Center, Na Mea Kupono Lo'I Kalo, Hanauma Bay, Hui O Ko'olaupoko, and Polynesian Cultural Center. Our projects will focus around the issue of environmental stewardship and caring for the land." I'm an international student coming from the University of Applied Sciences Vorarlberg in Austria with my major being InterMedia, which is quite similar to my major here at Weber State: Communication: Digital Media. One big difference though is in Asuria we already chose the topic for our Bachelor Thesis in the first semester and already started working and researching on our specific issue. My main topic is tourism, more precisely the negative impacts of overtourism, what to do about it, how sustainable tourism functions and how to promote it in an effective way. That is the reason why I decided to come to Utah in the first place, because it is the perfect spot to do research on tourism, with its five national parks and environmentally sustainable ski resorts like Powder Mountain. Going to Hawaii with the project's main focus being on environmental stewardship and caring for the land would be a perfect fit for my studies and an amazing opportunity to do research and one of the most well-known "dream destinations" all around the world. I plan on doing interviews with locals, hotel/hostel owners and different kinds of activity providers. Things I would like to ask include: What impact did Tourism have on Hawaii's environment? What impact did Tourism have on Hawaii's locals? Did living conditions change over the years? Which kinds of Tourists do you see most often in Hawaii? Is there an obvious trend considering age, income and/or ethnicity? Which

kinds of Tourists would you like to see more/less? Is there anything the tourism industry does to protect the environment/culture? If yes, what? If no, what would you like to see to be done? What is your personal view of Hawaii's Tourism? What makes Hawaii so interesting for tourists? Should the overall number of tourists be reduced? My focus would lie on the social and environmental impacts of tourism on Hawaii and how it's perceived by different people. On the other hand, I am constantly searching for new ideas and concepts to reduce the negative impacts of tourism and would like to talk to locals about their suggestions.

ERGO

Use of Silver Diamine Fluoride in Preventing Early Childhood Caries

Sheree Brand
Mentor: Shelly Costley | Department: Dental Hygiene

American Dental Gygienists' Association Annual Session
Louisville, Kentucky

Abstract

Children of low socioeconomic status and those with poor access to care are at higher risk for Early Childhood Caries (ECC). Fluoride varnish has become the standard of care for patients at moderate to high risk for caries especially in populations at risk for ECC. The use of silver diamine fluoride (SDF) has higher potential to prevent ECC than NaF 5% fluoride varnish. However, few traditional dental providers are using SDF to prevent Early Childhood Caries. Purpose: The purposes of this poster was to research the efficacy of silver diamine fluoride (SDF) vs. NAFL 5% varnish to prevent instead of just stop ECC. We also will explore the role of the public dental hygienist in providing SDF to underserved, lower socioeconomic children. Methods: Search words used: Silver diamine fluoride, silver diamine fluoride in children, silver diamine fluoride and caries, use of silver diamine fluoride and NAF 5% varnish, public dental hygienist. Search Engines used: Google scholar, one search, the local State University Library, Academic Search Ultimate. Expected Results: We expect that silver diamine fluoride (SDF) will be more effective in preventing caries when compared to NAF 5% varnish as applied by the public dental hygienist in children with low socioeconomic status or low access to care. Conclusion: Articles found that silver diamine fluoride (SDF) helps prevent and arrest caries in both different age groups and socioeconomic status populations. SDF shows promising results when used as a preventative agent instead of NaF 5% fluoride varnish. SDF could be used to prevent ECC instead of just using it to stop the progress of carious lesions. The public dental hygienist can play a major role in prevention of ECC in children with moderate to high risk of ECC.

The Psychological Outcomes of Open Adoption Agreements on Birth Mothers

Kailee Brown
Mentor: Alexander Lancaster | Department: Psychology

Western Society of Criminology
Honolulu, Hawaii

Abstract

The Psychological Outcomes of Open Adoption Agreements on Birth Mothers: How does the presence of an open adoption agreement affect psychological outcomes among birth mothers? Currently open adoption agreements can be drawn up as a contract and signed by both parties, but they are not legally binding. This raises questions about the impact of non-legally binding contracts on signatories to the contract. To better understand how open adoption agreements affect birth mothers, student researchers from Weber State University are collaborating with Forever Bound Adoption to conduct an online survey of birth mothers over in the United States. The survey will ask them if they have an open adoption agreement, if it has changed, and if they were a part of changing the agreement. The results of this study will benefit current and future birth mothers who put a child up for open adoption by helping them make an informed decision on whether to create an open adoption agreement. More broadly, by explaining the impact of non-legally binding contracts on the parties involved, this research will inform laws and policies about whether contracts should be legally binding.

Scenic Painting for Ruthless!

Alina Cannon
Mentor: Samantha Transleau | Department: Performing Arts

The Kennedy Center American College Festival
Los Angeles, Califonia

Abstract

Alina Cannon will be attending The Kennedy Center American College Theatre Festival (KCACTF) February 12th - 17th. While at the festival she will present her work as Charge Artist on Weber State University's production of "Ruthless". This dark comedy musical by Joel Paley with music by Marvin Laird, is set in the late 1950s and early 1960s, and tells the story of young Tina Denmark, who will do ANYTHING to be the lead in the school show.

Scenic Design for Asylum Song (NYC Experience)

Alina Cannon
Mentor: Jessica Greenberg | Department: Performing Arts

New York City Off-Broadway Theatre Production
New York, New York

Abstract

The Weber State University theatre department is taking a group of students to New York to work on the production of Asylum Song by Jeanne Marie Beaumont, with The Adjusted Realists theatre company. For this Production, I will be collaborating on the scenic design, and will be on the run crew for the run of the show. I will work directly with the scenic designer on research, drafting, building, and painting the set and props for the show. As a part of the run crew, I will be at every performance to help run the show. This experience will give me valuable professional experience and skills from working in New York, on an Off-Broadway production. This will also be my first time working with a professional scenic designer for a production, which is an emphasis for my degree. This is a great opportunity to network with theatre artists in my field, to grow on the skills I have learned so far, and to build my portfolio. This project will help to prepare me for graduation and working in the professional world.

ERGO

An Eye for an iPhone

Tamara Cardon
Mentor: Sarah Herrmann | Department: Psychology

Rocky Mountain Psychology Association 2019
Denver, Colorado

Abstract

Past research has investigated vigilante acts, but no current research exists that examines digilante (digital vigilante) acts. One of the studies in our literature review looked at how feminists responded in a digilante manner to slut shaming on Facebook (Jane, 2017). Another examined the advent of "hacktivism" and the digital mayhem it caused (Hampson, 2012). We also reviewed several bodies of work on vigilantism. Johnston (1996) states that vigilantism involves premeditation, voluntary participation by private citizens, actions unsanctioned by authority and an "aim to control crime". The project that I am currently working on aims to look at the perceptions and endorsements of digilante acts. The internet offers those that may be inclined towards this type of behavior the ability to carry out vengeful acts via the internet that can have real world consequences. Our goal is to gather information on this type of behavior and to what degree people would support these types of actions. Our hypothesis is that people will have a higher endorsement of digilante acts and recommend more lenient sentencing than they would for real world vigilante acts. We also hypothesize that participants will be more inclined to endorse a non-violent response to a violent precipitating act and will be less inclined to accept a violent response to a non-violent precipitating act. We will be presenting a poster and engaging discussion of our findings at the Rocky Mountain Psychology Association Conference on Friday April 5th 2019. References Hampson, N. C. (2012). Hacktivism: A new breed of protest in a networked world. Boston College International and Comparative Law Review, 511-542. Jane, E. A. (2017). Feminist digilante responses to a slut-shaming on Facebook. Social Media + Society, 1-10. Johnston, L. (1996). What is vigilantism? British Journal of Criminology, 220-236.

Kennedy Center American College Theatre Festival

Estephani Cerros
Mentor: Jennifer Kokai | Department: Performing Arts

The Kennedy Center American College Festival
Los Angeles, California

Abstract

An actor's job is to convincingly portray a character towards an audience. But how far is an actor willing to go in order captivate said audience and pull them into the story's world. As a sexual assault survivor, I was challenged to play a rape victim in "Class of '94" whose story line was disturbingly similar to my own. For several months I pulled from my own personal trauma to create a realistic and relatable character, I allowed myself to open old wounds with the hope a stirring a more morose feeling within the audience's stomach. Although this is a method that is sometimes encouraged, most famously by actor/mentor Konstantine Stanislavsky, you are also at risk of falling into varying levels of psychosis. It is because of my role in "Class of '94" that I was nominated to compete for an Irene Ryan Scholarship. The competition this year will be held in Los Angeles California. Which is inherently why I am requesting a travel grant of $1000.00 from the Office of Undergraduate Research. I have teamed up with another nominee to combine our funds to reduce traveling costs as best possible. With this grant I plan to attend the Kennedy Center American College Theatre Festival to not only compete for the Irene Ryan scholarships; but to also emerge myself in a week-long study of some of the best theatre pieces and most knowledgeable workshops throughout our region. I intend to represent Weber State University in the most professional manner possible, both in my performance and in my overall attendance.

Bridging the Divide Between Government and Citizens

Breanna Child
Mentor: Pepper Glass | Department: Sociology and Anthropology

Pacific Sociological Association
Oakland, California

Abstract

With the changing ways by which people receive information, and increased language barriers from immigrant communities, governments have a more difficult time connecting with their citizens. Using surveys and comparisons with other local municipalities, this study of a mid-sized city considers how governments might overcome problems of communication. While the city relied upon a newsletter enclosed with its water bill, this was not reaching the large number of renters (42% of the population) and Spanish-speaking residents (12% of the population). This study suggests solutions that provide more communication and transparency for local government and better include economically disadvantaged, foreign-born, and other marginalized people.

Can Utah Farmers Grow Economically Viable Hemp in Existing Fields?

Jeffrey Colbert
Mentor: Katharina Schramm | Department: Botany

Institute of Cannabis Research 2019
Pueblo, Colorado

Abstract

Spring of 2019 I will be conducting a research project utilizing Cannabis sativa L. commonly known as Hemp. Recently the Utah Department of Agriculture and Food (UDAF) has allowed research into hemp because of its potential in becoming an addition to economic growth in Utah (R68-22 Industrial Hemp Research). My project will consist of growing hemp in soils from different geological strata along the Wasatch Front. Fiber quantity will be measured and compared to the plants grown in the different soil types and the control. This project will allow Utah farmers know if their soils can support the growing of hemp and add to Utah's economy. I have submitted my project to The Institute of Cannabis Research (ICR) Conference 2019 as a poster to gain feedback for this project from those in the industry. Because of the strict legal restrictions placed on the plant, there isn't much local knowledge about growing it. The IRC is an accredited institution of higher learning, and is a part of the University of Colorado, offering minors directly related to cannabis. The ICR Conference offers a wide variety of classes that will provide me with a better understanding of the requirements needed for a successful project. Some of the classes available to me that will benefit my research are; Agriculture and Plant Body, Genomics, Analytical Methods for Cannabis Analysis and Research, Cannabis Source Identification, Phytoremediation (using plants to remove heavy metals from soil). One of the most valuable outcomes of attending the ICR conference will be the ability to meet industry experts. The knowledge I can obtain from these relationships will aid me in the development of soil, resource location, and purchasing vendors. I will also utilize these relationships beyond this project and apply them to when I move into the career I want after graduation, which is to become a hemp farmer. By attending this

conference, it will benefit me in my research and future career goals. It may also open the door to a valuable addition to Utah's economy. After I have completed my research, I will present my findings at the WSU Undergraduate Research Symposium and ERGO for peer review.

Educator Ethics

Aaron Cook
Mentor: Shirley Dawson | Department: Teacher Education

Council for Exceptional Children 2018
Indianapolis, Indiana

Abstract

Continuing instances of educator misconduct harms the public perception of and trust in teachers and frustrates the profession. More important to consider is the detrimental impact on the child victim of a teacher's misconduct. In order to improve the safety and effectiveness of the students' learning environment, ethical training can be used to improve educators' awareness of decisions and actions and therefore lessen the occurrence of educator misconduct. In lieu of an exploration of the combined influences of individual factors and various policy influences on one's ethics, a collection of 18 scenarios based on actual instances of educator misconduct were chosen. These scenarios were then aligned with the Jones Moral Intensity Model (1991) as used by McMahon and Harvey (2006). Over the duration of three years, these scenarios were vetted via Edisonian (Tuncer, et al., 2010) and Delphi approaches (Colman, 2015). These scenarios strongly support the use Jones's model in educational settings making it highly applicable for use in ethical training for future and current educators. The scenarios can be examined by teachers to determine individual factors involved in ethical decision-making.

Redlining in Salt Lake City - A Case Study Using GIS

Amanda Cooley
Mentor: Daniel Bedford | Department: Geography

American Association of Geographers Annual Meeting
Washington, D.C.

Abstract

Salt Lake City is one of 238 cities for which the Home Owners Loan Corporation (HOLC) generated a Residential Security Map during the 1930s. HOLC maps depicted neighborhoods color-coded based on the estimated risk of extending a mortgage loan in that area. Areas were coded green for "best," blue for "still desirable," yellow for "definitely declining," and red "hazardous," which indicated the highest perceived risk of default. This practice came to be known as "redlining". A myriad of factors went into the determination of neighborhood class, but a significant factor was the racial composition of the neighborhood. This is reflected in the language used in HOLC annotations describing neighborhoods. As a result, African Americans were disproportionately excluded from homeownership throughout the period when these maps were in use. This research examines the lasting impact of HOLC maps on Salt Lake City's urban geography. Using a Geographic Information System (GIS), a digital copy of the original HOLC Residential Security Map of Salt Lake City was overlain onto a modern city map. The HOLC map is georectified to match the projection and scale of the modern map. The redlined areas from the HOLC map are then compared with modern patterns of racial composition, homeownership and home vacancies, thus illustrating how today's patterns of ethnic composition and socioeconomic inequality can be traced to the 1930s practice of redlining.

Kennedy Center American College Theatre Festival

Callahan Crnich
Mentor: Tracy Callahan | Department: Performing Arts

The Kennedy Center American College Festival
Los Angeles, California

Abstract

The Kennedy Center American College Theatre Festival offers four main goals every year, but the one goal that sticks out to me is the goal "To provide opportunities for participants to develop their theater skills and insight; and achieve professionalism". This goal speaks out to me now more than ever since this will be the last festival I will attending before graduating in the Spring of 2018. Achieving professionalism is something that I'm going to have to learn through experience and that's something I want to focus on when attending this festival. I have been nominated for the Irene Ryan competition for my role as Cripple Billy in "The Cripple of Inishmaan" this past Fall. Going to this competition to perform would be a great way to represent Weber State as well as continue growing my skills as a performer and artist. I will perform three contrasting theatre pieces that will best represent my acting ability, along with my acting partner. Getting the chance to learn as much as I can through constructive criticism and feedback from my peers and respondents. I would love to attend this KCACTF so I can get as much experience and education from professors and other attendees before I graduate from Weber State. It's my last chance to learn about the professionalism and life struggles that come with the career after graduation. It will be one last checkpoint before getting ready for my professional career.

Travel to Present Research Data at 9th International Conference on Nemertean Biology

Rachel DuBose
Mentor: Brian Chung | Department: Zoology

9th International Conference on Nemertean Biology
Sylt, Germany

Abstract

The carnivorous ribbon worm *Paranemertes* sp. are able to tolerate the cyclic changes in osmolarity of the intertidal zone while still continuing to hunting for prey during high and low tides. We hypothesized that *P.peregrina* tolerated these cyclic osmotic changes by regulating the amount and chemistry of mucus secreted during these stresses. During the summer of 2017, approximately 76 of these ribbon worms were collected from the intertidal mud flats of the reserve of University of California-Davis, Bodega Marine Laboratory and preserved for microscopic analysis. Paraffin-embedded sections of *P.peregrina* sp. were stained by periodic acid-acid shift to determine mucin chemistry and volume remaining within the cuticle of these animals as a reflection of the amount and quality of mucus secreted during these conditions. Preliminary analysis there is evidence that mucus protects the ribbon worm from osmotic stress by selectively secreting different types of mucus into its surface epithelium and changing the mucus-free weight due to the purge of mucin on the epithelium. Therefore, in response to either hypertonic or hypotonic stress, the nemertean *P.peregrina* secretes different amounts of mucin proteins in order to protect themselves from inherent osmotic damage.

New York City Off-Broadway Theatre Production

Pedro Flores
Mentor: Jessica Greenberg | Department: Performing Arts

New York City Off-Broadway Theatre Production
New York, New York

Abstract

While spending a month in New York City, the epicenter of American theatre, I will be working on an Off-Broadway theatre production with the Adjusted Realists Theatre Company. I will collaborate with the director of the production, giving me the opportunity to contribute to the production and be mentored by a professional director, directly feeding off their creativity and integrating what I experience in my undergrad education. This will give me priceless experience to work with professionals in the business, network with people who can help further my career, and learn firsthand how a professional theatre production functions. My role in this production is extremely valuable and necessary, and the ability to take part in it will help set me up to eventually move to the city and pursue a full-time career. I will also be representing Weber State in bringing the school's name into a professional environment.

Use of Laser to Identify Delicate Structures in the Human Anatomy Laboratory

Kelton Friedel
Mentor: Brian Chung | Department: Zoology

Human Anatomy & Physiology Society Annual Conference
Portland, Oregon

Abstract

Identifying cranial nerves and other central nervous system structures can be particularly challenging and is often done through numbered pins. However, the pinning method is destructive to these delicate structures. We worked in collaboration with our Engineering college to develop a multi-articulate laser pointer apparatus specifically for use in these situations for quizzes and exams. A number of lasers could then be aimed at specific anatomic structures and activated by students sequentially. This innovative, non-destructive, low-cost and collaborative design allowed a single cadaver to be used for multiple quizzes and exams throughout the semester.

Lighting Design for Ruthless!

Daniel Garner
Mentor: Jessica Greenberg | Department: Performing Arts

The Kennedy Center American College Festival
Los Angeles, California

Abstract

I am a student of technical theater in the Department of Performing Arts here at Weber State University. I am specializing in Lighting Design and Stage Management. I am presenting my lighting design of Ruthless! at the Kennedy Center American College Theater Festival for the second year in a row. Last year, I was a finalist and this year I aim to win. I am so proud of this production and I would love to share what I experienced with my colleagues and peers. Among the many students in our department, I'm honored that I have this opportunity for many reasons. First, the work I have done and am presenting will allow me the chance to receive feedback from industry professionals who do this kind of work every day for a living. Second, I will be able to learn from other students who are also presenting at this festival and receive inspiration for future projects. Third, I will be able to build brand new professional networks I can use in my career. Finally, this is an incredible experience that is very rare among undergraduates, which is why I feel honored to be invited again for a second year. I know that this trip to KCACTF will only help to increase my skills and make work even harder during my college stay here at Weber.

Using Mannequins to Aid in Teaching the Human Anatomy Laboratory

Shelby Geilmann
Mentor: Brian Chung | Department: Zoology

Human Anatomy & Physiology Society Annual Conference
Portland, Oregon

Abstract

Teaching anatomic surface regions and sense fields can be challenging, particularly for undergraduate teaching assistants. Rather than relying on unidimensional pictures, we employed fashion mannequins in our anatomy laboratory in effort to improve these lessons. Removable tape was used to identify body surface regions, after which, the tape was removed for quiz and exam purposes. Skin sense fields were identified through the use of different colored paints. Undergraduate lab instructors found these methods to be particularly helpful in conveying the information to their students. In conclusion, the use of mannequins provides a novel method to immerse students in anatomic pedagogy.

Caching and Building Behavior of Woodrats in Captivity

Courtnee Goodwin
Mentor: Michele Skopec | Department: Zoology

Annual Meeting of the American Society of Mammalogists
Washington, D.C.

Abstract

The woodrat (genus *Neotoma*), is known for its prolific caching and building behaviors. While these behaviors have been studied in both natural and lab settings, the majority of studies lasted only a few days. We therefore completed longer term (2 week) caching and building trials utilizing large double decker cages. Woodrats were provided with a mixture of essential items (cotton and sticks for nest building) and non-essential items (jingle bells) over two trials. We compared speed of caching between animal groups (*N. albigula* and two populations of *N. lepida*), caching items, and experimental trials. We also categorized level of organization and nest building at the end of each trial. We found that all woodrats demonstrated significant and observable caching and building behavior during the trials. As expected, essential items were cached more quickly than non-essential items. During the second trial, both species cached the non-essential items more quickly than during the first trial, showing that experience mattered. Based on field observations, we expected *N. lepida* to display more organized caching and building behavior than N. albigula. However, we found that during the first trial, *N. albigula* was more likely to make large, well-built nests than *N. lepida*. Overall, the large double decker cages serve as ideal home cages for the woodrats by allowing them to express innate caching and building behaviors.

Stage Management for Cripple of Inishmaan

Caitlynn Garner
Mentor: Samantha Transleau | Department: Performing Arts

The Kennedy Center American College Festival
Los Angeles, California

Abstract

Caitlynn Gramer will be attending The Kennedy Center American College Theater Festival. While at the festival she will present her various works created as a stage manager for Weber State.

Stage Management for Ruthless!

Cydney Hall
Mentor: Samantha Transleau | Department: Performing Arts

The Kennedy Center American College Festival
Los Angeles, California

Abstract

Cydney Hall will be attending the Kennedy Center American College Theatre Festival (KCACTF) February 12th-17th. While at the festival she will present her Stage Management prompt book for Weber State University's production of Ruthless! a musical by Joel Paley and Marvin Laird.

ERGO

Irene Ryan Audition at KCACTF

Sarah Hekking
Mentor: Jenny Kokai | Department: Performing Arts

The Kennedy Center American College Festival
Los Angeles, California

Abstract

The Kennedy Center American College Theatre Festival is an opportunity for students to showcase their talents and improve their art. This is a perfect opportunity for students to "make discoveries" and learn in an environment with some pressure. So much of acting is the ability to perform and discover while in a high-stakes situation. As an Irene Ryan nominee, I will compete at this year's KCACTF and present a 1minute scene, a 2minute scene, and a 1minute monologue or song. I hope to present strong and authentic material with my partner, Hailey Weeks, and hopefully make some new discoveries as a student or an actor. Most importantly, I will conduct myself in a way that accurately represents the quality of the program offered at Weber State University and show the level of professionalism that our educators have encouraged us to carry.

Practice-Based Coaching in Early Childhood

Robyn Johnson
Mentor: Sheila Anderson | Department: Child and Family studies

National Association for the Education of Young Children
Washington, D.C.

Abstract

Throughout the past decade, the field of education has undergone major revisions and rethinking of best practices to educate our children. Early Childhood (EC) teacher education may arguably be one of the most important parts of this process. EC educators have a substantial influence on the lives of the young children in their care. The role of EC programming is to provide healthy development and early learning environments where children thrive in high-quality care with trained professionals who embrace Developmentally Appropriate Practice (DAP; Copple & Bredekamp, 2009) beliefs and can effectively implement these practices (Institute of Medicine and National Research Council, 2015). As support for highly trained EC educators that provide developmentally appropriate curriculum and meet young children's developing needs increases, preservice early childhood education programs are rising to meet these early learning needs. However, the nature of the problem for professional learning remains: there tends to be a gap between EC educator DAP beliefs and the implementation of practices. This study explores how implementing a rigorous action research project to examine the effectiveness of a Practice-Based Coaching (PBC; The National Center on Quality Teaching and Learning, NCQTL, 2017) model across a preservice EC higher education program may influence the beliefs and practices of preservice EC educators. Results are promising and may be useful for other programs, suggesting that PBC is a model worthy of continued study about the influence of ongoing coaching on the development of DAP beliefs and practices, including the transition from preservice to in-service teaching. One hope for this research is that it will raise awareness of the necessity of providing preservice and in-service EC educators with ongoing, individualized professional learning opportunities

that support professional identity and decision-making autonomy, anchored in adult learning theory (Beavers, 2009; Hunzicker, 2004).

Costume Designs for Ruthless!

Alicia Kondrick
Mentor: Catherine Zublin | Department: Performing Arts

The Kennedy Center American College Festival
Los Angeles, California

Abstract

Alicia Kendrick will be attending The Kennedy Center American College Theatre Festival (KCACTF)February 12th- 17th. While at the festival she will present her costume designs for Weber State University's production of Ruthless! This comedic musical was written by Joel Paley and takes place in a suburban household in the 1950's.

The Kennedy Center American College Theatre Festival

Liberty Lockett
Mentor: Jennifer Kokai | Department: Performing Arts

The Kennedy Center American College Festival
Los Angeles, California

Abstract

Acting jobs for performers of color are scarce and force the actors to find jobs that are race neutral. Many studies have been done that show just how striking these numbers are. How does this change how a performer might prepare for the role they were cast in? Does being cast for a race neutral role limit one's ability to connect with said character on a personal level? When I was cast as Marina a race neutral high schooler, I, as a biracial woman, got the opportunity to challenge myself in deciding who Marina was. Would I have had a different experience in preparing and playing Marina if she was written as a black teenager instead of race neutral? It is because of my portrayal of Marina that I was nominated for an Irene Ryan Scholarship. Through this nomination I am given the opportunity to compete in The Kennedy Center American College Theatre Festival in Los Angeles, California. This nomination is the heart of why I am requesting a grant of $1000.00 from the Office of Undergraduate Research. This travel grant will not only get me and my scene partner to the festival but give me the opportunity to compete at a collegiate level for the Irene Ryan Scholarship. By attending this festival, I will be able to participate, view, and represent Weber State University in the best workshops and productions in our region.

Off-Broadway Production of Asylum Song

Kierian Lockwood
Mentor: Jessica Greenberg | Department: Performing Arts

New York City Off-Broadway Theatre Production
New York, New York

Abstract

This trip will be an amazing experience for Kierian Lockwood to be able to work on a play and experience a full New York production. Along with 8 other students and Mentor Jessica Greenberg, these students all have individual positions in which they will be able to experience different parts of the process. Kierian Lockwood is head of wardrobe crew and will be able to help put together the shows costuming beforehand as well as be able to guide a group of people to create a successful run of the show and clean up afterward. This experience will help strengthen her understanding of a full production being able to work hands-on with professionals and strengthening her resume.

The Impact of Climate Change on Water Quality in the Cordillera Blanca, Peru

Carmen Longo
Mentor: Elizabeth Balgord | Department: Geosciences

Geological Society of America Annual Meeting
Indianapolis, Indiana

Abstract

The Cordillera Blanca, within Huascaran National Park in Ancash, Peru, is the highest elevation range in the northern Andes and contains the largest collection of tropical glaciers in the world. High alpine glaciated areas, especially those in the tropics, are extremely susceptible to minor changes in temperature. The overall warming trend of the last few decades has led to deglaciation within the Cordillera Blanca raising concerns about water quality and quantity now and in the future. Water chemistry in the Cordillera Blanca is primarily controlled by the bedrock composition of the watershed. The bedrock exposed in the Cordillera Blanca is dominantly granodiorite, which is heavily altered along a fault surface that defines the western margin of the range. The granodiorite is even more extensively altered within a re-mineralized contact zone that juxtaposes Jurassic and Cretaceous marine sedimentary units on top of the granodiorite. The contact zone is located along the high spine of much of the Cordillera Blanca which was, until recently, covered by glaciers. Oxidation of freshly exposed sulfide minerals within the contact zone increases heavy metal contamination and extremely reduces pH in the Cordillera Blanca watersheds, causing issues for both humans and animals that depend on precipitation and glacial runoff from the Cordillera Blanca to live. Glacial melt is the primary source of fresh water for the heavily populated and arid western portion of Peru, so water contamination in the Cordillera Blanca is a major concern. This study presents new geologic maps and geochemistry of the sulfide rich mineralization zone in relation to the modern ice fields and glaciers to more accurately quantify the current and future water contamination hazard.

Perceived Inclivities on Fear of Sexual Assault

Cooper Maher
Mentor: Heeuk Lee | Department: Criminal Justice

Western Association of Criminal Justice
Las Vegas, Nevada

Abstract

Since initial efforts to understand fear of crime by Taylor and Hale (1986), several efforts have been made to better understand fear of crime through specific measures. Efforts made to explain fear of crime typically involve one of several models, including disorder/inclivities models, including vulnerability and inclivity models. In general, the present study Identifies a strong and positive effect experienced by respondents in regard to fear of crime from inclivities, understood as social and physical disorder.

Travel to Present at the 9th International Conference on Nemertean Biology

Augustus Malan
Mentor: Brian Chung | Department: Zoology

9th International Conference on Nemertean Biology
Sylt, Germany

Abstract

Transcription is the beginning of cell processes in all organisms and is the process of creating a copy of the cells genetic code (DNA) called into a mobile and usable code called messenger RNA (mRNA). The mRNA is transported to ribosomes to undergo translation into a carefully constructed and folded protein. The act of folding the proteins is assisted by other proteins called Heat Shock Proteins (Hsp). Our lab has previously found that even the expression Hsp themselves varies on the stress that an organism endures (Okazaki, 2006). This project sought to test the hypothesis that regulation of cellular calcium concentrations is vital to the transcriptional regulation of Hsp. Every eukaryotic cell tightly controls the amount of calcium within or outside itself and changes to calcium levels are normally associated with significant metabolic activity. Our model utilizes the intertidal ribbon worm *Paranemertes peregrina* subjected to daily environmental stress represented by water of solute concentrations 24 ppm, 34 ppm, and 44 ppm for two hours, while simultaneously being incubated with a blocker of cellular calcium transport Nifedipine. Each worm was weighed before and after exposure to the stress and significant changes ($p<0.05$) in weight were noticed after exposure. Following exposure to stress, all mRNA was extracted from the specimens and processed to determine if osmotic shock alters Hsp transcription by Reverse Transcription - Polymerase Chain Reaction (RT-PCR). Our preliminary data indicates that the transcriptional regulation of Hsp mRNA does not require changes in cell calcium and that the regulation of Hsp following environmental stress is likely a robust mechanism that can function despite significant inhibition to normal cell processes.

How Painted Bones Aid Undergraduate Students in Learning the Human Skeletal System

Alexis Mathews
Mentor: Brian Chung | Department: Zoology

Human Anatomy & Physiology Society Annual Conference
Portland, Oregon

Abstract

Effectively and efficiently teaching the various structures on skeletal bones is a challenge for undergraduate laboratory teaching assistants. Since bone structures are often unmarked on most models, we painted these surface features to aid our undergraduate laboratory instructors and their students. Instructors were surveyed about their teaching experience with painted versus unpainted bones. Student quizzes and exams from previous semesters were compared to determine if painted models aided in learning. Our preliminary evidence indicates that while the student lab instructors preferred teaching with the painted models, there was not a significant difference of student scores.

Effects of Division I Cross-Country Training on Iron Markers and Systemic Inflammation

Chandler McDonald
Mentor: David Aguilar-Alvarez | Department: Athletic Training and Nutrition

American College of Sports Medicine Annual Meeting 2019
Orlando, Florida

Abstract

Inflammatory cytokine and immune cell production is modulated by iron status including storage measured by ferritin levels. Cross-country athletes have an elevated risk of iron depletion; the effects of long-term cross-country training on inflammatory cytokine profile and its relationship with iron storage markers have yet to be elucidated. PURPOSE: To determine the influence of cross-country training on markers of inflammation and iron storage and to interpret potential mechanisms underlying these relationships. METHODS: Twelve NCAA division 1 cross-country athletes, ages 18 to 25 years old, were followed for two years. Blood was collected at the beginning of the season and analyzed by complete blood count (CBC) and ferritin levels were assessed by enzymatic spectrophotometry. Cytokines IL-1ß, IL-2, IL-4 IL-5, IL-6, IL10, TNF-a and IFN-? were measured with the Luminex® MAGPIX® system. Dependent samples t-test was used to compare ferritin cytokines and CBC mean difference between first and second year measurements. Pearson correlations were conducted to assess associations between ferritin and immune cells/inflammatory cytokines. IBM® SPSS Statistics 22 software was used to analyze the data. RESULTS: TNF-a levels increased from the 1st to the 2nd year (98.60 ± 11.17 vs. 121.41 ± 11.93 pg/dL, p=0.006). Platelets (253.63 ± 12.28 vs 267 ± 13.43 K/µL, p=0.041), Neutrophils (44.46 ± 1.26 vs 50.46 ± 2.70) K/µL, p=0.045) and Monocytes (8.58 ± 1.90 vs 10.61 ± 2.70 K/µL, p=0.003) also significantly increased from the 1st to the 2nd year. Ferritin levels were positively correlated with TNF-a both years (r=0.716 p=0.009, r=0.595 p=0.04). CONCLUSION: One year of cross-country training seems to influence increases in pro-inflammatory cytokines and immune cell

concentrations in NCAA Division 1 Athletes. Although there were no significant changes on ferritin levels over the years of study, ferritin increases were linked to increases in pro-inflammatory cytokine TNF-a.

Identification of 4-Hydroxyisoleucine in Human Breastmilk Using UHPLC-MS

Savannah Nelson
Mentor: Todd Johnson | Department: Chemistry

Chemistry for New Frontiers
Orlando, Florida

Abstract

Fenugreek is an herbal condiment that has been promoted as a lactating aid by fenugreek suppliers and several other groups within the herbal community. One of the components of fenugreek, 4-hydroxyisoleucine (4-OH-Ile), has been extensively studied and linked to several different pharmacological activities - including anti-diabetic properties. Ultrahigh-performance liquid chromatography and tandem mass spectrometry were used to identify and quantify 4-OH-Ile in urine and breastmilk after consumption of fenugreek. Human subjects were given a manufacture's recommended daily dose of fenugreek for three days (2480 mg/day – two 620 mg gel caps morning and night). Breastmilk and urine samples were collected over a six-day-study time period and analyzed for 4-OH-Ile using a previously verified isolation and detection method developed in our lab. The 148 m/z molecular ion was identified in urine within 2 h of the initial treatment and confirmed by positive identification of a 102 m/z SRM at the same retention time. The maximum urine load of 4-OH-Ile presented at 36 h and the total wash-out time was approximately 40 h after the final dose of fenugreek. 4-OH-Ile was positively identified in only one breastmilk sample that corresponded closely in time with the highest level of the compound in urine. The amount of 4-OH-Ile in breastmilk at this single time point was estimated to be less than 0.5 ppm. It appears as though breast tissue either excludes the uptake of 4-OH-Ile or catabolizes it under normal physiological conditions.

Alternative Cadaver Immersion Tanks for Long-Term Cadaver Storage

Thomas Odenwalder
Mentor: Brian Chung | Department: Zoology

Human Anatomy & Physiology Society Annual Conference
Portland, Oregon

Abstract

Storage of prosected cadavers is challenging due to the size and costs of cadaver immersion tanks, and many programs resort to spraying wetting agent instead. We sought a lower cost alternative to immersion tanks by collaborating with our peer College of Engineering, Applied Science & Technology and we have designed a potentially viable, long-term cadaver storage unit that combines an automated fluid spray and recycling system on a presentation table that uses our current cadaver gurneys. This collaboration can be produced by engineering students as a Senior Project while coupling significant financial savings to ease of long-term cadaver storage.

Irene Ryan Competition at the Kennedy Center American College Theater Festival

Katelynn Ostler
Mentor: Andrew Lewis | Department: Performing Arts

The Kennedy Center American College Festival
Los Angeles, California

Abstract

Attending the Kennedy Center American College Theatre Festival, would benefit me in many ways as an actor. Through attending professional productions of new works and exciting theatre, I will become more well-rounded and educated about theatre today. By attending workshops, I will improve my skills and learn completely new ones. I hope to participate in many different workshops that focus on skills that I already have, to grow them, and skills that I have either never had the opportunity to pursue, or skills that do not come easily to me. By attending dance classes, I hope to increase my ability to remember choreography and the time that I take to learn it, as well as improve on my technique. By performing for The Cabaret or Musical Theatre Initiative available at KCACTF, I will gain feedback from fellow students and network myself into the world of theatre outside of college. I will also learn what it is like to perform in professional settings. Competing in the Irene Ryan Competition, will allow me to grow through insight from other professors from all over the nation and work to improve my performance with my partner each round of the competition. At the festival, I will be able to attend performances of new and exciting theatre which will broaden my horizons and educate me as actor and member of the theatre community. In all that I do at KCACTF, I will be representing Weber State University. As a representative of Weber State, I will strive to show a spirit of professionalism, creativity, collaboration, devotion, and passion.

Parental Attitudes Regarding Comprehensive Sexual Education in an Abstinence Only State

Laura Pastrana
Mentor: Alexander Lancaster | Department: Psychology

Western Society of Criminology
Honolulu, Hawaii

Abstract

There are only two types of sexual education programs that are taught in the United States, comprehensive sexual education and abstinence-only until marriage programs (Steadman, Crookston, Randy, & Hall, 2014). These are state mandated programs and without special consent it is illegal for health teachers to teach anything other than the state mandated curriculum (Steadman, et al., 2014). Utah state law only allows a discussion of contraception use with parental approval and is up to the local school board if that can even be offered (Steadman, et al., 2014). If condoms and contraception are discussed amongst students, teachers are not allowed to explain how to use and or promote condoms or contraception even among students who engage in sexual behaviors in the state of Utah. The current study is looking at the possible discrepancy between what is legally currently being taught in public schools regarding sexual education and what parents would prefer to be taught. We are working with a small urban city Health Department to administer a cross-sectional social survey to the parents in two counties of Northern Utah. The survey will assist in gaining a better understanding of the knowledge, opinions, and attitudes of current practices but also parental opinions of different evidence-based opt-in options as well. We anticipate that the survey results will express parents wanting a more comprehensive form of sexual education for their children rather than an abstinence-based program. The finding from this project will be used to influence policy changes and improve sexual health education in Utah and other states as well.

Council for Exceptional Children National Conference, Multiposter Presentation

Katrina Pearce
Mentor: Shirley Dawson | Department: Special Education

Council for Exceptional Children 2018
Indianapolis, Indiana

Abstract

Preparation to become an educator involves training in content knowledge and teaching skills in field-based settings. An area of training receiving attention is training to be a professional. Trained teachers are more effective than untrained teachers. The need for teachers to remain in the field remains high as the shortage of classroom teachers preserves. A primary cause of shortage is the attrition rate of new teachers. The influence of involvement in professional organizations in teacher preparation programs to improve retention rates is a viable one. This paper explores the impact of professional support in the preparation, retention, and development of new teachers.

Scenic Art for Cripple of Inishmaan

Dustin Pike
Mentor: Sam Transleau | Department: Performing Arts

The Kennedy Center American College Festival
Los Angeles, California

Abstract

DJ Pike will be attending The Kennedy Center American College Theatre Festival (KCACTF) February 12-17th. While at the festival he will present his Scenic Art portfolio for Weber State University's production of Cripple of Inishmaan. This dark Irish comedy was written by Martin McDonagh and takes place on the small island on the western coast of Ireland in 1934.

Effectiveness of Community-Based Learning on the Will/Skill of Pre-Service Teachers

Karli Plant
Mentor: Natalie Williams | Department: Teacher Education

International Conference on Autism, Intellectual Disability & Developmental Disabilities
Maui, Hawaii

Abstract

Service-learning has a well-documented effect on university student's learning. It has a positive effect on personal and interpersonal development, provides a sense of social responsibility and citizenship, increases commitment to service, improves student academic learning through application to "the real world", reduces stereotypical thinking among students and facilitates cultural and racial understanding (Eyler, Giles, Stenson, & Gray, 2001). Service-learning for pre-service teachers has many forms, primarily visiting a school setting. Teacher preparation programs that include service-learning have documented similar findings about the positive effects warranted by service-learning. According to McMurtrie, Coleman, Ruppert, and Senn (2014), pre-service teachers who participated in service-learning (a) increased their knowledge of the unique characteristics of young adolescents; (b) understood differences that an adult advocate can make in the lives of young adolescents; and (c) improved their view as a professional. However, the use of community-based learning methodology with pre-service teachers in relation to serving students with disabilities has been fragmented and limited. Recently, Zagrodnik, Williams & Leytham (2018) demonstrated the impact a community-based program has on the will and skill of pre-service teachers when meeting the needs of students with disabilities. This presentation with describe CAPES!, a community-based learning program in which pre-service teachers participate in a skill development program for children with disabilities (ages 5-12). This presentation will share new results in relation to the will and skill of pre-service teacher's beliefs and attitudes in meeting the needs of students with disabilities. Results from a pre-post survey

regarding the amount of belief and attitudinal change that occurred will be shared. The presenters will also share with participants student reflections and how those were analyzed to support the survey results. Additionally, a student will also present her experience in CAPES! and how it has impacted her as a future special educator. The likelihood that students with disabilities participate in extracurricular activities is somewhat limited and is much lower than that of their typically developing peers. The CAPES! program provides an opportunity for students with a variety of disabilities (e.g., cerebral palsy, autism, intellectual disabilities, muscular dystrophy, Down syndrome etc.) to enhance their cognitive, physical, behavioral and social-emotional skills. CAPES! also provides pre-service teachers avenues to enhance their will, skill and confidence in meeting the needs of students with disabilities. As a future special educator, I cannot overstate how the CAPES! (Children's Adaptive Physical Education Society!) program has impacted my life for the better; including introducing and guiding me towards a future career in special education. When I first started my college career in teacher education, I was an elementary general education major with a minor in art. At that time, I had the opportunity to take an education course that focused on children with exceptionalities, and in conjunction with that course, participate in community-based learning through the CAPES! program at WSU. Never having worked with individuals with disabilities before that time, I would be lying if I said I wasn't nervous and a bit scared; nonetheless, I was excited to see how I could develop my skills as a future educator and hopefully gain an understanding for teaching students with disabilities. I never could have imagined how CAPES! would impact my life. Not only did I develop skills, confidence, and understanding for these individuals, my eyes were opened up to what I really wanted to be when I "grew up"; I still wanted to teach, but I wanted to teach individuals with disabilities. This community-based service-learning program (CAPES!) may seem insignificant in the broad scheme to some, but for me, it brought me to my calling in life and a future I am very excited to start. I have now been working with the CAPES! program for years (4 semesters worth) and have made CAPES! my senior project in the teacher education program at Weber State University. I have worked with a wide range of kiddos with differing special needs, from Autism to cerebral palsy. The love and confidence I have now gained working with children

with disabilities is astounding, and at this conference, I will present my story and experiences from participating in the CAPES! program as a pre-service teacher, and how it has drastically impacted my life.

Risk-Avoidant versus Comprehensive Curriculums: An Assessment of Northern-Utah Parental Attitudes Regarding Sexual Education

Alyson Rasmussen
Mentor: Pamela Payne | Department: Family Studies

National Council on Family Relations 2018
San Diego, California

Abstract

Currently, Utah educators must follow a state-mandated sexual education curriculum and without special permission, it is illegal for educators to deviate from this curriculum in any way. Parental attitudes towards two sexual education curriculums are evaluated to determine if there is a discrepancy between what is currently being taught in public schools regarding sexual education and what parents would prefer to be taught to their children. Working in conjunction with a small urban-city health department; a cross-sectional social-survey was disseminated to parents with children under 17 in two counties in Northern Utah.

Left Frontal Cortical Activation Predicts Attenuated Error-Related Negativity After Sexism

Jesus Saavedra
Mentor: Sarah Herrmann | Department: Psychology

Society for Personality and Social Psychology
Portland, Oregon

Abstract

Greater left frontal cortical activation is related to the behavioral approach system (BAS). While greater BAS activation increases sensitivity to rewarding and risky behaviors, it also attenuates the influence of the behavioral inhibition system (BIS), responsible for making negative stimuli salient. The present research examines the influence of the BAS, as measured by cortical alpha activation, on the BIS among women experiencing sexism. We hypothesized greater left frontal cortical activation, indicating BAS activation, would predict lower activation of the BIS, as measured by the error-related negativity (ERN) during a Stroop task. Results show after experiencing sexism, women with higher left frontal cortical activity displayed lower ERN amplitudes following incorrect responses on a Stroop task, particularly when they were instructed to maintain group harmony (i.e., not confront prejudice), $F(1, 27) = 4.21$, $p = .05$, ?R2 = .332. Results suggest women with higher left frontal cortical activity, associated with BAS activation, may show reduced sensitivity to errors following sexist interactions in environments that encourage group harmony, due to the demands of self-control.

Standing Up to Sexism: Motivation to Confront Prejudice in a Real-World Scenario

Jesus Saavedra
Mentor: Sarah Herrmann | Department: Psychology

Rocky Mountain Psychology Association 2019
Denver, Colorado

Abstract

Confronting prejudice often has negative consequences for confronters depending on their perceived involvement with targeted groups. We see differential concerns for men and women; namely, gender identity salience may influence women who would confront sexism, often working against intentions to explicitly confront sexist statements. However, confronting males are often viewed more favorably compared to their female counterparts. High motivation to confront prejudice has been shown to predict explicit confrontation by women against sexism from males. The present research seeks to understand the relationship between this motivation to confront prejudice and gender in the explicit confrontation of sexism. Participants are assessed in their motivation to confront prejudice through the Motivation to Confront Prejudice Scale (MCPS) two weeks before interaction with a sexist male or female confederate. Degrees of confrontation are assessed, and participants are administered the MCPS once more two weeks post interaction. Hypothesized are an effect of gender in which female participants will be more willing to confront female confederates, that those with high motivation to confront prejudice will exhibit more explicit confronting behavior, and that failure to confront prejudice by participants scoring higher in the MCPS prior to confederate interaction will result in depressed MCPS scores post interaction.

Macronutrient Caloric Distribution Affects Metabolic Syndrome Parameters Among College Students

Sara Saltzgiver
Mentor: David Aguilar-Alvarez | Department: Athletic Training and Nutrition

Nutrition 2019
Baltimore, Maryland

Abstract

Metabolic syndrome (MetS) is a cluster of medical ailments that puts one at risk for cardiovascular disease and type 2 diabetes. The acceptable macronutrient distribution ranges (AMDRs) have an accepted range that provides an overall adequate nutritional diet that can be linked to the rising epidemic of MetS and it's the risk factors. Purpose/hypothesis We analyzed macronutrient caloric distribution, and its effects on MetS among Weber State students. We hypothesize that MetS parameters will be positively affected by meeting AMDRs for carbohydrate, protein, and fat. Research Methods We gathered data from 385 Weber State student participants, ages 18 to 65. We analyzed each student's metabolic parameters, as well as a two-day diet record, using Diet and Wellness Plus. We separated the participants by gender (Male: 128; Female: 257), and by macronutrient distribution. Groups indicated those who met all AMDRs for carbohydrate, protein, and fat, and those who did not. We also categorized participants as deficient (below 67% DRI) or sufficient in fiber (above/ equal to 100% DRI). The mean value differences in macronutrient distribution and fiber intake, and its impact on MetS parameters, were evaluated by independent samples t-test. Data Results Females who met all the AMDR's, showed to have significantly lower body weight ($\mu1=64.8$ vs $\mu2=69.9$ Kg; $p=0.042$), waist circumference (WC) ($\mu1= 77$ vs $\mu2=81.2$ cm; $p=0.028$), HDL-C ($\mu1=51.2$ vs $\mu2=56.3$ mg/dL; $p=0.032$), and blood glucose levels ($\mu1=87.4$ vs $\mu2=90.2$ mg/dL; $p=0.029$) ($p<0.05$) than those who failed to meet these recommendations. Increased fiber intake correlated with lower body weight ($\mu1=75.3$ vs $\mu2=67.3$ Kg;

p=0.005) WC (μ1=83.3 vs μ2=77.8 cm; p=0.009), and higher HDL-C (μ1=48.5 vs μ2=55.4 mg/dL; p=0.021) ($p<0.05$) among all participants. Conclusions Meeting AMDRs showed little to no effect on metabolic factors among males. In females, meeting AMDRs had protective effects on most MetS parameters with exception of HDL-C. Although HDL-C was decreased, total cholesterol was also reduced, leading to an unaffected HDL/Total-cholesterol-ratio which is a more reliable predictor of cardiovascular disease. Adequate fiber intake beneficially affected central adiposity and was linked with higher HDL-C.

Performing at the InterHarmony Gala Concert at Carnegie Hall

Shu-Han Shen
Mentor: Yu-Jane Yang | Department: Performing Arts

InterHarmony Gala Concert at Carnegie Hall
New York, New York

Abstract

Shen I participated at the "InterHarmony International Music Festival" in Sulzbach– Rosenberg Germany this past summer with more than 200 international students and faculty from all over the world. At this festival, I was selected to perform Maurice Ravel's Gaspard de la Nuit, III. Scarbo in the festival's Student Showcase Recital featuring the most accomplished student performers of the festival. I have received an invitation from the InterHarmony International Music Festival to perform Ravel's Gaspard de la Nuit, III Scarbo at the Gala Concert of the InterHarmony Concert Series at Carnegie Hall in New York on November 3, 2018. I am thrilled to be one of the featured young artist performers for this amazing opportunity to perform at the Carnegie Hall, one of the most celebrated iconic concert venues in the world! I am also extremely excited that I will be able to represent Weber State University to perform on the professional concert stage in New York City at such prominent concert event.

Attend and Present at the National Council on Family Relations

Jordan Shuler
Mentor: Paul Schvaneveldt | Department: Child and Family Studies

National Council on Family Relations 2018
San Diego, California

Abstract

I will be presenting two posters at the National Council on Family Relations in November. Abstract for The Influence of Parenting Behaviors on Prosocial and Antisocial Behavior of Children in Ecuador Poster. The influence of parenting behaviors on child development has been thoroughly studied in a variety of contexts, but rarely in Latin America. Previous research has shown that parenting behaviors with children significantly impact child development (Eiden, Colder, Edwards, & Leonard, 2009). The current study assessed this association for a sample of 1,306 children in Ecuador using a questionnaire of Likert-type scales. Confirmatory factor analysis was used to create relevant variables which were then tested using structural equation modeling. Results indicate that positive parenting practices predict higher prosocial and lower antisocial behavior in children. Implications are discussed. Abstract for the Understanding Relationship Fidelity Poster Though many empirical studies have examined concepts relating to relationship fidelity, few utilize an operational definition for relationship fidelity (e.g. Watkins & Boon 2016). Relationship fidelity is often expected in romantic relationships (Wängqvist, Carlsson, van der Lee, & Frisén, 2016), but it isn't empirically understood. The current study qualitatively assessed a sample of 100 college student's definitions and descriptions of relationship fidelity in terms of the thoughts, feelings, and behaviors which they associated with it. Results indicate that loyalty, trust, behavioral exclusivity, and feelings of love and caring are important components of relationship fidelity. Implications are discussed.

Media Optimization to Differentiate Lactobacillus and Bifidobacteria Species in Fermented Dairy Products

Nicole Smith
Mentor: Craig Oberg | Department: Microbiology

American Society of Microbiology Microbe 2019
San Francisco, California

Abstract

Lactic acid bacteria (LAB) are used to produce a wide variety of fermented dairy products, many containing probiotic cultures (Lactobacillus and Bifidobacterium) that provide health benefits. To determine shelf life survivability of probiotic cultures, it is necessary to differentiate them from the LAB starter cultures. This research was done to determine the optimal media for differentiating probiotic species based on colony morphology differences and exclusionary growth from starter LAB. Eight media were examined for their ability to differentiate between 9 Lactobacillus species and 3 Bifidobacterium species. Results show RCA agar with methylene blue can differentiate between the colony morphology of St. thermophilus, Lb. fermentum, and Lb. brevis. MRS agar with vancomycin, used to enumerate Lb. casei, also supported growth of Lb. fermentum, Lb. brevis, and, even, Bifidobacterium animals ssp. lactis. All lactobacilli and bifidobacteria grew on MRS agar plus sorbitol, normally used to enumerate Lb. acidophilus. MRS-NNLP agar was developed to select for Bifidobacterium by excluding Lactobacillus species, however, Lb. fermentum, Lb. brevis, and Lb. casei produced colonies. Results show current plating media are inadequate for differentiating starter LAB from added probiotic cultures in fermented milk products.

Scenic Design and Workshop for Nebraska Wesleyan University

Victoria Snow
Mentor: Samantha Transleau | Department: Performing Arts

Xanadu at Nebraska Wesleyan University
Lincoln, Nebraska

Abstract

Victoria Snow will be traveling with her mentor Professor Sam Transleau to design the set for Xanadu at Nebraska Wesleyan University. Additionally, she will be leading two workshops for the students in attendance at NWU. She will be preforming duties such as researching and creating a design, as well as creating an engaging lesson plan to present in workshops. This will give her an opportunity to work professionally and hone her skills as a teacher and leader.

Costume Designs for "The Cripple of Inishmaan"

Victoria Snow
Mentor: Catherine Zublin | Department: Performing Arts

The Kennedy Center American College Festival
Los Angeles, California

Abstract

Victoria Snow will be traveling to The Kennedy Center American College Theater Festival in February of 2019 to present her Costume Design work for The Cripple of Inishmaan. She will be judged by a panel of professionals based on her design concept, renderings, completed work, and her presentation. She will be cooperating with undergraduate students and graduate students from colleges in Region VII which covers Utah, Hawaii, Arizona, central and Southern California, Southern Nevada, and Guam. If she performs well enough, she will be invited to participate in the National Festival held in Washington D.C.

Comparison of Officer- and Civilian-Initiation on Levels of Disproportionate Minority Contact

Carrie Stone
Mentor: Monica Williams | Department: Criminal Justice

Western Association of Criminal Justice
Las Vegas, Nevada

Abstract

The majority of previous research has explained disproportionate minority contact (DMC) using two hypotheses: differential offense and differential treatment. Many researchers have suggested that further explanations exist; but few studies attempt to seek out those explanations. During the 2017-2018 academic year, two students and a faculty advisor from Weber State University's Community Research Team worked with a local police department to discern if DMC was present in the target jurisdiction; and, if so, to analyze patterns of DMC in civilian- vs. officer-initiated contacts. The police department provided a multitude of redacted law records, citations, and field interview reports filed between April 1, 2016 to March 31, 2017. Utilizing this information, the researchers found that DMC was present in the target jurisdiction. Further analyses revealed that, with only two exceptions, patterns of over- and underrepresentation of racial and ethnic groups differed between civilian and officer-initiated contacts. Relative to their proportion in the target population, individuals perceived by officers to be black alone (not of Hispanic decent) were overrepresented in both civilian- and officer-initiated contacts with police. Similarly, individuals perceived by officers to be Asian alone were underrepresented in these same contacts.

Irene Ryan Nominee: The Kennedy Center American College Theatre Festival

Landry Thomas
Mentor: Andrew Lewis | Department: Performing Arts

The Kennedy Center American College Festival
Los Angeles, California

Abstract

When participating in the production of Ruthless as Tina Denmark, I had a question of why I keep getting cast as child roles? This is the second year in a row where I've been cast as a child. When in theatre there is a type cast or a character that you keep getting cast as. Whether the child, old lady, or leading lady. The question I asked myself is how am I going to show at this invited competition that I can perform mature roles too? As a student actor in this production, this most recent Fall semester, I had the opportunity to learn how to work with other student actors to bring this show from paper to the stage. Looking at the script by Joel Paley, this character tuned into my younger self to perform a child murderer. With direction from Andrew Lewis, we formed a spit fire of a character, that learned the value of talent and drive to become famous. My character also showed that being sweet isn't everything that it seems to be. This was different from other child characters I've played in the sense that this one was the craziest. That said, I keep getting cast as a child and I want to explore a more mature acting. Being able to attend workshops at the festival could help me have a learning tool. The Irene Ryan Scholarship competition allows students to prepare scenes and monologues that will be presented and performed at the Kennedy Center College Theatre Festival. There, I will have the chance to showcase my talents, judged by other actors and adjudicators, and have the chance to meet other professionals from the Theatre field. The festival will give me a chance to further my knowledge, take another student from Weber's theatre program, and show that if can play more than a child role. I have been invited to participate at the festival as an Irene Ryan Nominee. The grant would allow my partner and I to travel to Los Angeles, California and show what we worked on

to other students from other Western States. This competition includes the possibility of competing at the national festival in Washington DC and win a scholarship there. This grant would provide my registration, lodging, and educate me so I can be a well-rounded actress.

ERGO

Characterization of 4-Hydroxyisoleucine in Complex Mixtures by UHPLC-MS

Jared Thompson
Mentor: Todd Johnson | Department: Chemistry

Chemistry for New Frontiers
Orlando, Florida

Abstract

In various in-vitro and in-vivo studies, the naturally occurring amino acid found in fenugreek, 4-hydroxyisoleucine (4-OH-Ile), has been shown to stimulate insulin secretion and promote insulin sensitivity in type-II diabetic models. In this study, ultrahigh-performance liquid chromatography and tandem mass spectrometry were used to separate and detect 4-OH-Ile in complex biological samples. The structure and purity of isolated standard 4-OH-Ile was determined using high field HNMR and CMR. Collision of the precursor 148 m/z with argon in Q2 resulted in three major fragment SRMs with m/z ranges of: 74.22-74.33, 102.11-102.18, and 130.22-130.33. Increasing the collision energy in Q2 resulted in a much higher percentage of the 102 m/z peak, making it the most significant SRM for identifying 4-OH-Ile. Samples of water, breast milk, plasma, and urine were spiked with standard 4-OH-Ile at approximately 1 ppm, extracted, and then analyzed. The precursor 148 m/z and the product 102 m/z were detected in all samples tested. GC-MS was also used to confirm the identity of the amino acid in the spiked breast milk and plasma samples after derivatization.

MTNA National Final of the Senior Piano Competition

Min Shan Tsai
Mentor: Yu-Jane Yang | Department: Performing Arts

Music Teachers National Association
Spokane, Washington

Abstract

I have been chosen as the state first place winner of the MTNA Senior Piano (ages 16 to 18) Competition in Utah on October 26th, 2018. Then, I have submitted the video recordings for the Regional Round (which is the second stage of the three-tiered competitions) of the MTNA Southwest Division Senior Piano Competition in December 2018. I have just been informed that I will represent the Southwest Division to compete at the MTNA National Final of the Senior Piano Competition in Spokane, Washington on Mar. 15 – 19, 2019. I will be playing a 30-minute program consisting of 4 pieces at the MTNA National Final of the Senior Piano Competition, including: Ballade No.1 in G Minor by Frédéric Chopin, Prelude and Fugue No.12 in F Minor BWV 881 by Johann Sebastian Bach, 24 Preludes No.1 to 6 by Alexander Scriabin, and Piano Sonata in F Minor, Op.57 Mov. III by Ludwig van Beethoven. I feel very honored and delighted to compete at the MTNA National Final of the Senior Piano Competition. It is such an exciting and significant opportunity for me to compete at a national competition representing WSU, the state of Utah, and the Southwest Division.

ERGO

Non-Starter Lactic Acid Bacteria Growth in Cheese

Amanda Varley
Mentor: Michele Culumber | Department: Microbiology

American Society of Microbiology Microbe 2019
San Francisco, California

Abstract

Non-starter lactic acid bacteria (NSLAB) growth in cheese can cause issues with flavor, texture, and visual appeal of the finished product. Evidence suggests that as cheese ages, the number of NSLAB increases while the number of starter lactic acid bacteria (SLAB) decreases. Our objective was to monitor the growth of NSLAB during aging in Cheddar cheese and to correlate that growth with detection of Lactobacillus wasatchensis, a NSLAB known to cause gas defects. Two separate batches of Cheddar cheese were made in a facility with Lb. wasatchensis contamination and aged for between 5 and 48 weeks. Weekly, SLAB and NSLAB organism were quantified on M17+Lactose agar aerobically, and MRS-ribose agar anaerobically, respectively. Colonies were counted after 24 h for SLAB, and at 48 h and 5 d for slow-growing NSLAB. SLAB concentrations appeared to remain at about 108 cfu g-1, while NSLAB increased from below detection to 108 cfu g-1. During aging, DNA was extracted directly from the cheeses using a modified DNeasy Soil DNA Extraction Kit (Qiagen). Final extracted DNA yields ranged from 445 ng g-1 to 2.2 µg g-1 cheese but did not appear to correlate with the cell concentrations. Variation in the NSLAB and SLAB concentrations and DNA yields may be due to heterogeneity in the cheese or the changing chemical and physical properties of aging cheese. Lb. wasatchensis was detected by PCR with species specific primers at 3 and 13 weeks of aging in the different batches of cheese when NSLAB concentrations were 106 cfu g-1 and 107 cfu g-1, respectively. Lb. wasatchensis appears to represent a constant but low proportion of the NSLAB in cheeses produced in this facility but they accumulate as the cheese ages. Predicting how long it takes for detectable Lb. wasatchensis to grow probably depends on

the initial contaminant load. Further work to develop more sensitive detection techniques, including microbiome analysis, will allow us to better understand and control the growth dynamics of this organism.

Predicting Catabolic Pathways in Lactobacillus Wasatchensis Using Metabolic Modeling

Serena Young
Mentor: Craig Oberg | Department: Microbiology

American Society of Microbiology Microbe 2019
San Francisco, California

Abstract

Lactobacillus wasatchensis, an obligate heterofermentative nonstarter lactic acid bacteria can cause late gas production and splits and cracks in Cheddar cheese. Our goal was to identify potential sources of 6-carbon sugar-compounds that may be present in cheese and cause release of CO2 when converted to a 5-carbon sugar and utilized by Lb. wasatchensis for energy production. Previous studies did not explain late gas production in cheese when no galactose was present. Potential relevant metabolic pathways were determined based upon the genome of Lb. wasatchensis WDC04. The genome sequence was exported from the NCBI Genbank database, then metabolic modeling was performed using Knowledgebase Predictive Biology software to map the genes present for various metabolic pathways. Based upon data output from a flux balance analysis, it was confirmed that Lb. wasatchensis contains a complete pentose phosphate pathway (PPP), while pathways for glycolysis, tricarboxylic acid, and galactose metabolism were incomplete. To confirm these predictions and to look for alternative carbon metabolic pathways, we tested five strains of Lb. wasatchensis (CGL02, DH3, LD13, SH05, WDC04) in carbohydrate restricted MRS (CR-MRS) broth in micro-well plates supplemented with 7% oxyrase and 0.5% of either ribose, lactose, galactose, or N-acetylglucosamine (NAG). Growth occurred with ribose but was negligible when lactose, galactose, or NAG were the only carbohydrate present. The metabolic modeling also predicted additional carbohydrates that might be utilized by Lb. wasatchensis including gluconate which is the oxidized form of glucose. Gluconate contains 6 carbons and Lb. wasatchensis contains the genes for it to be converted to ribose-5-P using phosphogluconate

dehydrogenase by a decarboxylating step, producing CO2 in a similar way to galactose, when used as an energy source for the PPP. When inoculated into CR-MRS containing 0.5% sodium gluconate, four of the Lb. wasatchensis strains grew, confirming utilization of gluconate. Presence of gluconate in cheese thus becomes another risk factor for unwanted gas production and formation of splits and cracks in cheese.