

ERGO

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LETTER FROM THE EDITOR

Research is to see what everybody else has seen, and to think what nobody else has thought.

— **Albert Szent-Gyorgyi**

I am incredibly honored to present the tenth volume of Ergo. Weber State University offers a unique opportunity to participate in undergraduate-level research; as a result, our students are exploring the world around us, providing new information, and adding to the collective knowledge of their disciplines.

I have thoroughly enjoyed working on this tenth edition of Ergo. This journal would not have been possible without the amazing collaborative efforts of my staff. I would like to give special thanks to Erin Kendall, Tess Woodward, and Marisa Neil for their dedication to this journal and their hard work. I would especially like to express gratitude to Dr. John F. Cavitt; his passion for research and discovery continues to encourage and support undergraduate research and the publication of this Ergo.

Finally, I wish to thank the reviewers - both faculty and student. Each reviewer brought expertise from various areas of campus allowing Ergo to include diversity among the disciplines. I hope this journal causes you to pause and see things in a different light.

Kindest Regards,

A handwritten signature in black ink, reading "Megan Burton". The signature is fluid and cursive, with a long horizontal line extending from the end.

Megan Burton
Editor-in-Chief



ATHLETIC TRAINING

Jerry & Vicki Moyes College of Education

Correlation of Blood Type to Achilles Tendon Cross Sectional Area Measured via Imaging Ultrasound

Desirae Cruse | Mentor: Justin Rigby

Abstract

The purpose of this study was to determine if there is a correlation between Achilles cross sectional area thickness and blood type. This is a longitudinal study. Participants included division I NCAA cross country athletes (mass= 61.3 ± 20.2 kg, height= 168.9 ± 17.2 , gender= 9 males, 16 females, years of running experience= 6.5 ± 5.5 years, years run collegiately= 2.5 ± 1.5 years). The dependent variable was Achilles tendon cross sectional area measured by musculoskeletal imaging ultrasound. Repeated measures ANOVA was used to test difference between blood type and Achilles tendon area changes over a cross country season. There was no difference between blood type and cross sectional area of Achilles tendon thickness over the course of the cross country season ($P=745$).

Introduction

The Achilles tendon is the largest tendon in the human body. Its located in the lower leg provides a connection between the triceps surae muscles (gastrocnemius and soleus) and calcaneus. The Achilles allows the gastrocnemius and soleus to plantarflex the foot.

The Achilles tendon is one of the most common sights of injuries despite being the strongest tendon in the body. There are various types of injuries that can occur, including tendinopathy and tendon rupture. Tendinopathy caused by acute or overuse mechanisms leads to degeneration of the Achilles tendon. If the degenerated tendon is not managed properly, more serious injuries, such as a partial or complete rupture, may occur. These Achilles tendon conditions are common in elite runners because of the repetitive motions performed (Kvist 1994).

3 Athletic Training

Blood type may be correlated to Achilles tendon degeneration. On the end of human chromosomes, there is an ABO gene and encodes for enzymes. Your blood type is dependent on which antigens are produced by those antigens and then appear on your red blood cells. There are four blood types: A, B, AB, and O. Type O blood was found to have higher rates of Achilles tendon rupture (52.8% of study population) than other blood types. When re-rupture occurred, 68.7% of the patients were in the O blood group (Jozsa et al, 1989). It is unknown if this correlation of blood type is also correlated to changes in Achilles tendon thickness during long distance running. The purpose of my study is to identify any relationship between blood type and cross sectional area thickness of the Achilles tendon.

Methods

This experiment was a longitudinal study design, collecting data throughout the cross country season. The dependent variable was the measurement of the Achilles tendon cross sectional area. The independent variables were time and blood type, which included: A+, A-, B+, AB+, O+ and O-. Time was measured during the duration of the season, with a preseason measurement that served as the baseline, then measuring every three weeks until their conference championships meet which was the postseason measurement.

Participants

The participants were twenty-five members (mass= 61.3 ± 20.2 kg, height= 168.9 ± 17.2 , gender= 9 males, 16 females, years of running experience= 6.5 ± 5.5 years, years run collegiately= 2.5 ± 1.5 years) of the NCAA Division I cross country team at Weber State University. Participants were excluded if they had an injury to their lower extremity within the past two months, or had to limited normal cross country activities at any time during the study. Each participant provided informed consent after reviewing the Weber State University Institution Review Board form.

Procedures

The first time the athletes came to the lab, we tested their blood type by using an ABO-Rh Combination Blood Typing Kit. The finger of the athlete's choice was cleaned with an alcohol prep wipe and pricked with

a disposable lancet. The athlete then put a drop of blood on each square of the plastic cover plate. One drop of Anti A, Anti B, and Anti Rh serum was combined with each blood droplet. We then stirred the combinations with a toothpick. We then placed the plates on a heating pack to promote clotting. The blood clotted according to their type of blood they had. If a person was O-, no clotting was present because no anti-serum was used.

There were four measurements of their Achilles, both right and left, taken every three weeks throughout the cross country season. The athlete lay prone on a treatment table with their ankle dorsiflexed to 90 degrees. A strap tied to the table was used to hold their foot in place. Two cross sectional area ultrasound images were recorded. Images were recorded using a 12 Linear ultrasound probe and the GE Logiq e (GE Healthcare, Little Chalfont, UK) ultrasound parameters were set using the ankle musculoskeletal preset. Using internal software area of the imaged Achilles tendon was measured and the average of the 2 images was used for data analysis.

The same procedures were used for each visit. Participants were asked not to run within four hours of their measurements.

Data Analysis

We used a repeated measures ANOVA to determine the differences between blood type and Achilles tendon cross sectional area over the cross country season. We used SPSS version 22 (IBM Corp., Armonk, NY) for all data analysis and alpha was set at $P \leq .05$.

Results

There was no significant main effect for blood type ($F_{2,41}=1.85$, $P=.170$). There was no significant difference between participants' blood type and over time (blood type*time interaction) ($F_{6,123}=.581$, $P=.745$). There was an overall change of Achilles tendon cross sectional area for all participants throughout the cross country season ($F_{3,123}=10.89$, $P\leq.001$). Graph 1 shows the cross sectional area Achilles tendon thickness measurements throughout the cross country season. Graph 2 shows that in addition to the corresponding blood type. There were only enough participants to compare A+, AB+ and O+ blood types.

Discussion

The main hypothesis for this study was that there would be a correlation between cross country runners' blood type and their Achilles tendon thickness. The idea for this study came from a study conducted by Maffulli et al. (2000). It was found that individuals with type O blood types rupture their Achilles more than the other groups. Type A blood individuals had the lowest rate of Achilles tendon rupture (Maffulli et al., 2000). Kujala et al (1992) also found blood type to be associated with Achilles peritendinitis.

The results of this study show that there was no difference between blood type groups. Currently no research has investigated if there is a correlation between Achilles tendon cross sectional area and rupture rates. Our research has a small sample size and future research should continue to evaluate this. Also, future research should identify if there truly is a correlation between Achilles tendon cross sectional area and rupture. Further examination of this area will help healthcare providers, such as athletic trainers, and coaches provide better care for their athletes. If there is a correlation between a certain blood type and the likelihood of injury, it can allow those athletes to better watch their susceptibility to certain injuries.

There was, however, a difference between baseline cross sectional area measurement and the three cross sectional area measurements following. After the first measurements, the thickness increased, and then decreased toward the end of the season. This could be due to the cross country runners tapering off their workouts towards the end of the cross country season to better prepare for conference and national championships. Some research shows that it is common for Achilles tendon thickness to decrease immediately after training for big races (Magnusson & Kjaer 2003).

Conclusion

There was no difference between blood type and cross sectional area of Achilles tendon thickness over the course of the cross country season.

References

- Kvist M. Achilles tendon injuries in athletes. *Sports Med Auckl NZ*. 1994;18(3):173–201.
- Jozsa L, Balint JB, Kannus P, Reffy A, Barzo M. Distribution of blood groups in patients with tendon rupture. An analysis of 832 cases. *J Bone Joint Surg Br*. 1989;71(2):272–274.
- Maffulli N, Reaper JA, Waterston SW, Ahya T. ABO blood groups and achilles tendon rupture in the Grampian Region of Scotland. *Clin J Sport Med*. 2000;10(4):269–271.
- Kujala UM, Järvinen M, Natri A, Lehto M, Nelimarkka O, Hurme M, Virta L, Finne J. ABO blood groups and musculoskeletal injuries. *Injury*. 1992;23(2):131–133.
- Magnusson SP, Kjaer M. Region-Specific Differences in Achilles Tendon Cross-Sectional Area in Runners and Non-Runners. *Eur J Appl Physiol*. 2003;90(5–6):549–553.

Figures

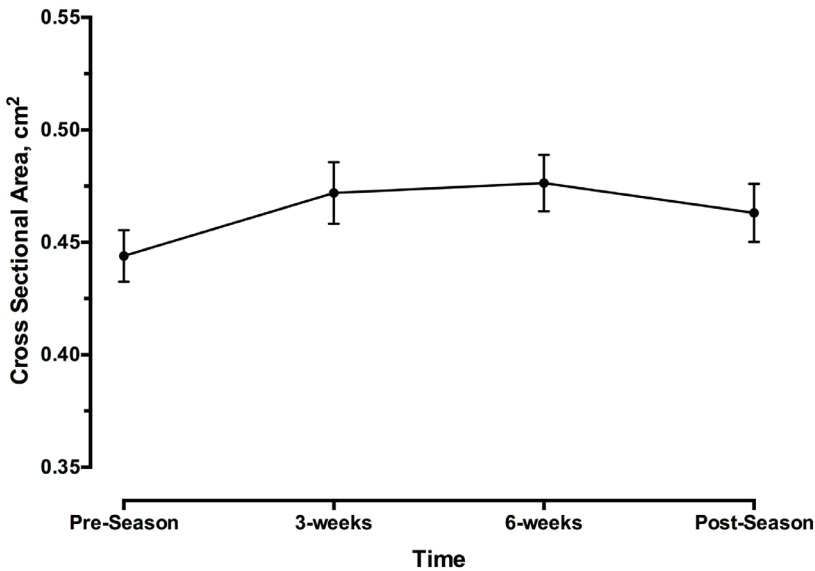


Figure 1. Cross sectional area of the Achilles tendons during NCAA cross country season.

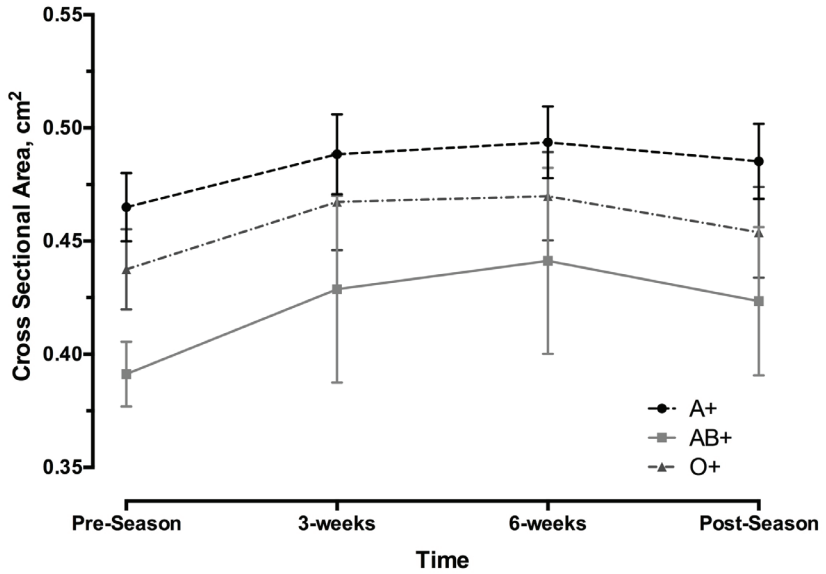


Figure 2. Cross sectional area of the Achilles tendons in correlation with their blood type during an NCAA cross country season.

Achilles Tendon Cross Sectional Area Gender Differences Within Division I Collegiate Athletes

Shaleese White | Mentor: Justin Rigby

Abstract

The aim of this study was to track adaptation in the Achilles tendon over a NCAA division I cross country season to determine the role of biological sex. This was a longitudinal study. Ultrasound images of the Achilles tendon were taken in the research lab. Twenty-seven participants were all division I NCAA cross country athletes (age= 19.88 ± 1.7 height= 66.2 ± 3.7 weight= 60.9 ± 9.3). Achilles tendon cross sectional area was obtained with diagnostic ultrasound imaging every 3 weeks starting before the first race. The independent variables are biological sex and time. The dependent variable was Achilles tendon cross sectional area. A repeated measures ANOVA was used to determine the cross sectional area changes between gender over the cross country season. Gender played a significant role ($P \leq .0001$) in Achilles tendon cross sectional area changes in NCAA division 1 cross country athletes.

Introduction

The Achilles tendon is the strongest and largest tendon in the human body. It is a band of connective tissue that joins the gastrocnemius and soleus muscle to the calcaneum (Buono, Chan, & Maffulli, 2013). The tendon can stretch up to 10% of its resting length (Neves, Johnson, Hunter, Myrer, 2014). The blood supply of the tendon is limited and decreases with age (Buono, Chan, & Maffulli, 2013).

The Achilles tendon sustains the largest loads of the body especially during high impact and repetitive motion such as running. It can reach a force up to 4 times an individual's body weight during walking and 8 times an individual's body weight during running (Hansen, Aagaard, Kjaer, Larsen, & Magnusson, 2003). These loads cause the tendon to be more susceptible to chronic and acute injuries (Obst, Newsham-west & Barrett, 2015).

There are many factors that come into play while discussing the effects of running on the Achilles tendon. Some include acute injury, chronic injury, tendon cross sectional area changes, and many others. We chose to determine how gender affects the Achilles tendon thickness of cross country runners over time. We hypothesized that male cross country runners thickness will increase more than females over a cross country season.

Methods

A longitudinal study was conducted that tracked Achilles tendon thickness changes among cross country athletes during their season. In the study Achilles tendon cross sectional area was measured as the dependent variable. The independent variables are gender and time. Other variables were assessed as covariates to determine if they influence genders effect of cross sectional area.

Imaging Ultrasound

In this study Achilles cross sectional area was measured using a musculoskeletal (MSK) imaging ultrasound (LOGIQ e General Electric, Inc, Fairfield, CT) to track Achilles tendon changes during the cross country season. The MSK ankle preset settings was used along with the focus position set at .2 to .5 cm and the image depth at 2.0 cm. The images measured tendon degradation and recovery during and after the cross-country season. Images were taken four times during the cross country season in 3 week intervals.

Participants

Twenty-seven participants consisting of 10 males and 17 females from the Weber State University cross country team (age= 19.88 ± 1.7 height= 66.2 ± 3.7 weight= 60.9 ± 9.3) were enrolled in the study. Before enrollment, participants were screened using the inclusion and exclusion criteria. Participants were included if they are a NCAA division I cross country athlete at Weber State University. Participants were excluded if they have had a lower extremity injury within the past 2 months of enrollments that has limited their regular activities for more than a week. All participants provided written informed consent and the study was reviewed and approved by the institutional review board (IRB) as

Weber State University before data collection occurred. Data collection occurred during the 2015 NCAA cross-country season.

Procedures

Participants were asked their age and gender at beginning of the study. Their height and weight were measured at the beginning of the study and measured throughout the study. They were instructed to refrain from exercises for at least 2 hours before testing. Each participant was asked to wear loose pants/shorts to allow access to the Achilles tendon. Patients were instructed to lay prone on the treatment table and each ankle was measured to 90° of dorsiflexion. Ultrasound gel was applied to the Achilles tendon and images were measured on both right and left sides. Two images were taken on each side and the average cross sectional area was used for these data analysis. The cross sectional area was measured using internal software on the imaging ultrasound. The same procedures were used for each participant visit.

Data Analysis

We used a repeated measures ANOVA to determine how the Achilles tendon cross sectional area changed during the cross country season based on gender differences over time. We first used a t-test to analyze the differences between the right and left Achilles tendon. There was no difference between right and left sides, therefore, we took the mean of both sides for the rest of the analysis. We ran a 2 x 4 (gender x time) repeated measures ANOVA to determine differences between genders over time. Statistical analysis was performed using SPSS version 22 (IMB Corp., Armonk, NY) and alpha was set at $P \leq 0.05$.

Results

A significant main effect of time was observed ($F_{2,144} = 15.73, P \leq .001$). The between subject main effect for gender was ($F_{1,48} 1.48 = 46.78, P \leq .001$). A gender by time interaction was also observed ($F_{3,144} = 956, P \leq .001$). Both findings indicate gender has a role in the cross sectional area changes in the Achilles tendon. Figure 1 shows the changes of the cross sectional area based on gender over the cross country season

Discussion

The aim of this study was to determine the difference in the cross sectional area of the Achilles tendon over the course of a cross country season. We analyzed the change in cross sectional area based on gender and time.

The cross sectional area with the male participants first increased, had a short period of decreasing, and then increased again. The cross sectional area for women increased until week 6 and then decreased toward the last race of the season. Males cross sectional area was larger compared to females throughout the whole study. Males generally have a larger body mass and muscle mass compared to females (Abe, Kearns & Fukunaga, 2003). In our study, male mass was higher than females creating a loading difference during running. The larger forces created by males aided Achilles tendon changes (Hansen, Aagaard, Kjaer, Larsen & Magnussen, 2003).

The cross country team, both male and female, had the same training schedule throughout the season. Towards the end of the cross country season as the team moved toward the postseason, training began to taper for both male and female teams. The female results followed the training pattern, increasing through the midseason and then decreasing as training began to taper. The males however had a different result. These difference result in males could be due to how tapering occurred between males and females. Toward the end of season those going to the conference championship continued their training but those who were not going to conference began tapering the training. For our study, we had more females than males participating. Therefore, about 50% of the males were able to compete at the conference championship meet, compared to only about 40 % of females. This could potentially account for decreasing in the cross sectional area within females as more of them had a tapering of training schedule.

Though biological sex differences of Achilles tendon cross sectional area occur, future research is needed to determine what this information mean for a health care clinician. There is no current literature that correlates Achilles cross sectional area to Achilles tendon injuries. We assume large Achilles tendon changes (either thickening or narrowing) could lead to tendon injuries, such as tendinopathy or rupture, but future research is needed to make this correlation. Additional research may

also be important to the timing of ultrasound images and when changes actually occur. The cross sectional area decreases in highly trained runners immediately after running (Tardioli, 2011).

The study's inferences are limited to NCAA division I cross country athletes. Those working with other types of athletes should keep in mind what has been presented however further research for the specific sport would be a good idea.

Conclusion

During the course of a NCAA cross country season the Achilles tendon cross sectional area increased more for males than females. Future research should identify if these biological sex differences play a role in Achilles tendon injury mechanisms.

References

- Del Buono A, Chan O, Maffulli N. Achilles tendon: functional anatomy and novel emerging models of imaging classification. *Int Orthop*. 2013;37(4):715–721. doi:10.1007/s00264-012-1743-y.
- Neves KA, Johnson AW, Hunter I, Myrer JW. Does Achilles Tendon Cross Sectional Area Differ after Downhill, Level and Uphill Running in Trained Runners? *Journal of Sports Science and Medicine*. 2014;13:8823–8828.
- Hansen P, Aagaard P, Kjaer M, Larsen B, Magnusson SP. Effect of habitual running on human Achilles tendon load-deformation properties and cross-sectional area. *J Appl Physiol*. 2003;95.
- Obst S, Newsham-West R, Barrett R.(2015). Changes in Achilles tendon mechanical properties following eccentric heel drop exercise are specific to the free tendon. 2015.
- Abe T, Kearns C, Fukunaga TN. Sex differences in whole body skeletal muscle mass measured by magnetic resonance imaging and its distribution in young Japanese adults. *British Journal of Sports Medicine*. 2003;37.

Tardioli A. Structural changes in the achilles tendon in response to a marathon: ultrasonographically detectable changes immediately and at 2 weeks post marathon. 2011;(45).

Magnusson SP, Kjaer M. Region-specific differences in Achilles tendon cross-sectional area in runners and non-runners. *Eur J Appl Physiol.* 2003;90(5-6):549-553.

Greenhalgh A, Sinclair J. Comparison of Achilles Tendon Loading Between Male and Female Recreational Runners. 2014;44:155-159.

Figure

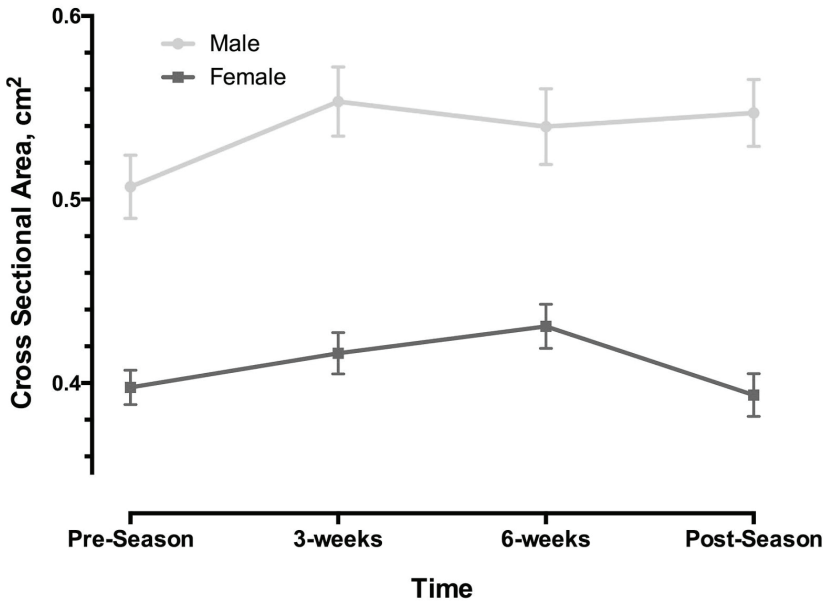


Figure 1. Changes in the cross sectional area (mean \pm 1 SE) based on gender over the cross country season.



ECONOMICS

John B. Goddard School of Business & Economics

Medical Marijuana Legalization and Its Effect on Crime

Cameron Lucker, Breckell Soifua, & Bryan Cook

| Mentor: Brandon Koford

Abstract

Using U.S. state panel data and difference-in-difference regression analysis, this study estimates the effect that medical marijuana legalization has on both property and violent crime rates. The results indicate that medical marijuana legalization leads to a decrease in property crime rates of approximately 4.51%. Violent crime rates were unaffected by medical marijuana legalization. Both of these results contradict the idea that medical marijuana legalization leads to increases in crime.

Introduction

Medical marijuana legalization (MML) in Utah as well as many other states has made its way to the forefront of discussions amongst state legislators (Leonard, 2015). What began with the state of California in 1996, has led to 22 additional states making the decision to enact MML laws ("23 Legal," 2015). Since the drug's criminalization in 1937, conducting research on both the effects of the drug itself and the impact its medical legalization has on society has been next to impossible due to strict government restrictions set in place by marijuana's classification as a Schedule 1 drug (Chesler, 2015). This obscurity has contributed substantially to MML remaining highly controversial. With a large number of supporters on both sides of the argument, there is a growing need for research and conclusive evidence on the effects on MML.

A significant portion of the debate focuses on the topic of crime and whether there are notable changes in crime following the legalization of medical marijuana (Leonard, 2015). One major area of concern is whether marijuana itself promotes violent or other criminal behavior (Moulton, 2015; Tremoglie, 2014). A definitive statement on the matter is yet to be accepted ("Marijuana," 2013). Without a clear understanding of marijuana's

side effects, it is difficult to accurately predict the effect that MML will have on society. We contribute through looking at the effect of MML on both property and violent crime rates by using a difference-in-difference regression design that makes it possible to isolate MML's true effect.

Literature

There remains to be very few studies on the topic of MML and its correlation to crime rates. Most literature on marijuana usage and its relation to crime deals strictly with recreational marijuana usage and not with MML. However, the results from these studies are interesting and should be considered when studying the correlation between MML and crime rates.

MML policies have evolved over the years and are often composed of different components. Pacula et al. (2015) use a difference-in-difference design to assess the relationship between MML laws and recreational marijuana use by the general population. They conclude that the specifics of the policy enacting MML play a significant role in recreational marijuana usage (Pacula, 2015). Their use of state and year fixed effects creates the same difference-in-difference design that we will apply in our model.

Morris et al. (2014) find that MML does not increase crime rates. In fact, the study concludes that legalization may even lead to reduced crime rates in some categories. We contribute to the literature by employing a difference-in-difference design for a more inclusive panel than the study by Morris et al. Their work examines the period from 1990-2006. Our data set extends through 2012 and thereby captures MML in eight additional states.

Economic Model

The econometric model is designed with the purpose of identifying whether a state enacting MML laws experiences a statistically significant change in crime rates. We will look for this change by using difference-in-difference regression analysis for panel data.

In order to see the effect on both violent and property crime in a specific state, two separate ordinary least squares regression models will be used. The models can be represented by:

$$y_{st} = \beta_0 + \delta_0 \text{MML}_{st} + \beta_1 x_{1st} + \dots + \beta_n x_{nst} + a_s + b_t + u_{st}$$

where y_{st} represents the dependent variable, property crime rate or violent crime rate, for a given state (s) and year (t). Our control variables $\{x_1, \dots, x_n\}$ include state and year specific values for unemployment rate, population in thousands, poverty rate, per capita income, prison population per 100k, and beer consumption per 100k. The coefficients $\beta_1 - \beta_n$ are used to describe the partial effect of the corresponding control variable on the crime rate. MML, our variable of interest, equals one when medical marijuana has been legalized in a given state, and zero otherwise. State and time fixed-effects are represented by a_s and b_t respectively. Finally, u_{st} represents the error term for a given state and year.

Since treatment status varies by both state and time, we have taken a difference-in-difference approach in our regression. The difference-in-difference method estimates the impact of MML on crime rates in target states using changes in crime rates in states that did not enact MML as a controls for unobservables that may affect both MML and non-MML states. The state fixed-effects control for unobserved state specific factors affecting crime rates that do not change over time while the fixed time effects control for unobserved time specific factors affecting crime rates that do not vary by state. The state and time fixed-effects along with the MML indicator variable in the model are what allow for the difference-in-difference interpretation of the results. In the empirical model, the impact of MML is given by δ_0 . Using expected values as an example, the difference-in-difference approach can be represented by:

$$[E(y_{sm} | s = s_i, m = 1) - E(y_{sm} | s = s_i, m = 0)] - [E(y_{sm} | s = s_j, m = 1) - E(y_{sm} | s = s_j, m = 0)]$$

where s_i represents any given state where the before effect ($m = 0$) and after effect ($m = 1$) of MML can be measured. We define s_j as any given state that experiences no MML policy change.

Data

As part of our contribution to the literature, we have gathered data for every state spanning the years 1990 to 2012, rather than from 1990 to 2006. This has allowed us to further analyze the “before and after” effect of MML on crime rates by including eight additional states who have passed MML laws from 2007 to 2012.

Our dependent variables are the numbers of property and violent crimes per 100k for a given state and year. In order to analyze the percentage

change in the crime rates, we will take the natural log of both the property and violent crime rates. The data we are using for both types of crime comes from the Uniform Crime Reporting Statistics via the U.S. Department of Justice.

Data for MML will be determined based on whether or not the state of interest has enacted or upheld MML laws in the given year. The control variables in our analysis include unemployment rate, population in thousands, poverty rate, per capita income, prison population per 100k, and beer consumption in 31 gallon barrels. Data used for these variables came from the Bureau of Economic Analysis, Bureau of Justice Statistics, U.S. Census Bureau, and the Beer Institute. Unlike the research conducted by Morris et al., we have decided not to control for educational attainment and police officers per 100k due to inconsistency in how the variables were defined in their respective surveys. Summary statistics for our variables appear in Table 1.

Results

Our regression model produced the results outlined in Table 2. The table includes estimates for the coefficients on each of the explanatory variables as well as the corresponding estimates for the standard errors. Statistical significance is determined at the 10%, 5%, and 1% levels. Each of the presented standard errors have been calculated as clustered robust standard errors to help mitigate against the effect of heteroskedasticity and to allow for intrastate correlation across observations.

If we first look at the results for property crime, we notice that MML has a negative impact of approximately 4.51%, significant at a 10% level. Additionally, our results suggest that MML leads to a positive impact of approximately 1.78% on violent crime. However, the effect is statistically insignificant. Therefore, there is no conclusive evidence to suggest that MML has either a positive or negative impact on violent crime. While only property crime sees a significant reduction as a result of MML, both results strongly contradict the idea that MML should lead to an increase in these criminal behaviors.

Robustness

The District of Columbia, although not a state, still holds a population that is roughly as large as North Dakota's. Additionally, MML has been enacted in D.C. since 2010. Although we had hoped to include D.C. in our model, several data points were missing in the prison population surveys. To conduct this sensitivity check, we included D.C. despite the missing data points for prison populations. The same results held true, with an even larger negative coefficient and smaller corresponding p-value ($\delta_0 = .0466$, p-value = .067).

A falsification exercise was also conducted by assigning MML values to neighboring states that do not currently have MML enacted, and removing the states that do have MML enacted from the model with the objective of observing a divergence from the effect that MML has in the original model. The falsification regression model results in a positive but insignificant MML coefficient of approximately 2.39% on property crime ($p = .397$), and a positive but insignificant MML coefficient of approximately 6.28% on violent crime ($p = .27$). The disappearance of MML's decreasing effect on property crime in this falsification exercise provides additional strength to the results found in the original model.

Conclusion

It is becoming more widely accepted that marijuana can serve a medicinal purpose amongst people suffering from a variety of mental and physical illnesses. If this is the case, it is crucial that society understands the potential adverse effects. This study contributes by controlling for several socio-demographic variables and implementing a difference-in-difference design in order to isolate the effect that MML has on property and violent crime rates. We have discovered evidence indicating that enacting MML laws does not affect violent crime rates, and may even lead to a statistically significant and practically important decrease in property crime rates. Since MML has been confirmed to increase overall marijuana usage, decreased property crime rates could very well be a result of the strong sedative effects brought on by marijuana use, reducing the overall desire for the user to partake in property related crimes (Frieze & Grube, 2013).

The key to further uncovering the true effect that MML has on crime rates will come from controlling for the potentially remaining endogenous

socio-demographic variables such as educational attainment and police officer populations (“Crime Rates,” 2013; Chalfin & McCrary, 2012). Without removing the endogeneity from our model, biasedness, to some degree, will continue to exist in the coefficient estimates. Another area to consider is the difference in MML policy details between states, and whether this has an effect on crime rates. Further work could also be done by applying missing data replacement (imputation) techniques in order to estimate the missing observations we encountered amongst some of the data. Despite these weaknesses, our results, alongside other MML literature strongly suggest that MML does not lead to an increase in property or violent crime rates.

References

- Leonard, W. (2015, August 19). Experts discuss health impacts of medical marijuana in Utah. Retrieved October 31, 2015, from <http://www.deseretnews.com/article/865634872/Expertsdiscusshealthimpacts-ofmedicalmarijuanainUtah.html?pg=all>.
- (November 12, 2015). 23 Legal Medical Marijuana States and DC Medical Marijuana ProCon.org. ProCon.com. Retrieved October 30, 2015, from <http://medicalmarijuana.procon.org/view.resource.php?resourceID=000881>.
- Moulton, K. (2015, August 19). Colorado drug investigator to Utah: Beware of medical marijuana. Retrieved October 30, 2015, from <http://www.slttrib.com/home/2855724155/coloradodruginvestigatorrecounts-mayhem-after>.
- Chesler, J., & Ard, A. (2015, August 19). Federal Restrictions Hamper Medical Marijuana Research. Retrieved October 31, 2015, from <http://fcir.org/2015/08/19/federalrestrictionshampermedicalmarijuana-research/>.
- Tremoglie, M. (2014, March 7). Does Marijuana Cause Violence? Retrieved November 3, 2015, from <https://www.mainstreet.com/article/doesmarijuanacauseviolence>.
- Marijuana and Aggression. (2013, June 1). Retrieved November 3, 2015, from <http://learnaboutmarijuanawa.org/factsheets/aggression.htm>.

- Pacula, R., Powell, D., Heaton, P., & Sevigny, E. (2015, February 2). Assessing the Effects of Medical Marijuana Laws on Marijuana Use: The Devil is in the Details. NCBI. Retrieved December 15, 2015 from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4315233/>.
- Morris, R., Barnes, J., TenEyck, M., & Kovandzic, T. (2014, March 26). The Effect of Medical Marijuana Laws on Crime: Evidence from State Panel Data, 19902006. Retrieved October 31, 2015, from <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0092816>.
- Friese, B., Grube, J. (2013, February 1). Legalization of medical marijuana and marijuana use among youths. NCBI. Retrieved December 10, 2015, from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3638722/>.
- (September 12, 2013). Crime Rates Linked To Educational Attainment, New Alliance Report Finds. Alliance For Excellent Education. Retrieved January 29, 2016, from <http://all4ed.org/press/crimerateslinkedto-educationalattainmentnewalliancereport finds/>.
- Chalfin, A., & McCrary, J. (2012, November 11). The Effect of Police on Crime: New Evidence from U.S. Cities, 19602010. Retrieved January 29, 2016, from http://eml.berkeley.edu/~jmccrary/chalfin_mccrary2012.pdf.

Tables

Dependent Variables (Prior to log transformation)	Mean	SD
Violent Crime per 100k	451.64	225.49
Property Crime per 100k	3719.76	1070.41

Independent Variable	Mean	SD
MML	.14	.35

Socio-demographic Control Variables	Mean	SD
Unemployment Rate (%)	5.65	1.89
Population (in thousands)	5610.75	6209.08
Poverty Rate (%)	12.67	3.56
Per Capita Income	30145.61	8950.04
Beer Consumption per 100k	74038.22	12298
Prisoners per 100k	387.77	168.28

Note: All summary statistics reflect statewide data from 1990 - 2012. Sample size for all variables is 1150.

Table 1. Summary Statistics.

Variables	Property Crime	Violent Crime
Medical Marijuana Legalization	-.0450768* (.0254266)	.0177671 (.0487775)
Unemployment Rate	.0025488 (.0100211)	-.0299654** (.0134895)
Population (in thousands)	-.000019 (.0000117)	-.0000644*** (.0000233)
Poverty Rate	-.1370552 (.2266635)	.5787803 (.4197913)
Per Capita Income	-.0000148*** (.00000528)	-.00000123 (.0000118)
Beer Consumption per 100k	.00000619*** (.00000172)	.0000137** (.00000641)
Prisoners per 100k	.0001174 (.0001331)	.0002638 (.00027)
State Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
N	1150	1150

Clustered robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

Table 2. Impact of MML of Property Crime and Violent Crime.

The Effect of Welfare Benefits on the Poverty Rate

Gerritt VanderToolen | Mentor: Therese Grijalva

Abstract

The debate ensues as to the effectiveness of welfare spending on the poverty rate. Some academics have demonstrated that welfare expansion leads to dependency and increased poverty. Others have shown that the welfare spending has a poverty reducing effect which is often masked by other variables. Using a two-way fixed effects model with state-level data for the 50 states from 2000–2012 I regress the poverty rate on welfare reception in the form of cash payments and a number of other control variables. One of these controls is a constructed work disincentive variable which allows me to isolate the effect of cash payments on welfare free from the work disincentive effect. I found that there is a significant work disincentive and poverty reducing effect of cash payments on the poverty rate. Quantitatively I find that a \$1000 annual individual increase in cash payments amounts to an approximate 1% decrease in the poverty rate.

Introduction

National poverty reduction efforts, most notably President Roosevelt's New Deal, President Johnson's Great Society, and President Clinton's welfare reformation efforts have induced public examination of welfare spending or government transfers on reducing poverty rates. The purpose of this study is to examine the efficacy of welfare spending on the poverty rate and determine whether a work disincentive exists.

In 2012, 15 percent of Americans, including adults and children of all ages, lived below the official poverty line. During that same year \$768 billion was spent on Social Security, \$251 billion was spent on Medicaid, \$78.4 billion was spent on Nutrition Assistance (formerly known as food stamps), and \$28.8 billion was spent on Temporary Assistance for Needy Families (TANF), commonly referred to as "welfare." These dollar figures are stated in nominal or unadjusted 2012 dollars (see Table 1 for data sources).

This research focuses specifically on measuring the effectiveness of cash benefits from TANF on the poor. *A priori* it is expected that welfare dollars reduce the poverty rate by supplementing the incomes of those below the poverty threshold.

Literature Review

Many studies have sought to measure the effectiveness of welfare and other government benefits on reducing the level of poverty. Some argue that these programs have failed to reduce poverty, and effectually perpetuate the problem by undermining the incentive to work (Marmor, Marshaw, & Harvey, 1990; Murray, 1984; Niskanen, 1996). Niskanen (1996) calls welfare a “social pathology.” He demonstrates that a one percent increase in welfare benefits increases the dependent population by 2.2 percent.

Other studies uphold the idea that benefit programs reduce the poverty rate, citing other factors (for example, a decrease in the manufacturing sector) that compete with the poverty reducing effect of aid spending (Ellwod & Summers, 1986; Greenstein, 1991, Marmor et al. 1990; Wilson,

1987). Fording & Berry (2007) developed a method that separates and analyzes two important effects of welfare reception, namely, the income enhancement and work disincentive effects.

The former implies that cash reception increases the income of the poor and reduces poverty, which is the intent. The latter implies that cash reception induces a lack of desire to obtain employment. This study will draw upon their methods to account for these effects.

Data

Data used for this study comes from a variety of sources including the U.S. Census, Bureau of Labor Statistics (BLS), Bureau of Economic Analysis (BEA), Centers for Disease Control and Prevention (CDC), Social Security Administration (SSA), Medical Statistical Information Systems (MSIS), U.S. Department of Agriculture Food and Nutrition Services (FNS), and the U.S. Department of Health Administration for Children and Families (ACF). See Table 1 for a complete listing of variable names, definitions, descriptive statistics, and sources. Data for all 50 states from 2000 to 2012 is used.

All dollar amounts in this study are adjusted to year 2000 dollars. This is accomplished through regional Consumer Price Index (CPI) data provided by the Bureau of Labor Statistics (BLS). An example of the methodology is as follows: CPI for Northeast in 2000 is 179.4. CPI in 2001 for the same region is 184.4. Adjusting a 2001 dollar figure to reflect 2000 dollars is accomplished mathematically as follows: $(179.4/184.4) \times (\text{nominal dollar figure})$. CPI data provided by BLS is divided into 4 regions (Northeast, Midwest, South, and West) and applied to each state respective of its region.

A variable of particular interest to this study is unskilled wage, which represents the typical wage a welfare recipient could earn if they chose to join the labor force, as opposed to being on welfare. These data come from the BEA and are represented by the retail sector wage. The retail sector includes clothing stores, toy stores, fast food restaurants, etc., and acts as a good proxy for what a typical welfare recipient would earn if they chose to work. This data will play an important role in calculating the work-disincentive effect.

Econometric Methods

To properly account for the panel nature of the data, this study uses a two way fixed effect least square dummy variable (LSDV) model. The LSDV model allows for heterogeneity between the different states and accounts for movement through time.

The poverty rate is the dependent variable. Poverty rates are explained by the level of welfare payments, represented as CASH in the model, holding all else constant. CASH is calculated as a ratio of total welfare cash payments to total welfare recipients in a given state in a given year.

An important independent variable is created to account for the work disincentive effect of welfare. It is calculated by dividing the total welfare benefit by the unskilled wage $TTLAID/USNWGE$. Total welfare benefits capture the entire individual welfare package, including both cash and in-kind assistance from TANF and SNAP.

It is expected *a priori* that the ratio of welfare benefits over unskilled wage ($TTLAID/USNWGE$) translates into a work disincentive effect. The closer the total welfare package (represented by $TTLAID$) begins to near or exceed what an individual could earn through work (represented by $USNWGE$),

the less incentive that individual has to work. This explanatory variable controls for the unintended behavioral side effect of welfare reception, which results in a more accurate interpretation of the CASH coefficient.

The complete model explains the poverty rate at time t and in state i as a function of cash payments, work disincentive, a lagged poverty rate variable, and other variables, Z , that vary by state and time such as high school graduation rates and percent out-of-wedlock births:

$$\text{Poverty Rate}_{i,t} = \beta_0 + \beta_1 \text{CASH}_{i,t} + \beta_2 \text{POVERTY}_{(t-1)i,t} \\ + \beta_3 \text{TTLAID}/\text{UNSWGE} + \sum (\beta_j Z_j) + \epsilon_{i,t}$$

Estimation Results

Preliminary experiments were conducted using a bivariate Ordinary Least Squares (OLS) regression model to test if regressing the poverty rate on cash benefits alone would produce a reasonable result. It produced the following equation (p-value was equal to 0.00):

$$\text{Poverty}_{i,t} = 15.2 - 0.00112 \text{CASH}_{i,t} + \epsilon_{i,t}$$

This result suggests that \$1000 annual individual increase in welfare payments (just over \$83/month) amounts 1.12% decrease of the poverty rate. The model is then upgraded from a bivariate model to one that includes the two variables of greatest interest to this study, cash benefits *and* work disincentive. It produced the following equation (p-value of 0.00 for both independent variables).

$$\text{Poverty}_{i,t} = 11.0 - 0.00490_{i,t} + 27.5 \frac{\text{TTLAID}}{\text{UNSWGE}_{i,t}} + \epsilon_{i,t}$$

The regression equation indicates that a \$1000/year individual increase in cash payments would decrease the poverty rate by 4.9%. The coefficient on the work disincentive variable is positive and statistically significant. When aid (TTLAID) increases relative to wages (UNSWGE) the overall work disincentive variable increases, causing a disincentive to take effect. Conversely, if wages were to increase relative to aid, the ratio would decrease and the work disincentive would lessen.

The experiment continues by incorporating a number of control variables known to influence the poverty rate. These include the unemployment rate, real per-capita income, percent of unwed births, percent of manufacturing

jobs relative to the population, percent of population with a high school diploma, and percent of the population on Social Security. The model also incorporates a 1-year time lag of the poverty rate as an independent variable. Relative unskilled wage and relative unemployment are included in the model consistent with Fording and Berry (2007). Applying these additions control variables, and employing the LSDV model, the following equation results (Table 3).

$$\begin{aligned} \text{Poverty Rate}_{i,t} = & 19.0 + 0.429\text{POVERTY}_{(t-1)i,t} - 0.000881\text{CASH}_{i,t} \\ & + 5.76 \frac{\text{TTLAID}}{\text{UNSWGE}_{i,t}} + \sum (\beta_i Z_i) + \varepsilon_{i,t} \end{aligned}$$

Results & Conclusion

Welfare aid has two opposing effects. It decreases poverty by supplementing the income of the poor above the poverty threshold. It also increases poverty by making work less attractive. The model demonstrates both outcomes. It shows that that a \$1000 individual annual increase would decrease poverty by just less than one percent. Assuming a linear relationship, this means that a \$200 individual monthly increase in cash benefits would decrease poverty by just under 2 percent. The model also indicates that a one percent increase in the ratio of total welfare to unskilled wage increases poverty by over 5%. While the coefficient on this work disincentive variable is statistically significant, it is likely a gross overstatement of the true effect. This may be due to an inadequate construction of the proxy variable, which may lack accuracy in equating the disincentive. The model does affirm, however, the existence of a work disincentive component in the overall consideration of the effectiveness of aid spending. Future studies should consider this consequence when measuring the effect of welfare aid on the poverty level.

The weakness of this paper is that it lacks the ability to create a net measure of the overall effect of cash benefits on the poor when taking the opposing income enhancing and work disincentive hypotheses into effect. It does, however, demonstrate that both effects exist, and that cash welfare benefits do reduce the level of poverty in the United States.

References

- Ellwood, David T., and Lawrence H. Summers (1986). "Poverty in America: Is Welfare the Answer of the Problem?" In *Fighting Poverty: What Works and What Doesn't*, ed. S. Danziger, and D. Weinberg. Cambridge, MA: Harvard University Press, 78–105
- Fording, R. C., & Berry, W. D. (2007). The Historical Impact of Welfare Programs on Poverty: Evidence from the American States. *Policy Studies Journal*, 35(1), 37–60.
- Greenstein, Robert (1991). "Universal and targeted Approaches to Relieving Poverty: An Alternative View." In *the Urban Underclass*, ed. Christopher Jenks, and Paul E. Peterson. Washington, DC: Brookings Institution, 437–459.
- Marmor, Theodore R., Jerry L. Marshaw, and Philip L. Harvey. 1990. *America's Misunderstood Welfare State: Persistent Myths, Enduring Realities*. New York: Basic Books.
- Murray, Charles (1984). *Losing Ground: American Social Policy, 1950–1980*. New York: Basic Books
- Niskanen, William A. 1996 "Welfare and the Culture of Poverty." *Cato Journal* 16 (1): 1–15
- Wilson, William Julius (1987). *The Truly Disadvantaged*. Chicago:University of Chicago Press.

Tables

Variable	Explanation	Data Source	Mean	St. Dev.
POVERTY	Percent U.S. Poverty Rate	U.S. Census	12.96%	3.26%
UNEMP	Percent U.S. Unemployment rate	BLS	5.70%	2.11%
RELUNEMP	Relative Unemployment	BLS and U.S. Census	1.007	0.197
INCOME	Per capita income	BEA	\$30,595	\$6,557
UNWEDBRTHS	Percent out-of-wedlock births	CDC	36.6%	6.6%
UNSKLDWGE	Unskilled Wage	BEA	\$21,093	\$2,108
RELUNSKLDWGE	Relative unskilled wage	BEA and U.S. Census	0.998	0.089
MANUF	Percent manufacturing jobs	BLS	4.76%	1.95%
HSGRAD	Percent adults H.S. Graduates	U.S. Census	85.96%	3.91%
CASH	Average benefit/individual	DHS	\$5,072	\$2,711
SSREC	Percent SS recipients	SSA	2.19%	0.08%
TTLAID/UNSWGE	Total Benefits/Unskilled Wage	Medicaid Statistical Info. System, FNS	39.78%	12.26%

Table 1. Variable Explanations.

Independent Variable	Coefficient	t-stat
POVERTY _(t-1)	0.42899**	12.01
CASH	-0.0008806**	-2.11
TTLAID/UNSWGE (work disincentive)	5.759*	1.96
UNEMP	0.13421**	3.78
RELUNEMP	0.2348	0.71
INCOME	-0.00014382**	-3.22
UNWEDBRTHS	-0.08696**	-3.75
UNSKLDWGE	0.00012052*	1.73
MANUF	-36.37**	-3.48
HSGRAD	-0.08602**	-2.92
SSREC	0.2990	0.81

**p<0.05, one-tailed, *p<0.10 one tailed

Table 2. Estimation Results.

Is the Bookstore an Efficient Market?

Mengqi Hua | Mentor: Rong Rong

Abstract

This study tests the efficient market hypothesis (EMH) in the bookstore market. According to the EMH, the same product for the same use should have the same price level. I use paired-sample t-test and OLS regression to examine whether the bookstore market satisfies the EMH. The result shows that the bookstore market at WSU is not an efficient market. One possible reason is that buy-back options have a high risk due to the possibility that the bookstore may not buy the books back at the end of the semester. Future research may benefit from the study of the risk element.

Introduction

Students need to buy textbooks every semester. They have two ways to get their textbooks. First, they may rent the books. Second, they may buy the books upfront and perhaps resale it to others at the end of the semester. Thus, for the same usage value of a book for a semester, there are two types of prices, the rental price and the "Gap Price" (the difference between the initial purchasing price minus the resale value). The bookstore at Weber State University provides students both options.

The purpose of this research is to figure out whether the bookstore at Weber State University is an efficient market by comparing the rental prices of the books sold in the bookstore to the Gap Prices. I chose 85 books, which are used by general education classes to conduct this research.

Efficient Market Hypothesis (EMH) is an investment theory that states it is impossible to "beat the market" because stock market efficiency causes existing share prices to always incorporate and reflect all relevant information. According to the EMH, the same product for the same use should have the same price level. If the bookstore is an efficient market, the prices of using a book for a semester should be the same whether it is rented or purchased upfront and sold back. Otherwise, people can earn money through arbitrage. Therefore, I test the difference between

rental prices and Gap Prices to test whether the bookstore market is an efficient market.

The idea of EMH was first proposed by Bachelier (1900) and was developed by Fama (1970). They indicate that the price of a stock should be the present value of expected dividends. Ball (2011) shows that in an efficient market, people can choose stocks randomly because no stock can earn more money than others. Otherwise, people can earn extra money through arbitrage. Feenstra & Taylor (2014) indicates that arbitrage is a trading strategy that people can have the opportunity to get profit through price differences. People earn money by buying low and selling high. At that time, the market is out of equilibrium. Then the market price will adjust and reach equilibrium. Therefore, there will be no arbitrage existing in the market in the long run.

Many have found that the stock markets are not efficient markets (Lee et al. 2010, Dragota and Tilica 2014, Kumar 2013, Munir et al. 2012, Al-Ajmi & Kim 2012). However, controversy in this topic exists: Kumar (2013) and Munir et al. (2012) find that the stock markets in Portugal, Ireland, Greece, Malaysia, and Thailand are efficient markets.

The EMH can be applied to the product market. Dasgupta et al. (2007), Desai and Mehta (1997), and Mannering et al. (2002) show that the car market is not an efficient market. Henderson & Ioannides (1983) and Hjalmarsson & Hjalmarsson (2009) point out that the housing market is not efficient.

The result of this study shows that textbook market is not efficient, since the average rental price of a book is 16.67 higher than the average Gap Price. This study contributes the literature by implementing a novel method to test the market efficiency of a physical product market. Additionally, students could use the result this study to guide their choices between renting a book and buying a book upfront.

Methods

Data

The sample includes 85 textbooks officially listed for the general education classes, for both the new and used version. I obtain three kinds

of prices from campus bookstore: sale prices, buy-back prices and rental prices. Then, I construct the measure called Gap Price by subtracting the buy-back prices from the sale prices. I also collect data on the condition of the book (used vs new), the editions of the books and the current class enrollment from official sources. Table 1 lists all the statistical variables used in my research. The types of prices and the conditions of the book are the focus variables in the study, and the prices of the book are the dependent variables. The control variables are the enrollment and the editions of the books.

Econometric Methods

To figure out if the bookstore market is an efficient market or not, a paired-sample t-test will be used. I specify the null hypothesis of the t-test as follows:

H_0 : Rental prices = Gap Prices.

Additionally, I will use OLS Regression to investigate the influence of the variables on the prices of the books with control variables and without control variables. **Equation (1)** and **Equation (2)** are for regression specifications.

$$y = \beta_0 + \beta_1 + \beta_2R + \beta_3(N^*R) + \epsilon \quad (1)$$

$$y = \beta_4 + \beta_5N + \beta_6R + \beta_7(N^*R) + \beta_8Ed + \beta_9En + \epsilon \quad (2)$$

in which y represent the price (either rental price or gap price), N take the value 1 if the book is new, 0 if it is used. R takes the value 1 if the price is marked as rental, 0 if it is a Gap Price. Ed refers the edition. En refers to enrollment. If EMH holds, I expect to see that β_2 and β_6 equal to 0.

Results

The paired-sample t-test is used to examine whether the rental prices of the books are equivalent to the Gap Prices. The t-test shows that the mean of the rental prices [\$66.76 (\pm 41.37)] is significantly different from the mean of the Gap Prices [50.09 (\pm 35.10)] ($P < 0.01$) (see Figure 1).

Table 2 summarizes the regression results when the prices of the books are dependent variables with two different model specifications.

Model (1) is the multiple regression model without control variables. The model explains 22.35% of the variability of the dependent variable around its mean (adjust r-square = 22.35%). The variable "Rent" has a significant effect on the prices of the books ($p = 0.002$). The rental prices are \$17.01 higher than the Gap Prices holding other variables constant. The prices of new books are \$34.07 higher than the prices of used books holding other variables constant. This effect is also statistically significant ($p < 0.01$). The interaction effect between the conditions of the books and the types of prices does not have significant effect on the prices of the books ($p = 0.932$).

Model (2) is the multiple regression model with control variables. The model explains 33.47% of the variability of the dependent variable around its mean (adjust r-square = 33.47%). The rental price of a book is expected to be \$17.01 higher than the Gap Price holding other variables constant ($P=0.001$). The price of a new book is expected to be \$34.92 higher than the price of a used book holding other variables constant ($p < 0.01$). The interaction effect between the conditions of the books and the types of prices does not have significant effect on the prices of the books ($p = 0.927$). If the enrollment increases by one person per semester, the prices of the books will increase by \$0.0495 ($p=0.037$). One unit increase in the edition of the books can lead to the increase of the prices of the books by \$3.15 ($P<0.01$).

The above evidence seems to suggest that the bookstore market is not efficient. I conjecture the following reasons for its lack of efficiency. First, students may not know the buy-back prices and whether the bookstore wants to buy the books back at the end of the semester. Only at the end of the semester will the students know this information. In the theory of EMH, it assumes that all the people in the market know all the information about the products. However, in the bookstore market, information may not be fully available. Therefore, the bookstore market does not meet the standards of the EMH.

Moreover, in case a buy back is not offered by the bookstore, it will cost students effort to resale the book to other outlets off campus and the prices offered then is again uncertain. These risk a student may encounter may lead them to lean towards the option of renting the book for the security and convenience. This tendency of avoiding risk may allow the bookstore to raise the prices of the rental book. As a result, the bookstore market appears to be not efficient. Another possible explanation could

be that students at Weber State are budget constrained. If a student does not have enough money to purchase a full priced textbook upfront, he/she may choose the more costly rental option.

Conclusion

In the market of some certain products, people have two ways to get the product. The first one is to rent it, and the second one is to buy it from the retail market and sell it back to others after using. According to the EMH, the rental price of the same product should equal to the Gap Price.

I collect data from WSU bookstore and conduct paired-sample t-test and OLS regression to examining the EMH. I found that the rental price is significantly higher than the Gap Price, rejecting the hypothesis that the textbook market is efficient. Additionally, the data also supports that the higher the enrollment and the editions of the books are, the higher the prices of the books are.

My study contributes to the literature by establishing a novel and straightforward method to test EMH. The same method can be applied to verify the efficiency of a physical product market if the products are offered both as a rental and a retail product. I also discuss that risk and budget constraint might be some key factors that leads to the rejection of the EMH. Future research may benefit from studying the risk factor or consumer budget constraint involved with the retail option.

References

- Al-Ajmi, J., & Kim, J. H. (2012). Are Gulf Stock Markets Efficient? Evidence from New Multiple Variance Ratio Tests. *Applied Economics*, 44(13–15), 1737–1747.
- Bachelier, L. (1900). *Theorier de la speculation*. *Annales Scientifiques de l'Ecole Normale Supérieure* 17, 21–88.
- Ball, L. (2012). *Money, banking, and financial markets* (2nd ed.). New York, NY: Worth.

- Dasgupta, S., Siddarth, S., & Silva-Risso, J. (2007). To lease or to buy? A structural model of a consumer's vehicle and contract choice decisions. *Journal of Marketing Research*, 44(3), 490–502.
- Desai, P. S., & Mehta, S. R. (1997). Automobile Leasing: Affordability, Convenience and Reliability. *Purdue University Krannert School of Management*.
- Dragota, V., & Tilica, E. V. (2014). Market Efficiency of the Post Communist East European Stock Markets. *Central European Journal Of Operations Research*, 22(2), 307–337. doi:http://dx.doi.org/10.1007/s10100-013-0315-6
- Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work*. *The journal of Finance*, 25(2), 383–417. Feenstra, R., & Taylor, A. (n.d.). *International macroeconomics* (Third ed.).
- Hau, H. (2014). The Exchange Rate Effect of Multi-currency Risk Arbitrage. *Journal Of International Money And Finance*, 47304–331. doi:http://dx.doi.org/10.1016/j.jimonfin.2014.05.001
- Henderson, J. V., & Ioannides, Y. M. (1983). A model of housing tenure choice. *The American Economic Review*, 98–113.
- Hjalmarsson, E., & Hjalmarsson, R. (2009). Efficiency in Housing Markets: Which Home Buyers Know How to Discount?. *Journal Of Banking And Finance*, 33(11), 2150–2163. doi:http://dx.doi.org/10.1016/j.jbankfin.2009.05.014
- Kumar, D. (2013). Are PIIGS Stock Markets Efficient?. *Studies In Economics And Finance*, 30(3), 209–225.
- Lee, C., Lee, J., & Lee, C. (2010). Stock Prices and the Efficient Market Hypothesis: Evidence from a Panel Stationary Test with Structural Breaks. *Japan And The World Economy*, 22(1), 49–58. doi:http://dx.doi.org/10.1016/j.japwor.2009.04.002
- Lee, Y., & Chiu, C. (2011). Arbitrage Behaviour in the Exchange Rates of Taiwan and Japan: Applying the Smooth Transition Vector Error Correction Model with GJR-GARCH and Spillover Volatility. *Applied Economics*, 43(13–15), 1935–1943.

Mannering, F., Winston, C., & Starkey, W. (2002). An exploratory analysis of automobile leasing by US households. *Journal of Urban Economics*, 52(1), 154-176.

Munir, Q., Ching, K. S., Furouka, F., & Mansur, K. (2012). The Efficient Market Hypothesis Revisited: Evidence from the Five Small Open ASEAN Stock Markets. *Singapore Economic Review*, 57(3), 1-12.

Tseng, H. (2011). International Risk-Averse Arbitrage and Exchange Rate Volatility. *Economia Internazionale/International Economics*, 64(4), 503-524.

Figures & Tables

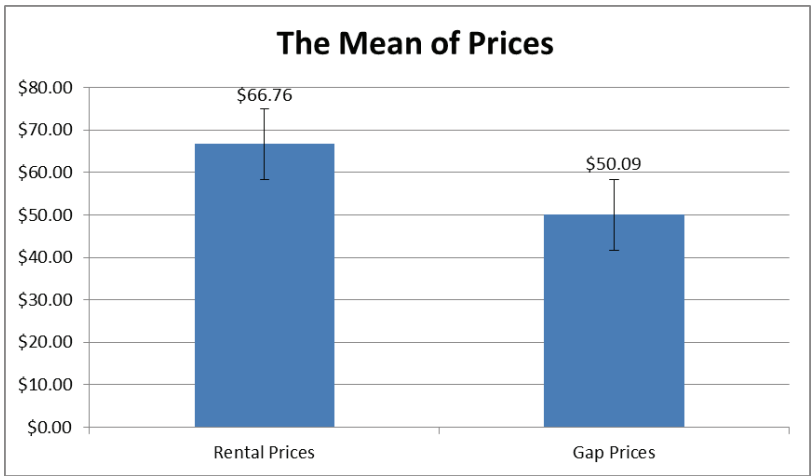


Figure 1. T-test.

Variable	Abbreviati	Explanation	Mean	St.	Min	Max
<i>Prices</i>	P	Rental price in the Fall 2014 semester; Gap between selling prices and buying prices in the Fall 2014 semester	\$58.43	\$39.21	\$-25.80	\$190.35
<i>Enrollment</i>	En	How many students register these courses.	80.23	75.14	13	458
<i>Edition</i>	Ed	Which editions these books are.	5.77	4.03	1	14
<i>Rent</i>	R	If the prices are rental price, it equals to 1. If the prices are Gap Prices, it equals to 0. (binary)	0.50	0.50	0	1
<i>New</i>	N	If the books are new, it equals to 1. If the books are used, it equals to 0. (binary)	0.52	0.50	0	1

Table 1. Statistical Variables.

Variables	Coef	Coef
<i>New</i>	34.07*** (5.44)	34.92*** (5.03)
<i>Rent</i>	17.01*** (5.57)	17.01*** (5.15)
<i>New*Rent</i>	-0.65 (7.69)	-0.65 (7.11)
<i>Enrollment</i>		0.0495** (0.0237)
<i>Edition</i>		3.151*** (0.441)
<i>Constant</i>	32.21*** (3.94)	9.61** (4.87)
Adj R ²	22.35%	33.47%
# of observations	324	324

Note: * = significant at 10%, ** = significant at 5%, *** = significant at 1%

in (): SE Coef

Table 2. Regression Result (dependent variable = the prices of the books).

Assessing the Impacts of Marijuana Policy on Tourism Demand in U.S

Mengshi Yu | Mentor: *Therese Grijalva*

Abstract

Faced with the heated discussion about “drug tourism,” the aim of this study is to find whether marijuana policy can affect tourism in the United States. Data was collected for fifty states from 2004 to 2013. I explore the relationship between state-level marijuana policies and income earned in the accommodations and food services industry; an industry greatly impacted by tourism. I find some evidence that less restrictive policies on marijuana use may promote tourism within a state.

Introduction

Drug tourism has recently been discussed as a means to generate income at the state level. As the name suggests, it “refers to the phenomenon of persons being attracted to a particular location because of the accessibility of licit or illicit drugs and related services” (Valdez and Sifaneck 1997). In the United States, Colorado has received a significant tax revenue increase since legalized marijuana, and as such the idea of legalizing marijuana has been on Legislative agendas as a means to promote economic growth.

There are many studies that have demonstrated the significance of tourism on economic growth (Sequeira and Nunes 2008; Gunduz and Hatemi 2005; Balaguer and CantavellaJorda 2002). Blake et. al (2008) demonstrates how tourism can alleviate poverty. Further, Nina Hyytia and Jukka Kola (2013) find that tourism has a positive relationship with economic development both in rural and urban areas. Furthermore, Ferro and Fluckiger (2003) finds that tourism policy is of vital importance in supporting OECD countries¹ by increasing tax revenues, and improving employment and regional economic development.

A number of studies explore factors that enhance tourism prospects. For instance, Moreno et.al (2015) finds that there is a negative relationship

between the volume of rainfall and tourist quantity in Mexico, and positive relationship between temperature and the tourist quantity.

Additionally, Altindag (2014) finds that countries with long coastlines are attractive spots for visitors. In terms of the role of legalizing an activity on tourism, Boger (1994) examined how tourism was affected after the legalization of Native American gaming (NAG). Boger found that state revenues increased from tourism after NAG was legalized.

Recently, marijuana policy has gained popularity among states. Pacula et al. (2002) found that many groups of people support the legalization of marijuana for medical benefits, such as medical, professional and policy advocate groups. Similarly, according to Anderson et. al (2013), legalizing medical marijuana can decrease traffic fatalities.

States are always exploring policies for economic growth and development. Given that tourism plays a large role in the economic wellbeing of some communities, it seems important to determine if marijuana policy can really affect tourism revenue.

Data was collected for all fifty states from 2004 to 2013. A one-way ANOVA and OLS regression model was used to explore the relationship between income in the accommodations and food services industry and various marijuana policies including legalization for medicinal use, decriminalization, and outright legalization. Results show that decriminalization and legalization is positively and significantly correlated with tourism demand, holding other variables constant.

Data

Data used for this study come from a variety of sources. Variable names, descriptions and sources are shown in Table 1. Information about states' marijuana laws was obtained from several websites including governing.com, Normal.org, and Wikipedia.com.

¹ Organization for Economic Cooperation and Development, whose origins date back to 1960, when 18 European countries plus the United States and Canada joined forces to create an organisation dedicated to economic development. Today, there are 34 Member countries span the globe, including many of the world's advanced countries but also emerging countries like Mexico, Chile and Turkey.

Method

Since my focus variables are categorical and my dependent variable is continuous, I will use one-way analysis of variance (ANOVA) and an OLS Regression model to analyze the data.

The one-way ANOVA is typically used when a study has more than two independent groups. There are two categorical focus variables: (1) decriminalization and legalization (Dec&Legal); and (2) legalized for medical use only (Medical). A one-way ANOVA can be used to determine whether there is a difference in tourism revenue based on different marijuana policies. Further, an OLS Regression model is used by pooling the state data across time and to control for other factors that may influence tourism. The following econometric model is used to explain income in the accommodations and food services industry (A&F):

$$A\&F = \beta_1 Medical + \beta_2 Dec\&Legal + \beta_3 ski + \beta_4 TEMP + \beta_5 coastlength + \beta_6 coastlength - sq + \beta_7 GDP + \beta_8 Gasprice + \beta_9 UNEMP + \beta_{10} Income \quad (1)$$

From this model, I will test the following hypotheses:

H_0 : Medical has no correlation with tourism demand.

H_A : Medical has a correlation with tourism demand.

H_0 : Dec &Legal has no correlation with tourism demand.

H_A : Dec &Legal has a correlation with tourism demand.

Descriptive statistics of variables included in the model are provided in Table 2.

Results

The results from the ANOVA are provided in Table 3, and shown in Figures 1 and 2. One oneway ANOVA was run on a sample of 500, which covers 50 states and 10 years of data in the US. It is set to determine if there were differences in tourism revenue considering whether a state has passed laws to legalize marijuana used medically. Of primary focus, the results indicate that states which have passed laws to decriminalize or legalize marijuana have statistically significantly higher tourism revenue compared to the other group, with F-value = 22.5 and P-value = 0.000 (see Figure 1).

The results from an OLS regression are shown in Table 4. Medical does not appear to affect income in the A&F industry, but the coefficient on Dec&Legal is positive and statistically significant at the 0.01 level. If states have policies that either decriminalize or legalize marijuana use, then income in A&F will increase 3223 thousand dollars. The results also show that ski states positively affect income in A&F industry at the 0.01 level. Holding other variables constant, income in the A&F industry will increase by 6927 thousand if a state is a ski state. Further, the miles of coastline in a state has a quadratic relationship and is statistically significant. Income in A&F will increase as the coastline increases, but at a diminishing rate. The coefficient on temperature is positive and statistically significant at the 0.01 level. The results also show that economic conditions affect income in the A&F industry. National GDP per capita is positively and significantly correlated with the dependent variable. As the coefficient shows, when national GDP per capita rise 1%, the tourism revenue should rise 23.87. Similarly, the variable personal income per capita by state level also has a positive and significant relation with the dependent variable. Its p-value is zero. Hence, with one unit increase in personal income per capita, the dependent variable will rise 4.73. The ninth variable is gasoline price. Its p-value is still 0, however, the coefficient is negative, indicating that with 1% increase in gasoline price, the tourism revenue will decrease 4.396. Finally, the unemployment rate by state level has an unexpected positive relationship with income in the A&F industry. As the data suggest, when the unemployment rate increases 1%, the dependent variable increase 1.226.

Conclusion

In the United States, drug tourism has taken many states by storm. Facing this phenomenon, it is quite meaningful to determine if marijuana can really promote tourism demand. Hence, state governments could adjust their marijuana policies to promote regional economic growth.

There are also some important control variables related to tourism demand. The first is ski states. As results show it has a positive and significant relation with tourism. It is easy to understand since a large number of people are crazy about skiing. Under this circumstance, a state can do things to promote its skiing resorts. Similarly, states with long coastline usually have high tourism demand. Third, mean

temperature also has a positive and close correlation with tourism demand. Next, as national GDP per capita increase, the tourism revenue increases. Likewise, when the personal income per capita rises, people are more likely to travel. Unemployment rate also has a positive and significant relation with tourism development. It should be mentioned that gasoline price is the only variable that has a negative relation with tourism revenue. Higher gasoline price will bring about a rise in living costs, so people have to endure higher life pressure, which reduce travel possibilities. As a result, the tourism demand decreases.

In conclusion, some marijuana policies can promote the tourism development; however, the legalization for medicinal use has no correlation with tourism revenue.

Reference

- Altindag, D. T. (2014). Crime and International Tourism. *Journal Of Labor Research*, 35(1), 114. doi:<http://dx.doi.org/10.1007/s1212201491748>
- Anderson, D. M., Hansen, B., & Rees, D. I. (2013). Medical Marijuana Laws, Traffic Fatalities, and Alcohol Consumption. *Journal Of Law And Economics*, 56(2), 333-369.
- Blake, A., J.S. Arbache, M.T. Sinclair, and V. Teles. 2008. Tourism and Poverty Relief. *Annals of Tourism Research* 35 (1): 107-126.
- Balaguer J, Cantavella-Jorda M (2002) Tourism as a longrun economic growth factor: the Spanish case. *Appl Econ* 34:877-884
- Boger Carl A., Jr., Ph.D. (1994) The Effects of Native American Gaming on Other Tourist Businesses. *Gaming Research & Review Journal* 1(2).
- Ferro Luzzi, G., & Fluckiger, Y. (2003). An Econometric Estimation of the Demand for Tourism: The Case of Switzerland. *Pacific Economic Review*, 8(3), 289-303.
- Gunduz L, Hatemi JA (2005) Is the tourism-led growth hypothesis valid for Turkey? *Appl Econ Lett* 12:499-504

- Hyttia, N., & Kola, J. (2013). Tourism Policy as a Tool for Rural Development. *Applied Economic Perspectives And Policy*, 35(4), 708-730.
- Moreno Moreno, L. R., Lopez Torres, V. G., & Marin Vargas, M. E. (2015). Actividad Turística y Cambio Climático en México, 1980-2012. (Tourism Activity and Climate Change in Mexico, 1980-2012. With English summary.). *Revista Internacional Administración And Finanzas*, 8(4), 617-6.
- R.L. Pacula, J.F. Chriqui, D.A. Reichmann, Y.M. TerryMcElrath (2002) State medical marijuana laws: understanding the laws and their limitations *Journal of Public Health Policy*, 23 (4), 413-439
- Sequeira T, Nunes P (2008) Does tourism influence economic growth? A dynamic panel data approach. *Appl Econ* 40:2431-2441
- Valdez, A.; Sifaneck, S J. (1997 fall). Tourists and Drug Policy on the U.S. Mexican Border: An Ethnographic Investigation of the Acquisition of Prescription drugs. *Journal of Drug Issues* Volume:27 Issue:4 <https://www.ncjrs.gov/App/Publications/abstract.aspx?ID=169759>

Figures & Tables

breviation	Description	Source
Dec&Legal	States that have laws decriminalized or legalized marijuana	Norml.ORG Wikipedia.org
Medical	States that have laws legalized medical use	Governing.com
Coastlength	Miles of each state's coast	Wikipedia.org
Coastlength-Sq	Square of miles of state's coast	Wikipedia.org
Ski	Whether a state has famous ski resorts	Forbes.com
Temp	Annual mean temperature	Noaa.gov
GDP	National GDP per capita	BEA.gov
Gas price	Annual gasoline price in each state in dollar	Eia.gov
Income	Income per capita	BLS.gov
UNEMP	Percent unemployment rate	BLS.gov
A&F	Total revenue of accommodation and food service in dollar	BEA.gov

Table 1. Data Sources.

Variable	Definition	Min	Max	Average	SD
Dec&Legal	Categorical	0	1	0.256	0.437
Medical	Categorical	0	1	0.276	0.447
Coastlength	Continuous	0	339.04	18.824	49.478
Coastlength-sq	Continuous	0	114948.26	27975.63	160904.19
Ski	Binary	0	1	0.12	0.325
Temp	Continuous	36.09	77.72	54.335	8.427
GDP	Continuous	4.671	4.921	4.813	0.084
Gasoline Price	Continuous	1.789	3.984	2.902	0.591
Income	Continuous	2.527	6.066	3.894	0.655
UNEMP	Continuous	2.5	13.7	6.334	2.237
A&F	Continuous	0.621	57.167	7.872	9.244

Table 2. Variable Explanations.

Source	DF	Adj SS	Adj MS	F-value	P-value
<i>Medical</i>	1	163.2	163.19	1.91	0.167
<i>Error</i>	498	42477.5	85.30		
Total	499	42640.7			
<i>Dec&Legal</i>	1	1843	1843.10	22.50	0.000
<i>Error</i>	498	40798	81.92		
Total	499	42641			

Table 3. Analysis of ANOVA

Dependent variable: A&F	
Independent variables	Model
Medical	-99 (743)
Dec & legal	3223 *** (772)
Ski states	6927 *** (1036)
Miles of coast	1.987 *** (0.231)
Square of miles of coast	-0.000069 *** (0.000007)
Mean temperature	333.6 *** (45.1)
National GDP per capita	2.387 *** (0.555)
Per capita personal income	-4396 *** (874)
Gasoline price \$	-0.4730 *** (0.0620)
Unemployment rate	1226 *** (199)
Constant	-142006 (26429)
R^2_{adj}	46.19%
# Of sources	500
* 1% significant ** 5% significant *** 10% significant	

Table 4. Regression Analysis.

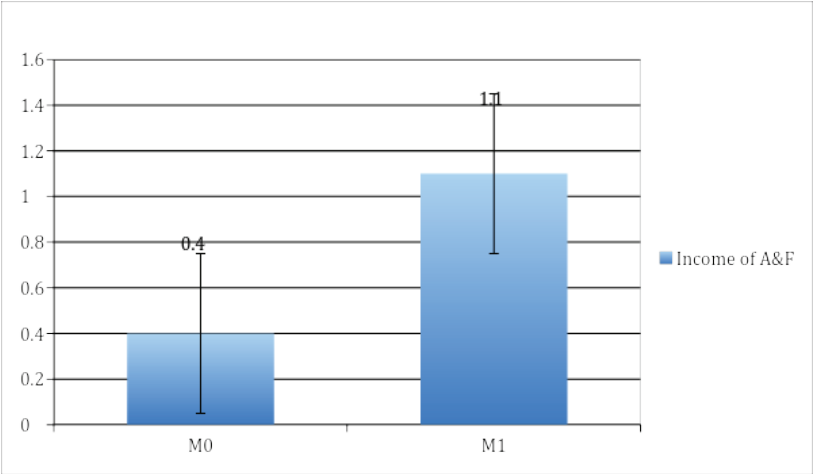


Figure 1.

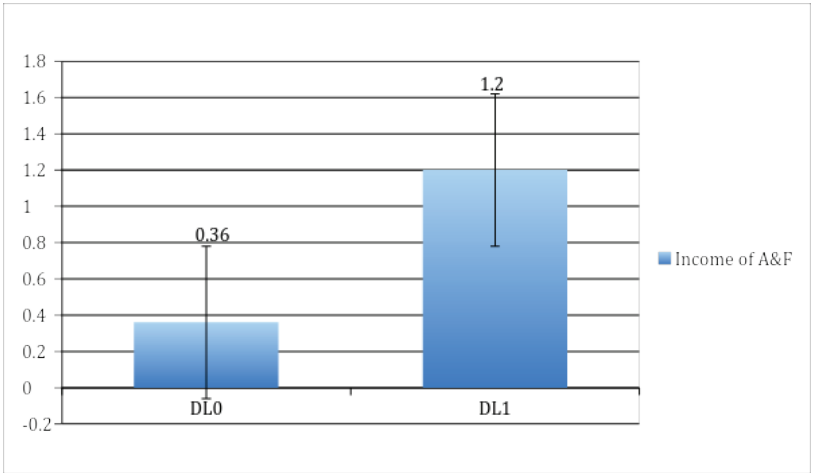


Figure 2.

The Effect of Information Overload on Decision Accuracy

Min Zhou | Mentor: Rong Rong

Abstract

As the capacity of data storage grows ever larger and the speed of Internet ever faster, people face a tremendous amount of information each day. Scholars have argued that information could “overload” causing consumers’ difficulty in making the optimal choices. Based on the theory of utility maximization, this research explores whether information overload, in terms of the amount of attributes and the number of alternatives, reduces consumers’ decision accuracy. We designed surveys that varied in the levels of information overload, and collected the decision accuracy from survey participants. T-test, and OLS regression were used to analyze data. The results suggested that more alternatives reduced decision accuracy, while the amount of attributes did not influence decision accuracy. The results of this research may help to design better strategies that alleviate consumer information overload.

Introduction

In this age of information, people experience ever-growing amount of information coming from various channels. At first, consumers are happy to welcome abundant information. However, in order to find the products that best satisfy their demands, consumers have to spend lots of time to compare all the products. This may lead to a higher level of confusion in dealing with information. If a large number of details about offered products or the amount of options lead to impatient shopping behavior, it may imply that information overload will negatively influence decision accuracy (Keller and Staelin 1987).

¹ I would like to thank Prof. Yuhong Fan for letting the survey be conducted in her FIN 3300 class. However, the author is fully responsible for all the errors.

Many researchers have already tested the association between information overload and decision accuracy. Among all the factors affecting the probability of choosing the best product or services, the amount of attributes is one of the most critical elements (Jacoby, Speller, and Kohn 1974a; Lurie 2004; Keller and Staelin 1987; Malhotra 1982). Lurie (2004) stated that a higher attribute level leads to lower choice quality. He also pointed out that when considering about attributes, researchers should also take the distribution of attributes into consideration. Keller and Staelin (1987) also found that there was a negative relationship between the number of alternatives and decision accuracy.

A 3*3 factorial experiment conducted by Jacoby, Speller, and Kohn (1974a) revealed that while consumers do feel more satisfied and less confused, they actually make poorer purchase decisions with more information. Malhotra (1982) provided respondents with 10, 15, 20, or 25 choice alternatives or with information on 15, 20, or 25 attributes and reached a conclusion that consumers' choice quality decreased with increases in information. Another experimental study suggested that increasing amounts of information causes consumers to divide their processing time among pieces of information presented causing an apparent information overload (Scammon, 1977).

In addition, a recent study by Shang, Chen, and Chen (2013) stated that what actually affected consumer behaviors were "consumers' subjective psychological status towards buying decision," which were determined by the number of alternatives. In their experiment of choosing overseas tour packages on a website, the results showed that although there was a non-linear effect on consumers' subjective status, consumers' feelings towards shopping decisions would be negatively influenced when the number of alternatives exceeded the maximum captivity of consumers. In addition, time pressure and the quality of information also influence decision accuracy (Lurie 2004; Keller and Staelin 1987).

Theory

The impact of information overload on decision accuracy can be best explained by the classical economic theory on utility maximization. Economists often use "indifference curve" (see Figure 1) to represent those combinations of good X and good Y from which the individual derives the same level of satisfaction (utility). The slope of this curve "U" represents the rate at which the individual is willing to trade X for Y while

maintaining the same level of utility. The budget constraint (I) shows the combinations of X and Y that the individual can afford. Point A in the figure represents the highest utility level that can be reached by the individual, given the budget constraint. The combination of X^* and Y^* is therefore the rational way for the individual to allocate purchasing power, which means that utility is maximized at point A (Nicholson 1995).

In this study, when consumers face information overload, they tend to spend less time on “one decision”. This is because when facing information overload, making a decision becomes “expensive”, in terms of time spent. Therefore, the time budget constraint fans in from I_1 to I_2 , and the utility maximization point moves from point A to point B (see Figure 2) (Nicholson 1995). Consequentially, this implies that the utility level decreases and decision accuracy falls under information overload.

Study Design

Built upon the studies illustrated in the Section I, we focused on two dimensions of information: the number of alternatives and the amount of attributes. We collected survey data from 120 Weber State University students. All surveys were conducted in Ogden campus, Utah. Each survey was divided into two parts. The first part collected the basic demographics including gender, age, marriage status, the number of children in the household, academic status, overall GPA, employment status, working hours per week, and personal annual income. The second part was designed to test the association between information overload and decision accuracy, we varied the number of alternatives in this study to be either 5 or 10 and the amount of attributes to be either 2 or 8. By interaction these two dimensions, we created four unique surveys (see Table 1). The four different information conditions were 5 alternatives with 2 attributes, 5 alternatives with 8 attributes, 10 alternatives with 2 attributes, and 10 alternatives with 8 attributes. Each survey participant only experienced one of the four survey conditions. The complete survey can be found in the Appendix 1.

By designing this study, we adopted the classical utility maximization theory in a novel way by changing budget constraint of money into a budget constraint of time. In the survey, participants were asked to rank the products from the desirable to the least desirable. We designed the products in the survey so that the third product on the list was the best in terms of all the attributes among all the alternatives. The best product was not known to survey participants.

According to the above theoretical framework and study design, we reach the following hypothesis:

H_0 : Information overload does not influence decision accuracy.

H_a : Higher level of information overload leads to lower decision accuracy.

Methods

The best product, the third product, was determined by the rules: the lower the ratio of price and weight, the higher the calorie contained, the lower the fat contained, etc. Once a participant provided his or her ranking, I created the ranking deviation (RD) measure to be the distance between the location of a participant ranked the third product to the top location. For example, if a survey participant put the third product in the sixth location, the RD of this survey was 5 ($=6-1$). Average measure of RD was created for each survey, namely RD_{s1} , RD_{s2} , RD_{s3} and RD_{s4} . Survey 1 and 3 correspond to two attributes, price and weight, so I named the RD measure for lower attributes surveys, RD_{s1s3} . Similarly, RD_{s2s4} measured the average ranking deviation in high attribute surveys; RD_{s1s2} measured the average ranking deviation for in low alternative surveys, and RD_{s3s4} for high alternative surveys. Please see Table 2 for the descriptions of all variables and descriptive statistics in this study.

T-test

We used T-test to compare the RD between two different levels of attributes and two different levels of alternatives. T-test tests the following hypothesis:

$$H_1: H_0: RD_{s1s3} = RD_{s2s4}$$

$$H_a: RD_{s1s3} < RD_{s2s4}$$

$$H_2: H_0: RD_{s1s2} = RD_{s3s4}$$

$$H_a: RD_{s1s2} < RD_{s3s4}$$

OLS Regression

In Model 1, we used OLS Regression to control demographic variables of the survey participants. Equation 1 below shows the specification without control variables:

$$RD = \beta_0 + \beta_1 ATTR + \beta_2 ALT + \beta_3 INTAC + \varepsilon \quad [1]$$

In Model 2, nine control variables are included: gender, age, marriage status, the number of children in the household, academic status, overall GPA, employment status, working hours per week, and personal annual income.

$$RD = \beta_0 + \beta_1 ATTR + \beta_2 ALT + \beta_3 INTAC + \beta_4 GENDER + \beta_5 AGE + \beta_6 ACAD + \beta_7 GPA + \beta_8 MRTL + \beta_9 CHD + \beta_{10} EMPLMT + \beta_{11} WK_W + \beta_{12} INCM + \varepsilon \quad [2]$$

Empirical Results

An independent t-test showed that there are differences in decision accuracy for different levels of attributes. Low and high levels attributes groups consisted 60 participants each. The results showed that higher level attributes had higher Ranking Deviation (2.32 ± 2.24) than lower level attributes (1.72 ± 2.13) ($p=0.136$). Another T-test result showed that higher level alternatives had higher RD (3.23 ± 2.29) than lower level alternatives (0.80 ± 1.23), which implied that the higher level alternatives led to lower decision accuracy (see Figure 3) ($p<0.01$). These results can be seen in Figure 3.

To provide further evidence on the effect of information overload on decision accuracy, we also conducted an analysis based on Equation 1 in section III, which only contained focus variables. The OLS regression results showed that only the number of alternatives was statistically significant ($p<0.01$). When the number of alternatives increased from the lower level (5) to the higher level (10), Ranking Deviation (RD) increased by 2.433. Other variables did not impact RD significantly.

In Model 2, we added nine more control variables as it is in Equation 2 in Section III; however, the number of alternatives was still the only independent variable which was statistically significant ($p<0.01$). The result showed that when the number of alternatives increased from the lower level (5) to the higher level (10), RD increased by 2.4873, a similar size as it is in Model 1. Although more control variables were added in Model 2, none of them was statistically significant. The aggression results of Model 1 and Model 2 can be found in Table 3.

Furthermore, in Model 1, R^2 equaled 32.7%, while in Model 2, R^2 equaled 33.7%, and it was a small increase when control variables were added. When consider the penalty for including more independent variables, the

Adjusted R^2 in Model 2 ($R\text{-Sq}(\text{adj}) = 26.3\%$) was smaller than that in Model 1 ($R\text{-Sq}(\text{adj}) = 31.0\%$), perhaps because that adding control variables in Model 2 did not have effects on decision accuracy.

Conclusions

We designed a novel survey with four different levels of information overload to study the effect of levels of alternatives and attributes on decision accuracy. The results of this study show that the number of alternatives has an impact on decision accuracy, while the amount of attributes does not influence decision accuracy, and there is no interaction between these two factors.

One thing worth mentioning is that monetary incentive was not used when participants provided their product ranking, therefore, the result of this research might not fully reflect the incentive consumers face in daily life. Future studies may benefit from including monetary reward in the survey design.

References

- Jacoby, J., Speller, D. E., & Kohn, C.A. (1974a). Brand Choice Behavior as a Function of Information Load. *Journal of Marketing Research*, 11(2), 63–69.
- Keller, K. L., & Staelin, R. (1987). Effects of Quality and Quantity of Information on Decision Effectiveness. *Journal of Consumer Research*, 14(2), 200–213.
- Lurie, N. H. (2004). Decision Making in Information-Rich Environments: The Role of Information Structure. *Journal of Consumer Research*, 30(4), 473–486.
- Malhotra, N. K. (1982). Information Load and Consumer Decision Making. *Journal of Consumer Research*, 8(3), 419–430.
- Nicholson, W. (1995). *Microeconomics theory: Basic principles and extensions*. Orlando, FL: Dryden Press.
- Scammon, D. L. (1977). Information Load and Consumers. *Journal of Consumer Research*, 4(12), 148–155.

Shang, R., Chen, Y., & Chen, S. (2013). The Effects of the Number of Alternative Products and the Way They are Presented on the Consumers' Subjective Statuses in Online Travel Sites. *Behaviour & Information Technology*, 32(7), 630–643.

Figures & Table

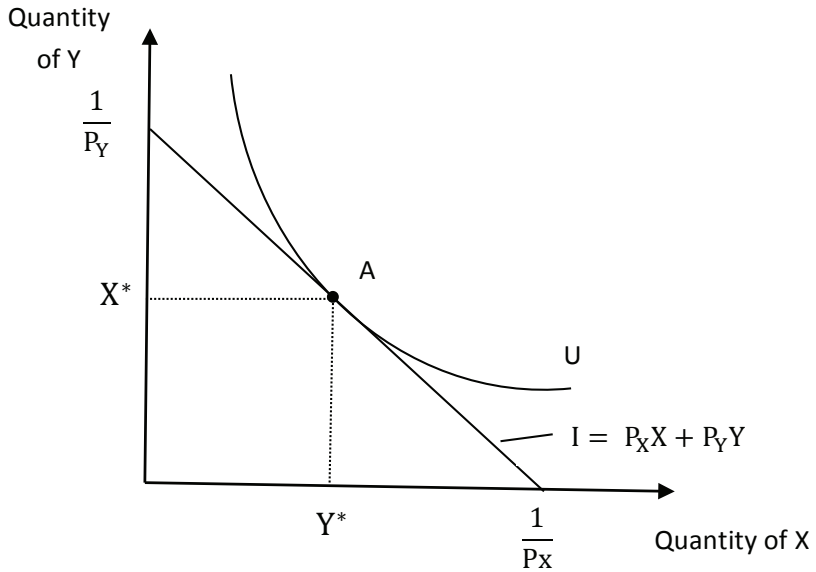


Figure 1. General Utility Maximization.

(Best Product Correctly Ranking)

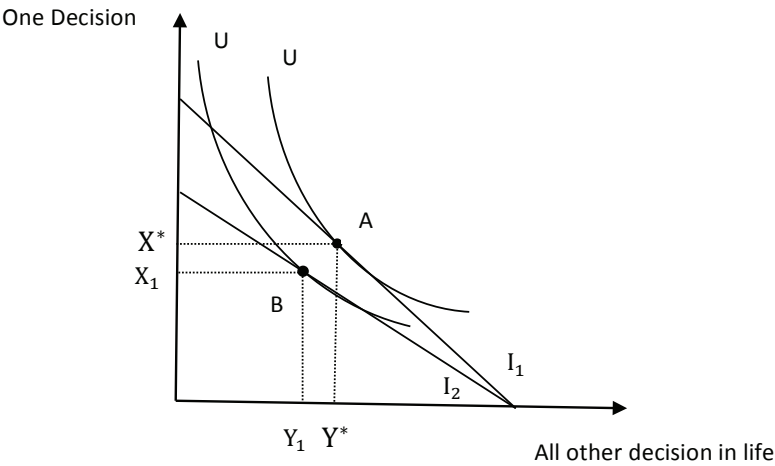
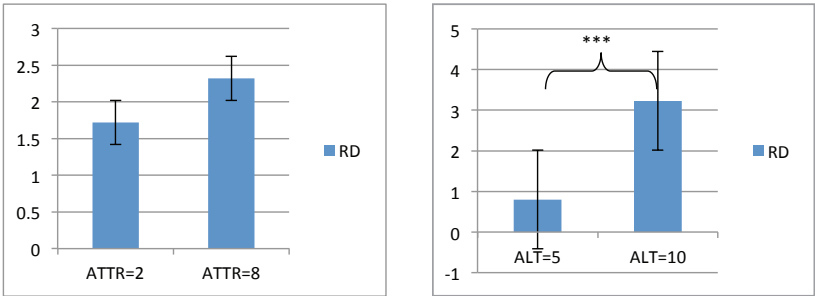


Figure 2. Utility Maximization of Time Constraint.



***: 1% significant

Figure 3. Ranking Deviation between Two Levels of Attributes and Alternatives.

	The amount of attributes=2	The amount of attributes=8	
The number of alternatives=5	Survey 1(30 copies) RD _{S1}	Survey 2 (30 copies) RD _{S2}	Survey 1 and Survey 2(60 copies) RD _{S1S2}
The number of alternatives=10	Survey 3(30 copies) RD _{S3}	Survey 4(30 copies) RD _{S4}	Survey 3 and Survey 4(60 copies) RD _{S3S4}
	Survey 1 and Survey 3(60 copies) RD _{S1S3}	Survey 2 and Survey 4(60 copies) RD _{S2S4}	

Table 1. Survey Design.

Variable	Abbreviation	Description (Type)	Min	Max	Mean	St. Dev.
Attributes	ATTR	The amount of information offered on one product (Binary)	0	1	0.50	0.50
Alternatives	ALT	The numbers of alternative products (Binary)	0	1	0.50	0.50
Interaction	INTAC	The level of attributes times the level of alternatives (Binary)	0	1	0.25	0.43
Gender	GENDER	Gender information (Binary)	0	1	0.52	0.50
Age	AGE	The mean of age is 23.32, and this is a little bit young, because the target population is students of Weber State (Continuous)	16	41	23.32	5.02
Marital Status	MRTL	Survey participants' marital conditions (Categorical)	1	3	1.77	0.48
# of Children	CHD	Since the ages of all the participants are young, the mean of the number of children each student has is low (Continuous)	0	5	0.30	0.93
Academic Status	ACAD	Survey participants' current academic levels (Continuous)	1	5	3.06	1.20
GPA	GPA	Overall GPA (4.00 is the highest) (Continuous)	1.86	4	3.34	0.45
Employment Status	EMPLMT	Survey participants' employment conditions. The mean is 0.86, which means that the target population is biased to part-time jobs. (Categorical)	0	2	0.86	0.69
Working Hours/ Week	WK_W	The number of hours a survey participant works per week (Continuous)	0	52	16.40	14.32
Personal Annual Income	INCM	Survey participants' personal annual income, ranging from \$0 to above \$80,000 (Categorical)	1	9	2.07	1.6
Ranking Deviation	RD	Distance of between the location of product 3 which each survey participant chooses and the no.1 location (Continuous)	0	8	2.02	2.20

Table 2. Variable Abbreviation Descriptions and Descriptive Statistics.

Independent Variable	Model 1	Model 2
ATTR	0.6000 (0.4719)	0.5848 (0.5141)
ALT	2.4333*** (0.4719)	2.4873*** (0.5003)
INTAC	-0.0000 (0.6674)	0.0510 (0.7235)
CONSTANT	0.5000 (0.3337)	0.997 (2.169)
Adjusted R ²	31.0%	26.3%
# of observation	120	120

Note: (1) ***: 1% significant
(2) All demographic variables including gender, age, marital status, number of children, academic status, overall GPA, employment status, working hours per week and personal annual income do not influence ranking deviation or decision accuracy.

Table 3. Regression Results.

Thanks for your interest in my study. I am conducting this survey as part of my ECON4980 class requirement. The purpose of this study is to find out the association between information overload towards products and the accuracy of decision. The survey is completely anonymous and the final report of the study will not contain any personally identifiable information. The survey is reviewed and approved by Weber State University Institutional Review Board (IRB Protocol #: 15-GSBE-009). The survey should take approximately 2-5 minutes. You may withdraw from it at any time if you feel uncomfortable answering certain question. By continuing with this survey you are consenting to participate in this study.

Research Survey

1. Gender: Male ☐ Female ☐
2. Age:
3. Marital Status: Married ☐ Never married ☐ Divorced ☐
4. Number of children
5. Academic Status: (☐) Freshman (☐) Sophomore (☐) Junior (☐) Senior (☐) Master
6. Overall GPA: / 4.0
7. Do you work while going to school? (☐) Full time (☐) Part time (☐) Unemployment
8. How many hours do you work per week?
9. What is the range of your personal annual income?

(☐) \$0-\$10,000 (☐) \$10,000-\$20,000 (☐) \$20,000-\$30,000 (☐) \$30,000-\$40,000 (☐) \$40,000-\$50,000

(☐) \$50,000-\$60,000 (☐) \$60,000-\$70,000 (☐) \$70,000-\$80,000 (☐) above \$80,000

On this page, there are some milk products with information. Based on the information given in the table, please rank the products from preferred to the least preferred. (In Number)

_____ > _____ > _____ > _____ > _____ > _____ > _____ > _____ > _____

Number	Brand	Price (\$)	Weight (L.)	Calorie (c/240ml)	Protein (g/240ml)	Fat (g/240ml)	Cholesterol (mg/240ml)	Sodium (mg/240ml)	Carbohydrate (g/240ml)
1	Vertical	4.44	1.89	130	7	8	10	120	11
2	Grade World	3.99	1.69	90	8	5	20	115	12
3	Universe	3.78	1.86	90	10	2. 5	10	115	11
4	Melody	4.12	1.76	130	9	5	15	135	16
5	Fresh Life	3.98	1.79	120	8	2	20	125	12
6	Blue Star	4.08	1.68	90	5	3	25	130	15
7	Milky Way	3.98	1.89	100	6	3.5	15	115	10
8	Dairy Gold	4.23	1.86	130	8	8	25	115	14
9	Meadow	4.98	2.06	90	7	2. 5	15	135	11
10	Livehood	2.98	1.33	110	10	2	10	120	13

Does Legalized Same-sex Marriage Improve Marital Stability?

Ming Ge | Mentor: Doris Geide-Stevenson

Abstract

Abstract: This paper examines whether states that legalized same-sex marriage observe reduced divorce rates and improved marital stability. While several studies have discussed the effects of legalized same-sex marriage, few of them have explored how allowing homosexuals to marry influences marital stability. In this study, the cross-sectional state-level data is collected from 2010 to 2012. A simple hypothesis test for a difference in means suggests that divorce rates are significantly lower in the states allowing same-sex marriage than in the states not allowing it. Then, we control for other determinants of the divorce rate and test for the impact of legalized same-sex marriage by combining these data with year dummies in an OLS regression model. The results reveal that there is no significant correlation between legal recognition of same-sex marriage and divorce rates.

Keywords: *Legal recognition of same-sex marriage, Divorce rates, Cross-sectional state-level data*

Introduction

In the United States, more than one million couples terminate their marriage every year, which means at least half of the marriages end in divorce. Marital dissolution has a negative impact on families and societies. There is evidence that broken families increase the financial pressure and social burden. Hence, the government has to attach importance to the control of divorce rates. On the other side, to advocate freedom of marriage and provide civil marriage rights for gays and lesbians, an increasing number of states have legalized same-sex marriage in the United States. On May 9, 2012, President Barack Obama publicly declared he supported the legal recognition of gay marriage.

Therefore, we examine whether allowing homosexuals to marry reduced a state's divorce rate. If the results show that recognizing same-sex marriage does have a negative impact on the divorce rate, it will be another powerful reason to prompt states to continue to reduce the restrictions on gay marriage.

Theory

According to matching theory, the stable marriage problem refers to the problem of looking for a stable matching between a set of individuals who have a set of preferences for their partners. A matching will be stable when both A and B cannot find any alternative pairing that is better than if they stay together. Weiss and Willis (1997) state that the couples are less likely to divorce if they are well-matched. In light of matching theory, we anticipate that allowing same-sex marriage reduces a state's divorce rate because of better matches of homosexuals.

The family economic theories developed by Gary Becker (1981) describe that couples tend to divorce when the utility expected from marital dissolution surpasses the utility expected from remaining married. Therefore, divorce will happen when

$$U^S_h + U^S_w > U^M_h + U^M_w$$

Where U^S and U^M represent single utility and marital utility, and the subscripts h and w represent husband and wife.

In the family economic theories, the likelihood of marital dissolution depends on the variables that influence the utility inside and outside of the marriage. This theory not only provides us with a conceptual framework, but also gives us clear determinants that we should control in the study.

Literature

3.1 The literature on same-sex marriage

Using the data from 1990 to 2004, Langbein and Yost (2009) test whether same-sex marriage poses a negative externality on society. The results reveal that legalization of gay marriage has no effect on divorces. Because 2004 was the first year during which one state permitted same-sex couples to marry, this lack of observations may have biased results.

3.2 Literature on other determinants of the divorce rate

Several studies have examined the personal characteristics (education attainment), family characteristics (duration of marriage, marital-specific capital, and state of residence), and state characteristics (property distribution law and female labor force participation) that influence the decision of marital dissolution.

Higher education attainment raises marital utility from the division of labor between mates, which reduces the probability of marital dissolution. Becker *et al.* (1977) show that an increase in education has a consistently negative effect on the marital dissolution.

Ruggles (1997) finds that the rise of female labor force participation (LFP) is closely associated with the growth of divorce and separation. The results are consistent with the theory that women who work outside of the home gain less utility from marriage than women who stay at home.

The factor of regional residence influences the probability of marital dissolution as well because the tastes for single and married life and the social acceptance of divorce directly determine the marital utility and single utility. Kalmijn and Uunk (2007) investigate the individual attitudes about divorce and find that the divorce rate not only significantly differs among countries, but also significantly differs among regions within countries.

There are two property distribution laws in the United States—community property law and equitable distribution law. Under community property law, community property is separated evenly between the husband and the wife after marital dissolution. Equitable distribution law means that each spouse, after the termination of the marriage, will be awarded a share of community property equal to that of his or her contribution. This law takes female contributions as homemakers and childcare providers into account. Kate (1996) shows that states that follow community property law have significantly lower divorce rates than states that follow equitable distribution law. The reason is that community property law decreases female financial options outside of marriage, thereby reducing the probability of divorce.

As the duration of a marriage increases, the likelihood of marital dissolution will decline because the marital-specific capital augments

continuously after marriage and it would be worth less after divorce or in any other marriage. However, Kephart (1954) points out that the peak period of the divorce rate does not lie in the first of marriage, but lies within the second and fourth year. The reason of the time lag is that it takes time for couples to know their partners and for the legal machinery of divorce to operate.

Children are the main marital-specific capital of marriage. Waite and Lillard (1991) find that young children (0-1 years old) can keep marriage stable, while children older than 12 significantly raise the probability of marital dissolution.

Data

In the study, we collect cross-sectional state-level data from 2010 to 2012. (See Table 1 for the descriptive statistics).

The state-level divorce rate for every 1000 people in the total population is obtained from Centers for Disease Control and Prevention (CDC), excluding California, Georgia, Hawaii, Indiana, Louisiana and Minnesota that did not release their divorce rates in this period.

The National Conference of State Legislatures provides the information about same-sex marriage laws in the United States. In 2010, there were six states with legalized same-sex marriage—Massachusetts, Connecticut, District of Columbia, Iowa, Vermont, New Hampshire. In 2011, New York accepted same-sex marriage. In 2012, Washington and Maine allowed homosexuals to marry. The legal recognition of same-sex marriage is the dummy variable. The states with legalized same-sex marriage are labeled as 1, and 0 represents the states without legalized same-sex marriage.

To control for the factor of education attainment and female labor force participation, we collect the percentages of a Bachelor's degree or higher and the female labor force participation rate from U.S Census Bureau. According to the pervasive regional divisions defined by the United States Census Bureau, fifty states are separated to four regions—northeast, midwest, south and west.

After checking the property distribution law in the United States, we find there are nine community property states and forty-two equitable

distribution states. Community property states are labeled as 1, and 0 represents equitable distribution states.

Considering the effect of the duration of marriage and young children on marital dissolution, we collect last year's marriage rate per 1,000 total population and the birth rate per 1,000 women in each state from CDC.

Method & Result

Initially, we conduct a simple hypothesis test for a difference in means of divorce rates between the states with legalized same-sex marriage and the states without legalized same-sex marriage. The results of the T-test (Table 2) show that the statistical difference exists. Moreover, divorce rates are significantly lower in the states allowing same-sex marriage than in the states not allowing it.

Next, we test for the effect of legalized same-sex marriage on the divorce rate in an Ordinary Least Squares (OLS) regression model. OLS regression, also called linear regression, is a statistical technique, which can be used to examine the correlation between explanatory variables and dependent variable. Moreover, non-experimental designs often suffer from omitted variable bias. To reduce this risk, we control for the other determinants of the divorce rate.

The Multivariate Regression Model:

$$\text{Divorce Rate} = \beta_0 + \beta_1 * \text{Legalized} + \beta_2 * \text{Female LPF} + \beta_3 * \text{Marriage}_{t-1} + \beta_4 * \text{Community} + \beta_5 * \text{Bachelor} + \beta_6 * \text{Northeast} + \beta_7 * \text{Midwest} + \beta_8 * \text{South} + \beta_9 * \text{Birth} + \beta_{10} * 2010 + \beta_{11} * 2011$$

Table 3 presents that legalization of same-sex marriage has a negative impact on the divorce rate, but the effect is insignificant. The results are similar with the findings of Langbein and Yost (2009).

Moreover, the percentage of a Bachelor's degree is negatively and significantly correlated with the divorce rate. The states with community property law have significantly lower divorce rates than the states with equitable distribution law. Last year's marriage rates have a significantly positive impact on the marital dissolution. These results are consistent with the research of Becker *et al.* (1977), Kate (1996) and Kephart (1954). The divorce rate is significantly higher in 2010 than 2012 but

not significantly different in 2011 than 2012. Compared to the couples in west, the couples in northeast, midwest and south are significantly less likely to divorce.

The results indicate that there is no significant effect of the female labor force participation rate and the birth rate on the divorce rate, which violates Waite and Lillard (1991) and Ruggles (1997), which focus on individual characteristics and do not take the state-level determinants included in this study into account.

Conclusion

Following the current topic about same-sex marriage, this paper explores the effect of legislation of same-sex marriage on the divorce rate. A hypothesis test for a difference in means shows that the divorce rates in the states with legalized same-sex marriage are significantly lower than the divorce rates in the states without legalized same-sex marriage. However, after controlling for other determinants of marital dissolution, we find that the impact of legal recognition of same-sex marriage becomes insignificant in the OLS model. The results reject our anticipation that allowing homosexuals to marry reduces the probability of divorce. Therefore, based on this study, a lower divorce rate cannot be a strong argument to support reducing restrictions on same-sex marriage.

References

- Becker, G. S., Landes, E. M., & Michael, R. T. (1977). An economic analysis of marital instability. *The Journal of Political Economy*, 1141–1187.
- Becker, G. (1981). *A treatise on the family* Harvard University Press. Cambridge, MA. 219–227
- Births: Final Data for 2012. (2013). Retrieved April 9, 2015, from <http://www.cdc.gov/nchs/products/nvsr.htm>
- Divorce rates by State: 1990, 1995, and 1999–2012. Retrieved March 15, 2015, from http://www.cdc.gov/nchs/data/dvs/state_divorce_rates_90_95_and_99-12.pdf

- Kalmijn, M., & Uunk, W. (2007). Regional value differences in Europe and the social consequences of divorce: A test of the stigmatization hypothesis. *Social Science Research*, 36(2), 447–468.
- Kate, S. (1996). Do state-level variables affect divorce rates? *Review of Social Economy*, 54(1), 47–65.
- Kephart, W. M. (1954). The duration of marriage. *American Sociological Review*, 287–295.
- Langbein, L., & Yost, M. A. (2009). Same-Sex Marriage and Negative Externalities*. *Social Science Quarterly*, 90(2), 292–308.
- Marriage rates by State: 1990, 1995, and 1999–2012. Retrieved April 10, 2015, from http://www.cdc.gov/nchs/data/dvs/state_marriage_rates_90_95_and_99-12.pdf
- QuickFacts Beta. Retrieved April 20, 2015, from <http://www.census.gov/quickfacts>
- Ruggles, S. (1997). The rise of divorce and separation in the United States, 1880–1990. *Demography*, 34(4), 455–466.
- SameSex Marriage Laws. (2015). Retrieved February 10, 2015, from <http://www.ncsl.org/research/humanservices/samesexmarriagelaws.aspx>
- Stim, R. Property Division by State. Retrieved March 16, 2015, from http://www.divorcenet.com/states/nationwide/property_division_by_state
- Waite, L. J., & Lillard, L. A. (1991). Children and marital disruption. *American Journal of Sociology*, 930–953.
- Weiss, Y., & Willis, R. J. (1997). Match quality, new information, and marital dissolution. *Journal of Labor Economics*, S293–S329.

Tables

Variable	Max	Min	Mean	St. Dev.
% Divorce	5.9	2.2	3.72	0.799
Legalization	1	0	0.144	0.352
% Female LPR	66.8	49.7	60.498	3.663
% Marriage _{t-1}	40.3	4.7	7.590	4.781
Community	1	0	0.176	0.382
% Bachelor	51.2	17.3	27.916	5.689
Location				
Northeast	1	0	0.176	0.382
Midwest	1	0	0.235	0.426
South	1	0	0.333	0.473
West	1	0	0.255	0.437
% Birth	18.9	9.4	12.742	1.561

Table 1. Standard Descriptive Statistics.

Groups	Numbers	The means of divorce rates	Standard Deviation
States with Legalized Same-sex Marriage	22	3.086	0.549
States without Legalized Same-sex Marriage	113	3.843	0.783
Degree of freedom = 39		T-Value = 5.48	P-Value = 0.000

Table 2. Two-Sample T-Test.

Independent Variable	Coefficient	t-stat
Legalized (vs. No legalized)	-0.0205	-0.13
Female LPF	0.00831	0.44
Marriage _{t-1}	0.05028***	4.95
Community (vs. Equitable)	-0.3800***	-2.71
Bachelor	-0.05893***	-5.09
Northeast (vs. West)	-0.9200***	-4.76
Midwest (vs. West)	-1.1569***	-7.66
South (vs. West)	-0.3896***	-2.82
Birth	-0.04646	-1.32
2010 (vs. 2012)	0.1761*	1.67
2011 (vs.2012)	0.1366	1.30
R-Sq = 64.7%		R-Sq(adj) = 61.5%

*p< 0.10, **p< 0.05, ***p< 0.01

Table 3. *The Results of the OLS Model (N=135).*



GEOGRAPHY

College of Social & Behavioral Science

Utah Citizens' Perception of Public Lands

Drew Hodge | Mentor: Julie Rich

Abstract

In western states, debate about federal control of public lands has caught the public's attention, with tensions erupting into violence recently in the armed standoff at Malheur National Wildlife Refuge, Oregon. Such incidents, plus legislation like the Utah Transfer of Public Lands Act, suggest low trust in federal land managers. To verify this trend, an online survey instrument assessed trust levels in federal and state public land management among a sample of Utah residents active on public lands. Participants, voluntarily solicited through social media and email, rated trust in Bureau of Land Management, National Park Service, United States Forest Service, and Utah Department of Natural Resources, with trust defined as whether participants feel each agency supports public access to public lands. Respondents reported higher trust in all three federal agencies than state, and higher trust in federal over state management both historically and currently. The survey gathered socio-demographic data, like gender, age, and political affiliation, to identify potential independent variables affecting trust in land managers. Results suggest strongest correlation between low trust in all four government agencies and Republican affiliation. These results suggest the public lands debate divides primarily along political lines. Effective dialogue between stakeholders requires respectful engagement built upon shared values.

Introduction

Approximately two-thirds of Utah land is federally managed—35 million acres, or 66.5 percent (Schwartz, 2014). Bureau of Land Management (BLM) alone controls 42 percent of Utah, approximately 22.9 million acres (BLM, 2015). U.S. Forest Service (USFS) manages fifteen percent of Utah, approximately 8.2 million acres (Butkus, 2009). National Park Service (NPS) controls 3.9 percent of Utah, around two million acres spread between five national parks, six national monuments, one national recreation area, and one historic site (Butkus, 2009). The large portion

of Utah under federal management elicits heated opinions and political debate, with continued support from state legislators for enforcing the 2012 Utah Transfer of Public Lands Act and other calls for public lands' transfer to state control.

Background

Anti-federalists impatient with legal means have committed harassment, threats, and even armed militant action against federal employees. The current occupation of eastern Oregon's Malheur National Wildlife Refuge, for instance, represents erupting tension over federal management of western rangelands. The occupation has so far resulted in one death and the arrest of eleven militants on felony charges of "conspiracy to impede officers... through the use of force, intimidation, or threats" (U.S. v. Bundy et al, 2016; U.S. v. Patrick et al, 2016). The charges include harassment of a local resident who reported stalking and death threats after encountering two militants at a grocery store while she wore a BLM shirt (U.S. v. Bundy et al, 2016).

Other BLM and USFS employees in western states report assaults and death threats from anti-federalists (Ring and Swearingen, 2014). In July 2013, employees at a Mount Hood, Oregon campground were repeatedly firebombed (Ring and Swearingen, 2014). In Utah in May 2014, a BLM employee driving on Interstate 15 was threatened by two hooded suspects brandishing a handgun and a sign reading, "You need to die" (Alberty, 2014). *The Salt Lake Tribune* (2014) reports the incident prompted BLM to remove agency identification from vehicles in western Utah.

Employees also regularly report confrontations at BLM and USFS offices (Ring and Swearingen, 2014). West Desert administrators warn employees to "be prepared to encounter unfriendlies" (Alberty, 2014). One man stormed Moab's BLM office, threatened to "break some bones," and told a deputy he likes to wait on a nearby ridge with his rifle and "knows where to dispose of bodies so they will not be found" (Ring and Swearingen, 2014). An Idaho resident threatened to shoot USFS employees at a district office, saying, "This is our forest. You have no right to close roads...this is going to go to war and we'll start shooting if it keeps up" (Ring and Swearingen, 2014). Both men were angered by OHV restrictions. Such incidents represent extreme but common examples of animosity toward federal managers.

Literature Review

Federal agencies maintain public lands for public use by current and future generations. Because visits to public lands have increased exponentially in recent decades, along with OHV use (Butkus, 2009; USFS, 2004), agencies must carefully manage the land for sustainability. When expert management requires new use restrictions, however, the public may object. Management policies that prove controversial often involve OHV use, grazing, logging, and energy extraction. Opponents claim these policies can unduly restrict public access to public lands.

Previous studies assessed western residents' perceptions of federal land managers. Petrzela and Marquart-Pyatt (2013) found low trust in federal managers "to make good decisions about management of public lands" among Utah residents near Grand Staircase-Escalante National Monument. Schindler et al (2011) found "relatively low levels of trust in land management agencies to implement [management] actions" among Great Basin residents. The present study poses similar questions to Utah residents to learn what trust levels they feel for federal and state land managers.

Method

This study used an online survey instrument to sample a group of Utah residents active on public lands from June to October 2015. Subjects included current Utah residents 18 and older who signed an informed consent form. Voluntary participation was solicited through email and social media, primarily Facebook. To sample active public lands stakeholders, the study solicited participation on social media of community interest organizations focused on public lands or outdoor recreation, including conservation groups, four-wheeler associations, and fishing, hunting, and gun clubs, as well as public lands debate forums. Community interest groups were also e-mailed information about the survey and a link to share with interested members. Responses were submitted anonymously through the online host, SurveyMonkey.com. A total of 193 responses were collected.

Respondents rated whether they felt federal and state management of public lands has been effective both historically and currently. Respondents also compared three federal (BLM, NPS, USFS) and one state agency, Utah Department of Natural Resources (DNR), and rated their level of trust that each agency supports public access to public lands. The survey used a scale of

1 to 5, with 1 representing no trust, 2 representing little trust, 3 representing some trust, 4 representing moderate trust, and 5 representing high trust.

Results

A majority of respondents rated federal management as effective historically (63 percent) and currently (60.4 percent). A minority of respondents rated state management effective historically (46.4 percent) and currently (43.1 percent).

Across the four agencies, NPS earned highest trust by a clear margin, with moderate trust (average 4.07) that NPS supports public access to public lands. USFS ranked second (average 3.74), nearly moderate trust. BLM ranked third (average 3.54), midway between some and moderate trust. DNR fared worst with some trust (average 3.25).

The survey collected socio-demographic and other data to identify potential independent variables affecting trust levels, including frequency of use. On average, participants visited public lands managed by BLM, DNR, and NPS the same amount, one to three times a year. USFS land had more frequent visits. Participants reported visits exceeding once a month. Trust in USFS measured high in the survey, exceeding BLM and DNR, second only to NPS. With trust in NPS higher but frequency of use equivalent to BLM and DNR, results suggest no clear correlation between trust and frequency of use.

Other potential independent variables include socio-demographic traits like age, gender, and political affiliation. For age, no clear correlation existed between age of respondent and level of trust in any of the four agencies measured. For gender, results show some difference in trust levels between men and women for two agencies, one federal (USFS), one state (DNR). While women in the survey reported higher trust in USFS and DNR, men expressed lower trust. Male and female respondents reported similar trust in NPS and BLM.

Political affiliation formed the strongest correlation to low trust. Republican political affiliation strongly correlated to lower trust levels in all four agencies, federal and state. Respondents were asked to report their political affiliation as Democrat, Republican, or Independent. Of respondents, 45.30 percent identified as Independent, 23.92 percent identified as Republican, and 20.51 percent identified as Democrat. For a comparative baseline, out of all Utah

registered voters, 45.25 percent identify as Independent (either unaffiliated or one of three minor parties often categorized as independent: Independent American, Libertarian, and Constitution), 45.13 percent identify as Republican, and 9.63 percent identify as Democrat (Utah, 2015). The survey sample contains a nearly identical percentage of Independents as the Utah voting population, but a disproportionately low percentage of Republicans and an inflated number of Democrats. Survey results suggest interesting trends and correlations, but the sample population is not a representative sample of the Utah population. Trust levels for each agency have been broken down by political affiliation.

Discussion & Conclusion

The sample population consistently supports federal management over state, both historically and currently. Over 60 percent described federal management as effective historically and currently, but far fewer respondents expressed trust in state management of public land, either historically or currently (46.4 percent and 43.1 percent). A clear majority expressed trust in federal management, but a minority expressed trust in state management.

Respondents also preferred federal over state management when assessing each agency individually. All three federal agencies included in the poll (BLM, NPS, USFS) consistently rate higher in trust than state-run DNR. NPS ranked highest of the four, and was the sole agency surpassing moderate trust. DNR rated lowest, just above some trust, nearly a full rating below NPS. Among the survey sample, federal management is consistently preferred over state. This perspective may also be present among a significant portion of Utah residents active on public lands.

Among independent variables considered, only political affiliation had a consistent significant correlation to trust. Being a Republican was the single strongest predictor of lower trust in all four agencies, state and federal. Republicans' low trust in federal agencies may reflect partisanship, given the federal government's current Democratic leadership. Republican respondents also reported low trust in state land managers, however. This uniformly low trust may reflect the party's preference for smaller government in favor of private interests. Republicans may dislike all four government land agencies due to a preference for private ownership over public. Competing value systems create differing perspectives. Economic, recreational, and other special interests may outweigh the value of shared public land ownership. Any

discussion about public lands proceeds most effectively when participants acknowledge and show respect for other stakeholders' value systems. Without respect, disagreement devolves into conflict, as in the recent standoff in Oregon and other lesser confrontations across the west. Civil discourse, not armed confrontation, best serves Utahns and other western residents.

Private citizens, politicians, and media personalities can promote civil discourse by pursuing mutual understanding. With understanding that one's perspective on public lands may be strongly influenced by political affiliation and personal worldview, opponents may better tolerate differences and identify shared values. In Utah, shared values may include the frontier spirit and pioneer heritage, good stewardship based on religion or conservationism, love of outdoor recreation, pride in the state's unique landscapes, and a desire to provide for future generations. With respectful engagement based on shared values, western residents can work to achieve productive dialogue that decreases violence and helps all sides be fairly heard.

References

- Alberty, E. (2014, May 8). BLM workers on alert after wrangler threatened with gun on I-15. *The Salt Lake Tribune*. Retrieved from <http://www.sltrib.com/sltrib/news/57917374-78/wrangler-blm-reid-pickup.html.csp>
- Butkus, M. (2009). Recreation in Utah. Retrieved from extension.usu.edu/utahrangeland/files/uploads/RRU_Section_Eight_Recreation.pdf
- Bureau of Land Management (2015, Oct. 1). Utah: In the spotlight. Retrieved from <http://www.blm.gov/ut/st/en.html>
- Petrzelka, P., & Marquart-Pyatt, S. (2013, Fall). 'With the stroke of a pen': Designation of the Grand Staircase Escalante National Monument and the impact on trust. *Human Ecology: An Interdisciplinary Journal*, 41(2), 285-297. Doi:10.1007/s10745-012-9544-x
- Ring, R., & Swearingen, M. (2014, November 2). BLM, Forest Service workers under attack in the West. *The Salt Lake Tribune*. Retrieved from <http://www.sltrib.com/news/1765127-155/blm-forest-service-employee-federal-employees>

- Schwarz, H. (2014, December 2). The federal government controls two-thirds of Utah, and it's better that way, public lands groups say. *The Washington Post*. Retrieved from <http://www.washingtonpost.com/blogs/govbeat/wp/2014/12/02/the-federal-government-controls-two-thirds-of-utah-and-its-better-that-way-public-lands-groups-say/>
- Schindler, B., Gordon, R., Brunson, M.W., Olsen, C. (2011). Public perceptions of sagebrush ecosystem management in the Great Basin. *Rangeland Ecology and Management* 64 (4). Retrieved from <http://dx.doi.org/10.2111/REM-D-10-00012.1>
- State of Utah (2015). Elections. Retrieved from <http://elections.utah.gov/party-and-status>.
- United States of America v. Ammon Bundy, Jon Ritzheimer, Joseph O'Shaugnessy, Ryan Payne, Ryan Bundy, Brian Cavalier, Shawna Cox, Peter Santilli (2016, Jan. 27). U.S. District Court for the District of Oregon. Retrieved from http://res.cloudinary.com/bdy4ger4/image/upload/v1453933656/AmmonBundy1_kkivkn.pdf
- United States of America v. Jason Patrick, Duane Lee Ehmer, Dylan Anderson (2016, Jan. 27). U.S. District Court for the District of Oregon. Retrieved from http://res.cloudinary.com/bdy4ger4/image/upload/v1454017823/Newest_charges_p2bopq.pdf
- United States Forest Service. (2004). Four threats—key messages: Unmanaged recreation. Retrieved from www.fs.fed.us/projects/four-threats/key-messages/unmanaged-recreation.shtml

Tables

	BLM Level of Trust				
	No	Little	Some	Moderate	High
Republican	4%	9%	4%	6%	6%
Democrat	0%	3%	4%	6%	12%
Independent	1%	4%	14%	22%	6%

Table 1.

	DNR Level of Trust				
	No	Little	Some	Moderate	High
Republican	3%	8%	6%	11%	1%
Democrat	0%	4%	6%	7%	10%
Independent	1%	4%	18%	17%	4%

Table 2.

	USFS Level of Trust				
	No	Little	Some	Moderate	High
Republican	4%	4%	7%	8%	8%
Democrat	0%	0%	4%	4%	15%
Independent	3%	3%	7%	20%	15%

Table 3.

	NPS Level of Trust				
	No	Little	Some	Moderate	High
Republican	2%	4%	5%	4%	12%
Democrat	0%	2%	1%	6%	14%
Independent	0%	2%	8%	25%	16%

Table 4.



HISTORY

College of Social & Behavioral Science

Boils and Aversions: The Condemnation of Jews during the Black Plague, 1348-1350 C.E.

Tokiah Barker | Mentor: Branden Little & Stephen Francis

Abstract

In September 1348, officials from the county of Savoy, located within modern-day Switzerland and Italy, imprisoned the Jews of the township of Villeneuve after a trial convicted them of poisoning wells, springs, and food supplies in order to wipe out the Christian race. The prisoners, tortured by various townsmen, confessed to the alleged crimes whose prosecution reflected deep anxieties about the Black Plague ("Examination of the Jews," 1348). The Plague induced widespread terror throughout Europe and consequently exacerbated the longstanding, anti-Semitic rancor between Christians and Jews. According to Aberth (2005), Christians publicly rationalized pogroms, proudly stating they were avenging the sins of Jacob, but other reasons existed (p. 139). Jews were a minority and easy targets. Moreover, Jewish prominence within financial markets provided further justification for persecution, as it promised to enrich Christians who resented their achievements.

Discussion

Fourteenth-century Christians commonly associated Jews with impiety, characterizing them as "demons attendant on Satan, portrayed in drama or in pictures as Devils with the beards and horns of a goat" (Ziegler, 1991, p. 74). For Christians, these depictions confirmed the multitudinous convictions of Jews. Herman Gigas (1349), a German friar, recorded that Jews confessed to breeding spiders and toads in pots and pans and having obtained poison from overseas that they used to harm Christians (p. 207). The likelihood of this account's accuracy is minuscule, but stands as a testament to the anti-Semitic views held by members and officials of the Christian faith. This belief resonated throughout the Christian communities with such fervency that contrary ideas would falter as quickly as they were introduced. Incapable of halting the pandemic, medical practitioners provided answers they felt would be received well in their communities (Aberth, 2005, p. 40).

The majority of Savoyans accepted the idea of the Plague as a Jewish conspiracy to destroy Christianity. At the Jewish trials, the weak evidence presented was unlikely to have been upheld in a trial under ordinary conditions, but the Plague diminished evidentiary burdens among frightened people. Collective fear pardoned irrationality. Many Christians expected Jews to act fiendishly even if they had not committed the alleged crimes; they were certain that practically no crime was perpetuated without Jewish complicity (Seuse, 1360; Ziegler, 1991).

Just as those who believed the Plague originated from manufactured poisons, some believed it was God's wrath upon a wicked world. The staggering death rate inflicted severe emotional distress, leading survivors to question why the Plague erupted. Neither the clergy nor physicians with their limited knowledge of illness provided satisfactory explanations aside from blaming Jews for collusion with the Devil. Desperation drove hundreds of religious fanatics to whip themselves, marching in large processions across Europe, a phenomenon known as the Flagellant Movement. Historian Robert S. Gottfried (1983) described the Flagellants as "martyrs who atoned for the sins of the world and, hence, helped to avert further suffering from the plague and future visitations" (p. 71). Some believed they could "drive out devils, heal the sick and even raise the dead". When the blood of the Flagellants was spilled, the people collected it, treating the rags themselves as sacred relics. Though these practices deviated from standard Catholic rituals, the populace welcomed them.

The Flagellants' violent purification also encouraged the destruction of Jews. In July 1349, the arrival of Flagellants in Frankfurt whipped the local populace into a frenzy, straight into the Jewish quarter of the town, wherein they slaughtered Jewish residents (Ziegler, 1991, p. 68, 69, 77). Flagellants disseminated throughout Europe, "striving to kill Jews, thinking that it pleased God to exterminate them" (Aberth, 2005, p. 119). The Flagellants embedded incendiary words in their incantations to target Jews for their association with finance:

Jew the hated

The horrible, the disloyal

Who is very sharp and loves all evil

Who loans both gold and silver... (Michon, 1860, p. 90).

The chants provided the people a scapegoat, tying their religious and financial burdens to one tangible entity. In medieval banking practices, if the creditor died, the debtor's burdens would dissolve, a law which acted as a catalyst for the massacres. Pedro IV of Aragon's (1349) response to the Jewish pogrom of Tárrega revealed such desires. He wrote, "Like hypocritical robbers, they carried off all [the Jews'] goods and possessions, and they tore up and also burned many debt instruments and records that had been contracted with various Jews...the Jews lost all their goods and as result they do not have the instruments with which they can bind their debt-ors" (p. 143).

On February 14, 1349, officials arranged for a mass execution in Strasbourg, France. Mathias of Neuenburg (1349) recorded that French officials led the Jews to a Stoltzenecke, a specially prepared house in which they would burn, and "two hundred of them were completely stripped of their clothes by the mob, who found a lot of money in them" (p. 154). It is doubtful that they did, in fact, find money within their clothing, as this was most likely a well-circulated rumor, though it can be implied that the mob "tore the clothes from the backs of the victims on their way to execution in hopes of finding gold concealed in the lining" (Ziegler, 1991, p. 77). Even after the Stoltzenecke was smoldering with the ash plumes of its victims rising into the air, "many Strasbourgers sifted through the bones to try to find any valuables not melted in the fire" (Gottfried, 1983, p. 74). When the execution ended, "the town council [then] ordered cancellation of all debts owing to the victims and distributed what remained of their property among the local citizenry" (Glick, 1999, p. 267).

Seldom did anyone note the injustices inflicted upon Jews, though a few intellectuals, observers, and chroniclers of the Plague refuted the possibility that Jews caused the disaster (Konrad of Megenberg, 1350). Jean de Venette (1359) argued that "many wicked Christians were discovered poisoning wells in a similar fashion. But in truth, such poisonings, even if they really happened, could not have been solely responsible for so great a plague or killed so many people" (p. 57). Pope Clement VI (1348) also expressed doubts about Jewish complicity:

Were the Jews...to be guilty or cognizant of such enormities...could scarcely be conceived; ...we should be prepared to accept...that it cannot be true that the Jews...are the cause...of the plague, because...the same plague...has afflicted and afflicts the Jews themselves and many other races who have never lived alongside them.

After receiving information regarding the atrocities perpetuated by the Flagellant Movement, the Pope issued *Sicut Judeis* on July 5, 1348, a papal bull designed to protect Jews. The Pope decreed no Christian could presume “to wound or kill Jews, or take their money or expel them from his service before their term of employment has expired...and that anyone who...dares to do the contrary shall lose his title and office, or suffer the penalty of excommunication” (p. 221-222). Though Pope Clement VI (1348) had the best intentions, Jewish pogroms continued unabated across Europe. Outraged, the Pope reissued the papal bull on October 1, 1348 (p. 159). Even at the risk of excommunication and profound spiritual repercussions, however, Christians still found sufficient reasons to persecute and kill Jews.

Jewish pogroms also created major financial ruptures within European governments. Jews constituted a large portion of the tax base in medieval Europe (Pasachoff & Littman, p. 154). Aberth wrote the pogroms “created a tense dynamic between city rulers, anxious to preserve Jews as potential sources of tax revenue, and the populace, equally anxious to be rid of the debts they owed them” (p. 141). The rulers of Cologne, for instance, warned that killing Jews would bring “unexpected dangers” (Cologne to Strasbourg, 1349, p. 220). Savoyan officials were willing to contemplate incarceration of Jews as they had in the convictions of Villeneuve Jews, but cautioned against Jewish extermination.

A few cities and rulers took such warnings seriously. The citizens of Freiburg safe-harbored twelve of their key Jewish bankers, “so that those who owed money to them would still be contractually bound to pay their debts” (Mathias of Neuenburg, 1349, p. 152). King Casimir of Poland offered Jews protection, probably because of the perceived economic benefits, but also owing to his sentiments. The king had “a Jewish mistress and seemed well-disposed in general to Jews” (Gottfried, 1983, p. 74). The rulers of Strasbourg, however, failed to persuade a mob from killing Jews en masse. Cities that had killed Jews stumbled upon a financial disaster much to their dismay.

Religious and economic motivations have taken center stage in interpretations of the massacres, but when considering the social climate of the Plague, fear emerges as the most com-pelling explanation. Although it is impossible to find definitive reasons for the Jewish pogroms, one must consider the vulnerability of human nature to fear. The currents of anti-Semitism and hysterical reactions to the Plague

provided the environment for a wave of Jewish pogroms. Violence and anti-Semitism in medieval Europe facilitated the fusion of new fears and longstanding hatreds in ways that proved destructive to Jews, society and the overall dignity of humankind. This frightful story exists as a blotch in European history, a memory of human error, which should not be cast into the throws of irrelevance, when the fear of “others” is more prominent than ever.

References

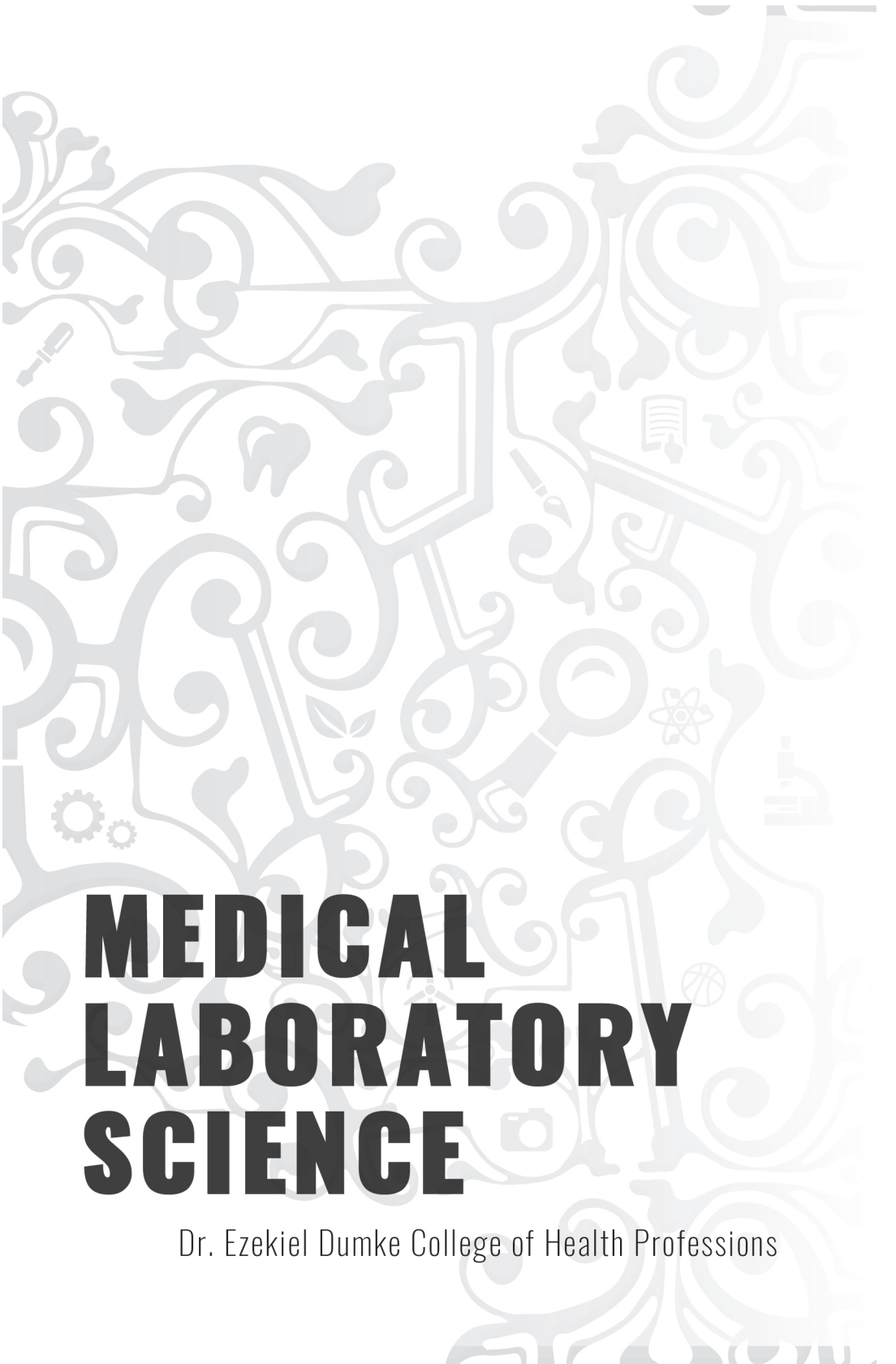
- Aberth, J. (2005). *The black death: the great mortality of 1348-1350, a brief history with documents* (pp. 40, 119-120, 139, 141). Boston: Bedford/St. Martin's.
- Cologne to Strassbourg. (1349). “Letter from Cologne to Strassburg.” In R. Horrox (Ed. and Trans.). (1994). *The black death* (pp. 219-220).
- de Venette, J. (1359). “The plague in France according to Jean de Venette.” In R. Horrox (Ed. and Trans.). (1994). *The black death* (pp. 57).
- “Examination of the Jews captured in Savoy.” (1348). In R. Horrox (Ed. and Trans.). (1994). *The black death* (pp. 211-215).
- Gigas, H. (1349). “Well-poisoning.” In R. Horrox (Ed. and Trans.). (1994). *The black death* (pp. 207).
- Glick, L. B. (1999). *Abraham's heirs: Jews and Christians in medieval Europe* (pp. 267). Syracuse, NY: Syracuse University Press.
- Gottfried, R. S. (1983). *The black death: Natural and human disaster in medieval Europe* (pp. 71-74). New York: Macmillan.
- Horrox, R. (1994). *The black death*. Manchester, UK: Manchester University Press.
- Konrad of Megenberg. (1350). “Concerning the mortality in Germany.” In J. Aberth (Ed.). (2005). *The black death* (pp. 157).
- Mathias of Neuenburg. (1349). “Chronicle.” In J. Aberth (Ed.). (2005). *The black death* (pp. 152-154).

- Michon, L. A. J. (1860). *Documents inédits sur la grande peste de 1348 (consultation de la fa-culté de Paris, consultation d'un praticien de Montpellier, description de Guillaume de Ma-chaut): Publiés avec une introduction et des notes* (pp. 90). Paris: J. B. Baillière et Fils. Re-trieved from [https:// archive.org/ details/ documentsindits00michgoog](https://archive.org/details/documentsindits00michgoog). Translated from its ori-ginal by the author.
- Pasachoff, N. & Littman, R. J. (2005). *A concise history of the Jewish people* (pp. 154). Syra-cuse, NY: Rowman & Littlefield.
- Pedro IV of Aragon. (1349). "Response to Jewish pogrom of Tárrega." In J. Aberth (Ed.). (2005). *The black death* (pp. 143).
- Pope Clement VI. (1348). "Mandate of Clement VI concerning the Jews." In R. Horrox (Ed. and Trans.). (1994). *The black death* (pp. 221-222).
- Pope Clement VI. (1348). "Sicut Judeis." In J. Aberth (Ed.). (2005). *The black death* (pp. 159).
- Seuse, H. (1360). "An accusation of wellpoisoning." In R. Horrox (Ed. and Trans.). (1994). *The black death* (pp. 225).
- Wohlgemut, M. (1493). *Illustration of Jews burned in Cologne after a woodcut*. Retrieved from [http:// www.BlackDeath.info/ blame.html](http://www.BlackDeath.info/blame.html).
- Ziegler, P. (1991). *The black death* (pp. 68-69, 73-74, 77). Gloucestershire, UK: Alan Sutton.

Figures



Figure 1. Jews Burn in Cologne during the Black Death, ca. 1493.



MEDICAL LABORATORY SCIENCE

Dr. Ezekiel Dumke College of Health Professions

Antimicrobial Effect of *Asparagus racemosus* on Five Clinically Significant Pathogens

Joseph Maes, Justin Judkins, & Bradley Sears

| Mentor: Scott Wright

Abstract

*The extensive use of antimicrobials has contributed to the increase of antimicrobial-resistant bacteria, which is a major issue in healthcare. Synergism of drugs is one way to combat this problem. Within the past several years scientific interest has increased in the biological effects of the chemical compounds in the roots of *Asparagus racemosus*, also known by its common name, Shatavari. The objective of this study was to evaluate the antimicrobial efficacy of *A. racemosus* on methicillin-resistant *Staphylococcus aureus* (MRSA), *Escherichia coli*, *Streptococcus pyogenes*, *Pseudomonas aeruginosa*, and *Shigella flexneri*. Furthermore, the objective was to determine if *A. racemosus* has synergistic effects on these organisms with clinically significant antimicrobials. Extracts of the root were prepared using root powder in separate flasks of solvents: methanol, acetone, chloroform, dimethyl sulfoxide (DMSO) and deionized water. Concentrations of the extract solutions were determined and used to test for antimicrobial activity using a serial broth dilution method. Each tube was inoculated with test organism, incubated overnight, and struck out on plates to determine the minimum inhibitory concentrations (MIC) of the extracts. The methanol, acetone, chloroform, and DMSO did not extract sufficient amounts of active ingredient to determine antimicrobial effect of the root compared to controls of solvents alone. Testing for synergism using 96-well MIC panels containing a 1:2 dilution of extract yielded an increase in susceptibility of *S. aureus* (MRSA) to linezolid, ertapenem, and oxacillin, as well as an increase in susceptibility of *P. aeruginosa* to ticarcillin/K clavulanate*

Introduction

Individuals in favor of using natural medicine in place of proven pharmaceuticals do so for a multitude of reasons, but this choice often comes with the cost of sacrificing clinically researched efficacy and empirical evidence. Despite this, plants are used medicinally in various regions across the world and are also looked to as a possible source of new drugs (Gull et al, 2013). *Asparagus racemosus* has been used primarily in India as a lactation promoter, a remedy for hyperacidity, and a possible treatment for infectious bacterial diseases (Sharma et al, 2012). Scientific interest in the roots of *A. racemosus* has increased in recent years and research has yielded some clinical evidence of antimicrobial efficacy in isolates from oral cancer patients, notably *Staphylococcus aureus*, of which the methicillin-resistant strain is particularly deadly (Panghal et al, 2011). Furthermore, studies on the trends of antimicrobial resistance as well as the common mechanisms of resistance of multi-drug resistant *Escherichia coli* and *Klebsiella pneumoniae* are scant (Datta et. al, 2012).

Thin-Layer Chromatography (TLC) and High-Performance Liquid Chromatography (HPLC) fingerprinting of root extracts, techniques used to separate compounds from solutions for analysis, have demonstrated presence of steroid-terpenes, alkaloids, and flavonoids (Potduang et al, 2008) that may be effective in inhibiting the growth of pathogenic bacteria by binding to their cellular membranes and subsequently causing lysis. Ongoing research continues to yield newly discovered compounds such as shatavaroside C, a steroidal saponin, and shatavarol, a diphenylpentendiol (Sharma et al, 2012). The objective of this study was to evaluate the antimicrobial efficacy of *A. racemosus* on methicillin-resistant *Staphylococcus aureus* (MRSA), *Escherichia coli*, *Streptococcus pyogenes*, *Pseudomonas aeruginosa*, and *Shigella flexneri*. Furthermore, the objective was to determine if *A. racemosus* has synergistic effects with clinically significant antimicrobials against these organisms.

Materials & Methods

Root Extraction

Samples of certified organic Shatavari root powder (origin: India) were measured to approximately 40 g and extracted in 350 mL of each of the following solvents: chloroform, dimethyl sulfoxide (DMSO), acetone,

methanol and deionized water (700 mL instead of 350 mL). The flasks containing the powder and solvent mixtures were sealed to external air using Parafilm and allowed to sit at room temperature for five days with agitation every few hours to maximize surface area of powder for extraction. After five days, the extracts were filtered using unbleached coffee filters to obtain undissolved root material for determination of concentrations of each extract. The filtered insoluble materials were air dried and measured. The concentrations of the extracts were determined by subtracting the dry weight of the insoluble material from the original weight of the powder. Concentrations were 1.29 g/dL for chloroform, 11.3 g/dL for DMSO, 0.530 g/dL for acetone, and 5.76 g/dL for methanol, and 16.1 g/dL for deionized water.

MIC Determination

For the determination of minimum inhibitory concentration (MIC) of these extracts, 1.0 mL of Columbia broth was placed in each of six tubes (13x300 mm) per test run. A serial dilution of each extract was performed, consisting of 1:2, 1:4, 1:8, 1:16, 1:32, and 1:64 dilutions starting with 1 mL of Columbia broth in each of the six tubes and 1 mL of extract in the first tube. Each tube was then inoculated with a volume of 20 μ L at concentration of one McFarland standard (1.5×10^8 CFU/mL) of test organism. The organisms included methicillin-resistant strain of *Staphylococcus aureus* (ATCC 43300), *Escherichia coli* (ATCC 25922), *Streptococcus pyogenes* (ATCC 19615), *Pseudomonas aeruginosa* (ATCC 27853), and *Shigella flexneri* (ATCC 12022). Each test was run in triplicate with a set of control tubes with solvent alone in place of the extract. The water extract required sterilization by autoclave prior to inoculation to remove bacterial contamination present in the powder. The tubes were incubated for 24 hours at 37°. To determine MIC of test extract, after the incubation period, each tube was plated on a 5% sheep blood agar (SBA) plate divided into six sections, one plate per set of six tubes, and incubated for 24 hours at 37°. After the incubation period, plates were examined.

Testing for Synergism

To test for a synergistic effect with antimicrobials commonly used in clinical applications, each organism was inoculated into Siemens MicroScan panels (NM38 or PM26 for Gram negative and Gram positive organisms, respectively) (Table 1). Panels were inoculated with a 1:2 dilution factor

of sterile saline with test extract and also without extract which served as a control. This dilution factor was chosen due to the fact that there was no effective inhibition at higher levels of dilution. Panels were incubated overnight and read by an automated panel reader. Any decrease in MIC (i.e. susceptibility) in a test plate antimicrobial when compared to control plate MIC for the same antimicrobial was considered synergistic.

Results

MIC concentrations of test extracts were determined by dividing the original concentration of each extract by the dilution factor of the last section of inhibited growth on an SBA plate. MIC of acetone was 0.13 g/dL, 0.081 g/dL for chloroform, 5.6 g/dL for DMSO, and 1.4 g/dL for methanol. These results were identical to controls (Figure 1).

The aqueous extract yielded no MIC as growth was not inhibited by any dilution of test extract (Figure 2).

The MICs of linezolid for *S. aureus* were 2 mg/L and 0.75 mg/L for the control and test panel, respectively. The MICs of oxacillin for *S. aureus* were 2 mg/L and 1.125 mg/L for the control and test panel, respectively. The MICs of ertapenem for *S. aureus* (MRSA) were 2 mg/L and 1.5 mg/L for the control and test panel, respectively (Figure 3). There was no difference between the MICs of the tests and controls for any other antimicrobials tested on MRSA nor the other pathogens.

Discussion

The methanol, chloroform, acetone and DMSO extracts when tested in comparison to their respective controls yielded the same results in their MIC determinations. This indicates that the amount of soluble material dissolved into solution from the root powder was not in high enough concentration in any of the extracts to infer that any antimicrobial activity may have been due to the plant itself. After determining there was no effective inhibition on *S. aureus* (MRSA) in the above mentioned extracts when compared to controls, an aqueous extraction was prepared to more accurately determine any antimicrobial activity. The aqueous extract had no antimicrobial activity against any organism, as indicated by growth in every SBA plate section from each respective tube. This may be due to an insufficient concentration, or it may be that *A. racemosus* possesses no antimicrobial properties.

Another explanation may be that since the aqueous solution was initially contaminated, its extracted dilutions were required to undergo sterilization in an autoclave prior to inoculation. The sterilization process may have denatured any active ingredient that may have been present. Synergism was demonstrated between the aqueous extract and oxacillin, linezolid, and ertapenem for *S. aureus*. Further study on the synergism of antimicrobials and extracts of *A. racemosus* must be done.

Acknowledgements

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References

- Datta, S., Wattal, C., Goel, N., Oberoi, J. K., Raveendran, R., & Prasad, K. J. (2012). A ten year analysis of multi-drug resistant blood stream infections caused by *Escherichia coli* & *Klebsiella pneumoniae* in a tertiary care hospital. *The Indian Journal of Medical Research*, 135(6), 907–12.
- Gull, I., Sohail, M., Aslam, M., & Athar, M. (2013, 12). Phytochemical, toxicological and antimicrobial evaluation of lawsonia inermis extracts against clinical isolates of pathogenic bacteria. *Annals of Clinical Microbiology and Antimicrobials*, 12(1), 36. doi: 10.1186/1476-0711-12-36.
- Panghal, M., Kaushal, V., & Yadav, J. P. (2011, 12). In vitro antimicrobial activity of ten medicinal plants against clinical isolates of oral cancer cases. *Annals of Clinical Microbiology and Antimicrobials*, 10(1), 21. doi: 10.1186/1476-0711-10-21.
- Potduang, B., Meeploy, M., Giwanon, R., Benmart, Y., Kaewduang, M., & Supatanakul, W. (2008, 12). Biological Activities Of *Asparagus racemosus*. *African Journal of Traditional, Complementary and Alternative Medicines*, 5(3). doi: 10.4314/ajtcam.v5i3.3127.

Figures

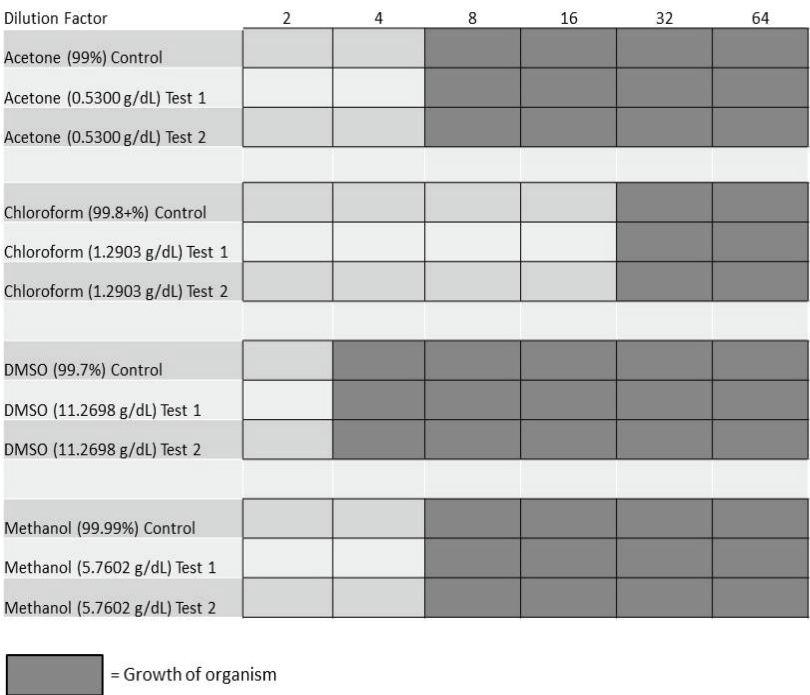


Figure 1. Minimum Inhibitory Concentrations of Extract Solution.

Dilution Factor		2	4	8	16	32	64
<i>S. aureus</i>	Control						
	Test 1						
	Test 2						
	Test 3						
<i>E. coli</i>	Control						
	Test 1						
	Test 2						
	Test 3						
<i>S. flexneri</i>	Control						
	Test 1						
	Test 2						
	Test 3						
<i>P. aeruginosa</i>	Control						
	Test 1						
	Test 2						
	Test 3						
<i>S. pyogenes</i>	Control						
	Test 1						
	Test 2						
	Test 3						


 = Growth of Organism

Figure 2. Minimum Inhibitory Concentrations of Aqueous Extract Solution on Five Pathogens.

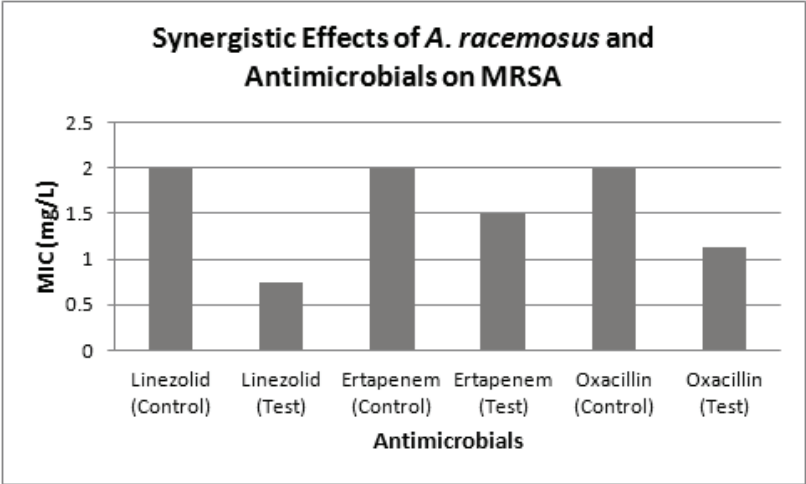


Figure 3. Synergistic Effect Between Three Antimicrobials and Aqueous *A. racemosus* Extract.

Gram positive panel (PM 26)

Aminoglycosides	Amikacin Gentamicin Tobramycin	Aminoglycosides	Amikacin Gentamicin Tobramycin
Carbapenems	Ertapenem Imipenem Meropenem	Carbapenems	Ertapenem Imipenem Meropenem
Penicillins	Ampicillin Ampicillin/Sulbactam Piperacillin/Tazobactam Ticarcillin/K Clav Piperacillin	Penicillins	Ampicillin Ampicillin/Sulbactam Piperacillin/Tazobactam Ticarcillin/K Clav Piperacillin
Monobactam	Aztreonam	Monobactam	Aztreonam
Fluoroquinolones	Ciprofloxacin Levofloxacin	Fluoroquinolones	Ciprofloxacin Levofloxacin
Sulfonamide	Trimethoprim/Sulfa	Sulfonamide	Trimethoprim/Sulfa
Nitrofurantoin	Nitrofurantoin	Nitrofurantoin	Nitrofurantoin
Cephalosporins		Cephalosporins	
First Generation	Cefazolin Cephalothin	First Generation	Cefazolin Cephalothin
Second Generation	Cefotetan Cefoxitin Cefuroxime	Second Generation	Cefotetan Cefoxitin Cefuroxime
Third Generation	Cefotaxime Cefotaxime/K Clav Ceftazidime Ceftazidime/K Clav Cetrixaxone	Third Generation	Cefotaxime Cefotaxime/K Clav Ceftazidime Ceftazidime/K Clav Cetrixaxone
Fourth Generation	Cefepime	Fourth Generation	Cefepime
Other	Tetracycline	Other	Tetracycline

Table 1. Antimicrobials in MIC Panels.

The Prevalence of Milk-borne Pathogens in the Northern Utah Supply

Landen Holmes & Quinn Bingham | Mentor: Matthew Nicholaou

Abstract

The belief that raw dairy products are more nutritional than pasteurized dairy products has led to an increase in raw milk consumption (Claeys, et al., 2013). However, raw milk can contain pathogenic organisms if it is not pasteurized or if pasteurized improperly. The purpose of this research was to determine the prevalence of Salmonella, Shigella, and Shiga-like toxin producing Escherichia coli (STEC) in unprocessed Northern Utah farm Bulk Tank Milk (BTM). A recent outbreak of Campylobacter stemming from consumption of raw milk from a Weber County farm demonstrates that the Utah public is generally unaware of the risk of contracting diseases associated with raw milk and dairy products (Anderson, 2014). Although most BTM will be processed and pasteurized, a small fraction may be sold as untreated raw milk. Samples were collected from each of 105 different Northern Utah farms. Duplicate samples of milk from each of the farms were collected in sterile containers, kept on ice, and brought to the Weber State University's clinical microbiology laboratory within two hours after collection. Pathogenic organisms were identified using selective culture media and Polymerase Chain Reaction (PCR).

Introduction

Milk can become contaminated during collection in many ways with improper cleaning of the udder before collection being one of the most common. Milk can also be contaminated during storage in the bulk tank if the farmer has not taken correct measures to sanitize the tank, which must be thoroughly washed before any storage of milk begins. Milk pasteurization is known to significantly decrease the amounts of pathogens that may be present in raw milk products. Because people believe there are significant benefits of consuming raw dairy products, consumption has significantly increased. The increasing consumption of raw milk products demonstrates that raw milk consumers are generally unaware of the prevalence of pathogens

in raw milk (Lejeune, & Rajala-Schultz, 2009). A 2006 study detected the prevalence of *Salmonella* at 6.0%, and STEC at 2.4% in 248 Pennsylvania farms' BTM samples (Jayarao, et al., 2006). This study specifically examines the prevalence of *Salmonella* sp., *Shigella* sp., and STEC in samples collected from farms in northern Utah.

Materials & Methods

Confidentiality

The identities of the individual dairy farms were kept confidential at all times and all samples collected were assigned numbers for laboratory reference.

Milk Sample Processing

Once samples arrived at the microbiology lab, the milk specimens were inverted thoroughly until fully homogenized. Well-mixed, homogenized samples were plated directly, without the use of an enrichment medium, onto Sorbitol MacConkey (SMAC) agar plates and incubated at 37°C for 24 hours. After 24-hour incubation, SMAC plates were read for presumptive STEC identification. One mL of each homogenized milk sample was incubated in Selenite Cystine selective enrichment broth at 37°C for 24 hours to enhance the recovery of *Salmonella* cells. Selenite Cystine enriched samples were then plated on Hektoen Enteric agar (HEA) plates and incubated at 37°C for 24 hours. After 24-hour incubation, HEA plates were read for presumptive *Salmonella* and *Shigella* identification. On HEA plates green colonies are indicative of *Shigella* and green colonies with black centers are indicative of *Salmonella*. On SMAC plates a negative sorbitol reaction indicates that some form of STEC is present.

Colony-Forming Units

In addition to plating samples on selective media, samples were also plated using sterile one µL calibrated loops onto Sheep's Blood Agar (SBA) plates to determine Colony-Forming Units (CFU) per mL of sample. This was done in order to quantify general bacterial contamination of the samples.

PCR Preparation

PCR was used for confirmatory testing of samples that produced presumptive pathogen colonies on the selective culture plates. Five mL from each fully homogenized sample was centrifuged at 3500 rpm for 10 minutes to produce a dense button of cells at the bottom of the centrifuge tube. DNA was extracted from the button and underwent PCR analysis. The amplicon products of the PCR were to be separated using gel electrophoresis and identified based on size and location of each band.

DNA Extraction

DNA extractions were performed on all milk samples using the Qiagen DNeasy DNA extraction kit. Once DNA extraction was completed on all samples, DNA was quantified to ensure enough DNA was extracted for PCR.

DNA Quantification

Quantification of the DNA was performed on all extractions to determine if there would be a sufficient amount of DNA to perform PCR. Milk sample extractions averaged 11.38 ng/ μ L and all were found to be suitable for PCR analysis. DNA quantification was performed using the Epoch II plate reader.

DNA Electrophoresis

PCR amplicons were visualized using DNA gel electrophoresis. A 3% agarose gel with ethidium bromide was used. Gels were run at 120 V for 75 to 90 minutes for complete separation of bands.

Results

Most samples in this study that were positive for pathogens on culture media were contaminated with greater than 10000 CFU/mL. This indicated that there may be a connection between general contamination and pathogen contamination. Most samples tested were at a concentration of 10000 CFU/mL or less. The average of all samples was 10700 CFU/mL, meaning that contamination among the samples was generally high. The total number of samples was 105. Out of all of the samples collected on the culture plates, 26% tested positive for at least one of the specific pathogens. 5% of all samples were positive for STEC, 7% were positive for Salmonella, and 14% were positive for Shigella in culture screening.

76% of samples tested negative for these three pathogens. Multiplex PCR analysis was first performed at 61.3°C with culture positive samples. Since the controls did not work properly, the first attempt at multiplex was not successful. Plans to rework the multiplex assay are currently pending.

Discussion

Selective culture media like HEA and SMAC plates are not extremely sensitive because the biochemical color reactions are not always 100% accurate. Therefore, PCR was performed to confirm culture identification. PCR was successfully validated and reagents were found to be working correctly. However, when the samples were run in the final multiplex reaction, the controls failed to show up on the electrophoresis gel. Subsequent runs to detect the presence of organisms must be performed in order to confirm the culture results. The study conducted by Jayarao et. al. in 2006 found that the presence of *Salmonella* in 6.0% of samples, and STEC in 2.4% of samples (Jayarao, et al., 2006). This study found slightly higher prevalence of both *Salmonella* in 7.0% of samples and STEC in 5.0% of samples. Given the relatively common occurrence of these pathogens in Northern Utah BTM samples, raw milk consumers in the area are likely to eventually be exposed to milk-borne pathogens found in this study, as well as many others that may exist in the state of Utah's raw milk supply. This study found that, in general, BTM might contain pathogenic organisms. Although exposure to these pathogens could occur by consuming raw dairy products, it is not known to this study what the specific risks of contracting disease from contaminated raw milk are. Further research could be conducted to find the link between exposure and disease in consumers of raw milk in the Northern Utah area.

References

- Anderson, M. (2014, August 26). At least 45 sickened after consuming Utah raw milk. Retrieved from <http://www.ksl.com/?nid=148&sid=31300568>.
- Claeys, W. L., Cardoen, S., Daube, G., Block, J. De, Dewettinck, K., Dierick, K., Thiange, P. (2013). Raw or heated cow milk consumption: review of risks and benefits. *Food Control*, 31(1), 251–62. doi:10.1016/j.foodcont.2012.09.035.

Jayarao, B. M., Donaldson, S. C., Straley, B. a, Sawant, a a, Hegde, N. V, & Brown, J. L. (2006). A survey of foodborne pathogens in bulk tank milk and raw milk consumption among farm families in Pennsylvania. *Journal of Dairy Science*, 89(7), 2451–8. doi:10.3168/jds.S0022-0302(06)72318-9.

Lejeune, J. T., & Rajala-Schultz, P. J. (2009). Food safety: unpasteurized milk: a continued public health threat. *Clinical Infectious Diseases*, 48(1), 93–100. doi:10.1086/595007.

Luxin, W. (2006). Simultaneous quantitation of *Escherichia coli* O157:H7, *Salmonella* and *Shigella* in ground beef by multiplex real-time PCR and Immunomagnetic separation, 45.

Ziemer, C., & Steadham, S. (2003). Evaluation of the specificity of *Salmonella* PCR primers using various intestinal bacterial species*. *Letters in Applied Microbiology*, 463–469. doi:10.1046/j.1472-765X.2003.01430.x.

Figures & Tables

PCR PRIMERS

E. coli O157:H7 Primers (Wang, Luxin, 2006)

PCR Target	Primer Sequence, 5' to 3'	Product Size
uidA-F	TTG ACC CAC ACT TTG CCG TAA	227 b.p.
uidA-R	GCG AAA ACT GTG GAA TTG GG	

Salmonella Primers

PCR Target	Primer Sequence, 5' to 3'	Product Size
SAL-F	GCT ATT TTC GTC CGG CAT GA	117 b.p.
SAL-R	GCG ACT ATC AGG TTA CCG TGG A	

Shigella Primers

PCR Target	Primer Sequence, 5' to 3'	Product Size
ipaH-F	CTT GAC CGC CTT TCC GAT A	261 b.p.
ipaH-R	AGC GAA AGA CTG CTG TCG AAG	

Table 1. Primers used for PCR identification of organisms.

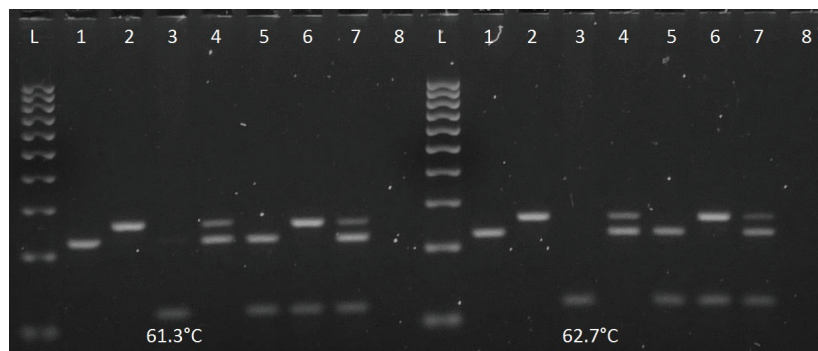


Figure 1. PCR Multiplex Optimization. PCR validation at 4 temperatures, 61.3°C and 62.7°C shown. Molecular ladder: L, lane 1: *E. coli* 0157:H7, lane 2: *Salmonella*, lane 3: *Shigella*, lane 4: *E. coli* 0157:H7 + *Salmonella*, lane 5: *E. coli* 0157:H7 + *Shigella*, lane 6: *Salmonella* + *Shigella*, lane 7: *E. coli* 0157:H7 + *Salmonella* + *Shigella*, lane 8: H₂O control. The 61.3°C run was chosen for PCR. PCR validation was performed using four different temperatures to determine if primers were functional and to find the best annealing temperature for the multiplex assay. Primers were able to detect their targets during validation at all temperatures; however, 61.3°C was chosen for multiplex PCR because most of the bands appeared to be highly visible at this temperature. The combinations of organisms in figure 1 were used to ensure that separation of the bands would occur when running the final PCR assay, as to avoid band overlap if any sample is positive for multiple organisms.

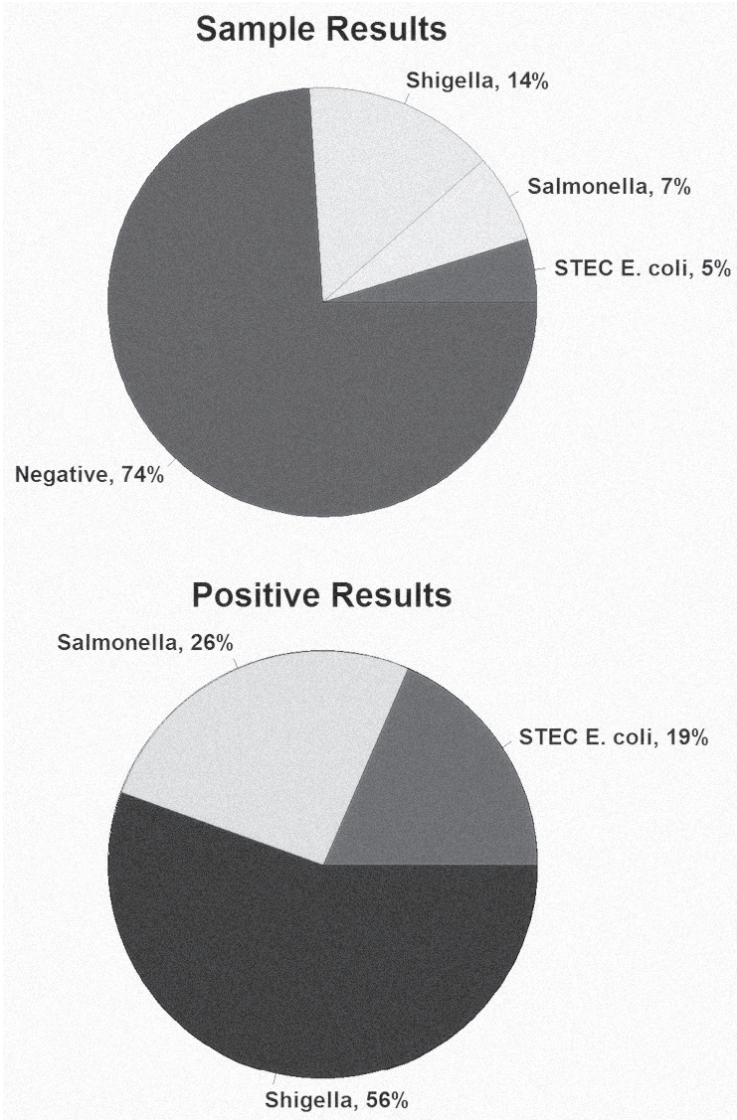


Figure 2. Summary of culture samples. The top pie chart shows the percentages of sample results with $n = 105$, note that most are negatives. The bottom pie chart shows percentages of only the samples that were preliminarily positive.

The Role of Blood Type in the Development of Celiac Disease

Zachary Gibson, Alex Rich, & McKenzie Carter

| Mentor: Janet Oja

Abstract

Research shows that certain lectins found in wheat can bind to specific monosaccharides in the intestinal mucosa contributing to intestinal damage in Celiac disease (CD). The N-Acetylgalactosamine (GalNAc) structure found on type A and AB red blood cells (RBCs) is one of such monosaccharides. The hypothesis of this research was that the prevalence of CD is greater in individuals with type A and AB blood due to the GalNAc structure present on their RBCs and in bodily secretions due to a positive secretor status. After IRB review and approval, 40 subjects, 14 with CD and 26 healthy controls, were recruited through a local gastroenterologist. Blood type and secretor status, through Lewis antigen typing, were determined for all subjects through the direct agglutination method. When comparing the prevalence of CD in A secretors to B and O secretors and non-secretors, an odds ratio of 0.40 (95% CI 0.10-1.6; $p = .1966$) was obtained and was not statistically significant. Although the odds ratio was statistically insignificant, it suggested a protective effect with A-secretors being less than half as likely to have CD than non-secretors with B or O blood types. However, further research is needed to validate this association.

Introduction

Celiac disease (CD) is an autoimmune intestinal disorder characterized by inflammation and cellular damage. Genetics and environmental factors lead to the development and continued pathology of the disease. Gluten is a key contributor to the disease and is found in products containing wheat, barley, and rye. When gluten is ingested, an intestinal mucosal immune response is triggered causing subsequent inflammation, destruction of nutrient absorbing structures, increased intestinal permeability and malabsorption of necessary nutrients. The gluten structure consists of proteins called glutenins and gliadins. Research

shows these gliadin proteins play a major role in the autoimmune response (de Punder & Pruimboom, 2013). Plant based lectins, such as Wheat Germ Agglutinin (WGA), also have the ability to bind to specific carbohydrate structures and cause an inflammatory immune response (Pittschieler, Ladinser, & Petell, 1994; Vojdani, 2011).

Biopsies from the intestinal mucosa have shown the carbohydrate-binding ability of certain lectins in CD patients (Pittschieler et al., 1994). This shows that lectins can bind to the N-Acetylgalactosamine (GalNAc) structure in the mucosa. Despite this, no association has been described between blood type and CD. Furthermore, recent research has only focused on the link between secretor status in CD and has shown a positive correlation between negative secretor status and the disease (Sanz, De Pama, & Laparra, 2011). Lectin activity has been overlooked recently due to the increased interest in gliadins, and bacterial causes of CD.

WGA has the ability to bind to GalNAc, a cell marker used for self-recognition in many tissues of the body. This marker is predominant on the cells of tissues lining body cavities and internal organs, including the intestinal mucosa. This structure is also predominant on certain types of red blood cells (RBCs), seen in Figure 1, in individuals with type A or AB blood. About 80% of individuals in the general population also express this marker in secretions such as saliva, semen, and intestinal mucosal fluids. These people are called secretors, and they can be discerned indirectly by testing for the Lewis b antigen, another cell marker, present on RBCs. Individuals who have A or AB blood that also secrete the GalNAc structure may have more of this GalNAc available for lectins to bind to in the intestines. This binding ability may enhance or initiate the CD process.

These researchers hypothesized that the prevalence of Celiac Disease is greater in individuals with type A and AB blood who also have positive secretor status due to the increased presence of the N-Acetylgalactosamine carbohydrate structure on their red blood cells, tissues, and bodily secretions. The described similarity between these antigens suggests there may be an association between blood group, secretor status, and the prevalence of Celiac Disease. Specimens were collected from individuals with Celiac Disease and healthy controls. These samples were tested for blood type and secretor status. After statistical testing was performed, this study found no significant link between the secretion of the type A substance and the presence of Celiac Disease in patients.

Materials & Methods

Sample Collections

Patients with CD were recruited through a gastroenterologist in Ogden, Utah. A control group of individuals with no gastrointestinal disease was recruited through social media, word of mouth, and advertising. Subjects were considered healthy if they had no past history of CD, no history of any other inflammatory bowel disease, and no history of autoimmune disease. All subjects in the study were between the ages of eighteen and seventy and lived in the Ogden area. In total, 44 subjects participated. Samples were collected by venipuncture into 4.0 mL collection tubes containing 7.2 mg of K₂EDTA. The samples were anonymized to blind the researchers to the disease status of each sample and to protect patient information. The RBCs were separated from whole blood by centrifugation at 1,600 rcf for 10 minutes. After centrifugation, samples were stored at 8°C and were tested within 7 days of collection.

Direct Agglutination Tests

ABO blood type, Lewis antigen typing tests, and quality control tests were performed using the Direct Agglutination method. Red blood cell suspensions of 3-5% were made using red blood cells from each sample respectively, and 0.9% w/v phosphate buffered NaCl solution. Murine monoclonal anti-Lewis A and anti-Lewis B reagent antisera were added, per the package insert, to one drop of the prepared cell suspensions to determine the Lewis antigen profile on each sample. Murine monoclonal anti-A₁ and anti-B reagent antisera were also added, according to specifications in the package insert, to one drop of the prepared cell suspensions to determine the ABO type of each sample.

Statistical Analysis

Statistical testing was completed using the Odds/Risk Ratio, comparing the relative odds of disease in the exposure groups, using the EpiR package of RStudio. The ratio was calculated using the 2x2 box seen in Figure 2. The positive exposure group (Exp+) consisted of samples that contained the GalNAc carbohydrate (A or AB blood type) structure and also had a positive secretor status, while the negative exposure group (Exp-) contained all other variations in ABO and secretor status. Graphs and tables were generated using the data output from RStudio.

Results

To investigate the possible association of GalNAc secretion and CD, the blood specimens of 14 individuals with CD and 26 healthy controls were analyzed in this experiment. The overall prevalence of CD was 23.5% for the group of individuals who possessed the A antigen and had a positive secretor status. In contrast the prevalence was 43.5% for the group negative for the A antigen, regardless of secretor status. The calculated odds ratio was 0.40 (95% CI 0.10-1.6; $p = .1966$). This odds ratio was statistically insignificant meaning that there was no interaction between the secretion of GalNAc and CD.

Discussion

Prior research and rationale suggested that the prevalence of CD would be higher in individuals with type A or AB blood due to presence of the GalNAc structure on RBCs, tissues, and in bodily secretions. The proposed mechanism of action in this study was that GalNAc, if present in secretions, could become associated with cells in the intestinal mucosa. Lectins could then bind to these carbohydrate structures and recruit the components necessary for an immune response, causing the classical damage to this tissue that is often exhibited in patients with CD.

Although the odds ratio was statistically insignificant, the results obtained in this experiment brought to light a different possible association. Contradictory to these researchers' hypothesis, it was determined that individuals who had the A antigen in secretions actually had lesser odds of having CD. In fact, the odds ratio corresponded to a .40 chance of having CD when compared to individuals of the negative exposure group. That is, individuals who had type A blood and were secretors were only 40% as likely to have CD when compared to all others included in the study. While the effect seen in this study was not statistically significant, this was most likely due to insufficient statistical power due to the small sample size. The prevalence of CD was almost two times greater in the experimental group of individuals that did not have the A antigen. The results, along with an odds ratio of .40, indicate that there may be some correlation between the presence of the A antigen in secretions and the reduced risk of having CD. The A antigen may, in fact, have a protective effect against the development of CD. Instead of participating in a sensitization reaction that would lead to an immune

response, the presence of the A antigen may contribute to a regulatory pathway that leads to its toleration by the immune system.

While CD has been highly scrutinized by the scientific community in the preceding years, it is still not completely understood. The bridge between HLA type and the involvement of gliadins, in addition to other proteins and carbohydrates, has not been fully discovered. The results of this macroscopic study provide a surface level observation and a simplified method of action explaining a very complex and variable disease. However, the results of this study are not to be ignored, as they may have uncovered another possible variable in the development of CD. The lower prevalence of the disease in individuals with the A antigen is curious and merits examination in future studies.

References

- De Punder, K., & Pruimboom, L. (2013). The dietary intake of wheat and other cereal grains and their role in inflammation. *Nutrients*, 5(3), 771–87. Retrieved August 22, 2014 from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3658803/>
- Pittschieler, K., Ladinsler, B., & Petell, J. (1994). Reactivity of gliadin and lectins with celiac intestinal mucosa. *Pediatric Research*, 36(5), 635–641. Retrieved September 2, 2014 from <http://www.nature.com/pr/journal/v36/n5/abs/pr1994805a.html>
- Rubio-Tapia, A., Hill, I. D., Kelly, C. P., Calderwood, A. H., & Murray, J. a. (2013). ACG clinical guidelines: diagnosis and management of celiac disease. *The American Journal of Gastroenterology*, 108(5), 656–76; quiz 677. Retrieved September 2, 2014 from <http://www.nature.com/ajg/journal/v108/n5/full/ajg201379a.html>
- Sanz, Y., De Pama, G., & Laparra, M. (2011). Unraveling the ties between celiac disease and intestinal microbiota. *International Reviews of Immunology*, 30(4), 207–18. EBSCO. Retrieved August 23, 2014 from <http://web.a.ebscohost.com/hal.weber.edu:2200/ehost/pdfviewer/pdfviewer?vid=2&sid=70a5c6ca-7cc4-4269-8945-cda97d652159%40sessionmgr4005&hid=4112>

Vojdani, A. (2011). The Characterization of the Repertoire of Wheat Antigens and Peptides Involved in the Humoral Immune Responses in Patients with Gluten Sensitivity and Crohn’s Disease. *ISRN Allergy*, 1–12. Retrieved August 22, 2015 from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3658803/>

Figures & Tables

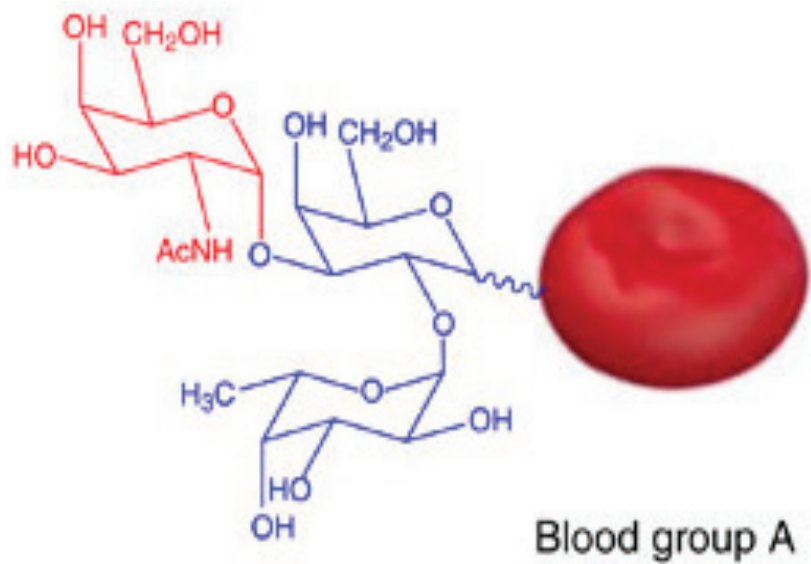


Figure 1. N-Acetylgalactosamine, in red, shown attached to a carbohydrate chain on the membrane of a red blood cell.

	Celiac +	Celiac -
Exposure +	4	13
Exposure -	10	13

Table 1. Celiac Disease status by Exposure status. The Exposure + group include all individuals who had the A antigen and a positive secretor status. The Exposure – group included all other participants.



MICROBIOLOGY

College of Science

Detection of Halophilic Bacteriophage in Soils Near the Great Salt Lake

Garrett Ward | Mentor: Matthew Domek & Michele Sulumber

Abstract

*Bacteriophages (or phages) are viruses that infect bacteria and may be involved with controlling microbial growth in the environment. Phages that target *Salinivibrio costicola* strains from the Great Salt Lake (GSL) have been isolated and studied previously; however, little is known about the distribution of bacteriophages in the soil surrounding the GSL. The objective of this study was to determine the presence of halophilic bacteriophage in the soils surrounding the GSL, facilitating a greater understanding of the role they play in the terrestrial ecosystem. A technique was developed to amplify and isolate known bacteriophage from soil. Three variations of this technique were utilized to test bacteriophage amplification, survival and attachment in soil, and allow for isolation of new bacteriophages. Soil samples were collected from Antelope Island (in GSL) at various distances from the water. Previously isolated *Salinivibrio costicola* strains (SA36, SA39, SA40, SA50, and B1) and their respective bacteriophage (DB01, NS01, JM01, CW02, and UTAK) were used to perform spot test assays to detect phages in the soil. When a phage was present, a plaque would form in the bacterial growth. The technique tested known bacteriophage-host pairs and demonstrated that strains SA39 and SA40 amplified markedly more than the other phages suggesting that certain phages bind to soil particles or are inactivated by soil components. Additionally, two potentially new bacteriophages were isolated and amplified, then observed with an electron microscope.*

Introduction

Microorganisms in aquatic environments are generally more uniformly dispersed than in complex, heterogeneous soil environments. Environmental variables, such as water activity, organic materials, temperature changes, and dense microbial populations, can affect a virus' ability to persist in soil (Hurst, 1980). Bacteriophages can bind tightly

to soil particles, which interferes with their detection. Understanding how bacteriophages are dispersed and retained in soil may be useful in determining the impact of environmental factors on dispersion of viruses.

In this study we used several strains of *S. costicola* and the associated bacteriophage that infect them to test bacteriophage retention in soils surrounding the GSL. The *S. costicola* strains used were SA36, SA39, SA40, and SA50. The bacteriophages that target these strains are DB01, NS01, JM01, and CW02, respectively. In addition we used a *S. costicola* host/bacteriophage pair originally isolated from a Spanish saltern (Goel et al 1996). Since bacteriophages may be scarce in the soil, a bacteriophage amplification method was utilized to increase the viral population size for easier detection. This enabled us to identify novel bacteriophages that infect *S. costicola* directly from soil samples. It also allowed us to determine if there were any inhibitory compounds or properties in the soil that prevent or inhibit the infection of the bacterium by the phage.

This technique could contribute to future research of bacteriophage in the environment, including their modes of dispersion (such as wind-borne movement), activity in various soil types, effect of temperature and/or weathering on phage, and retention in the soil. A greater understanding of soil phages may provide insight into the behavior of other types of phage and viruses that we, as humans, encounter. Knowledge of phage behavior may be used to develop a model of virus spread in the environment and could indicate the survival of halophilic bacteria associated with the GSL in surrounding drier soils.

Methods

Soil Sample Collection

Soil was collected in sterile bags from Antelope Island in the Great Salt Lake. The first sample was taken at the water's edge while other samples were collected along transects 1 m, 10 m, 100 m, and 1000 m from the shoreline. These samples were gathered on Oct. 31, 2014. Additional soil was collected 10 m from the water's edge on Feb. 9, 2015.

Growth of Host Bacteria

The host bacteria were incubated overnight at room temperature on a tube rocker in a modified halophilic broth made according to the following

recipe: 80.0 g of NaCl, 10.0 g of $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 5.0 g of KCl, 5.0 g of Casamino acids, 3.0 g of KNO_3 , 1.0 g of sodium citrate, 1.0 g of yeast extract, and 0.20 g of $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$ mixed into 1.0 L of distilled water at pH 7.5 (Atlas 1993).

Detection of Bacteriophage Amplification by Spot Test

Each soil sample was divided into three 10 g portions and placed into separate 50 mL centrifuge tubes. Ten milliliters of halophilic broth was added to all tubes. One milliliter of log phase *Salinivibrio costicola* SA36 was added to the first tube to act as a host. The second tube contained 50 μL of previously isolated DB01 bacteriophage. Both the *S. costicola* host and the DB01 bacteriophage were added to the third tube. These tubes were vortexed and then incubated overnight at room temperature.

After incubation, 1.5 mL from each sample was placed into microfuge tubes which were then centrifuged at 10,000 RPM for ten minutes. Following the first centrifugation, 0.75 mL of the supernatant was transferred to 0.22 μm filter microfuge tubes (Fisher Scientific, Pittsburgh, PA), and centrifuged for 10 minutes at 1000 RPM.

The filtrate was serially diluted in a sterile 8% NaCl (w/v) solution. Ten-fold dilutions were created up to a 10^{-9} dilution. Previously, halophilic agar overlays were prepared using 3 mL of soft agar and 50 μL of the log phase host. A 5 μL drop from each dilution was spotted onto the overlays, incubated at 28° C overnight, and then observed for plaques. This process was repeated with each of the host-phage pairs and soil samples (Figure 1).

Electron Microscopy

The bacteriophages that were found on the SA39 and SA40 host only plates were extracted, purified, and concentrated with the assistance of Brent Nelson. These concentrated samples were taken to the University of Utah for observation under an electron microscope.

Results

Plaques were predominantly observed on plates containing either the phage only or the host-phage pair. Some SA39 and SA40 host only plates revealed phage growth (Figure 2). The spot test showed that not all pairs amplified equally well in soil. Significant amplification of bacteriophage only occurred with strains SA39 and SA40 (Figure 3). They both amplified,

on average, 10^4 times the original concentration of phage added to the soil sample (Figure 3). The other hosts did not show clear evidence of bacteriophage amplification in the soil.

Bacteriophage amplification in SA39 decreased in soil samples more distant from the GSL where SA40 did not show a clear pattern (Figure 4). Plaques developed following amplification in soil samples 10 m from the GSL with hosts SA39 and SA40 and no added bacteriophage to the soil sample. This indicates that the phages were existing in the soil and may represent new bacteriophages for these host strains. These phages were amplified from the soil samples and were observed with an electron microscope. The bacteriophage image associated with host SA40 revealed a “tailed bacteriophage” similar in morphology to bacteriophage JM01 (data not shown).

Discussion

By adding known bacteriophages to the soil and then performing the spot test, we determined that these phages were not inactivated by the soil components. After being mixed and incubated with the soil, these phages did not bind to the soil particles in a way that inhibited their detection.

After observing plaque formation on some of the host-only plates, we determined that the soil can and does act as a reservoir for at least some of the bacteriophages found in the GSL. We showed that some of the bacteriophage originally isolated from the GSL amplified in soil near the GSL. The amplification of bacteriophage in soil may be influenced by several factors. There are a large variety of soil types with different salinity, pH, water content, and organic matter. All of these factors may play a role in phage retention and amplification, however, it remains unknown exactly why some phages were amplified while others were not. In one case we saw a trend toward a decrease in amplification as the distance from the lake increased, but in other cases the pattern wasn't clear.

Using some of the same techniques used in this study, additional research could be conducted to determine the effects of these differing soil characteristics on the bacterial hosts and bacteriophages. These studies could also serve as a model for both the movement and survival of pathogenic viruses that exist in aquatic systems but potentially also reside in the soil environment. New bacteriophage that infects bacteria

originally isolated from the lake suggests a connection between the aquatic and soil ecosystems. Future studies should include genetic analysis of bacteriophage to determine their relatedness to each other.

Acknowledgement

The authors thank the Weber State University Office of Undergraduate Research for funding this study. We also acknowledge Brent Nelson and Dr. Belnap of the University of Utah for their help with the electron microscopy.

References

- Atlas, Ronald M. 1993. *Handbook of Microbiological Media*. CRC Press, Inc.
- Goel, U., Kauri, T., Kushner, D. J., Ackermann, Hans-W. 1996. *A moderately halophilic Vibrio from a Spanish slattern and its lytic bacteriophage*. Can. J. Microbiol. 42 (10): 1015–1023.
- Hurst, C.J., C.P. Gerba, and I. Cech. 1980. Effects of Environmental Variables and Soil Characteristics on Virus Survival in Soil. Applied and Environmental Microbiology. Retrieved from <http://aem.asm.org/content/40/6/1067.full.pdf+html>

Figures

Soil samples collected from the GSL environment and placed in 50 mL tubes

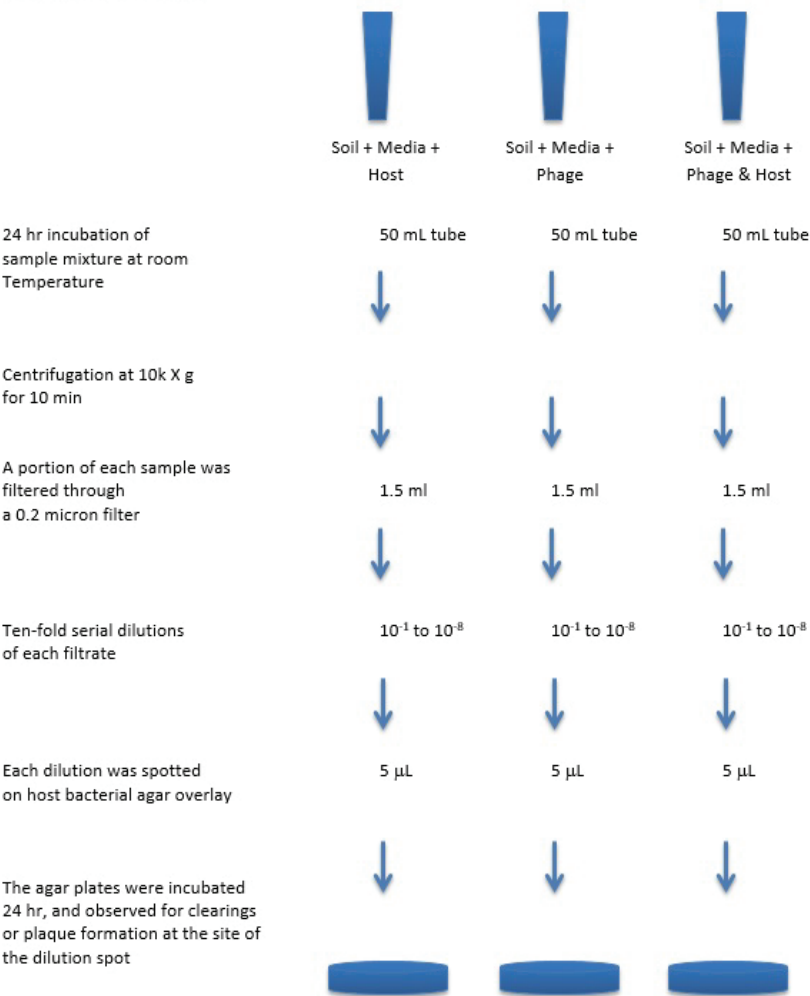


Figure 1. Flow chart of bacteriophage amplification in GSL soil samples.

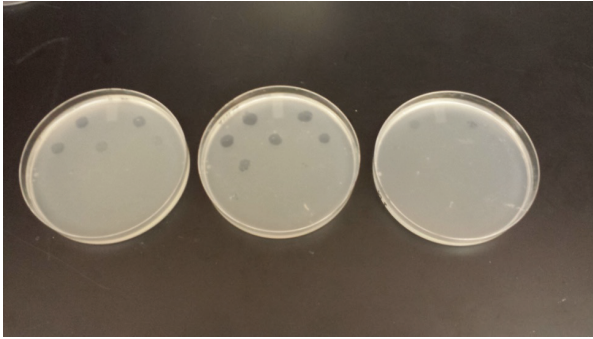


Figure 2. Plaques produced by bacteriophage JM01 shown on host SA 40 agar overlay. The left plate was bacteriophage only and showed plaques up to the 10^{-4} dilution, the middle plate was both host + phage and showed plaques up to 10^{-5} dilution and right plate was host only and showed a small amount of phage amplification.

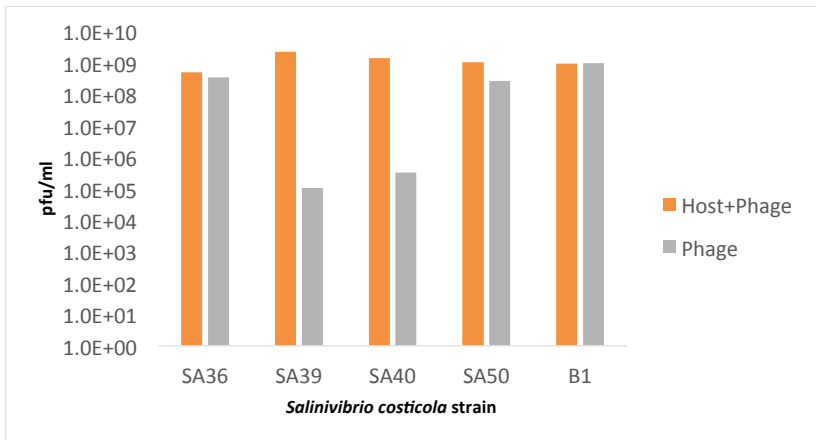


Figure 3. Average bacteriophage amplification from all soil samples. These were measured in plaque forming units/mL (pfu/mL).

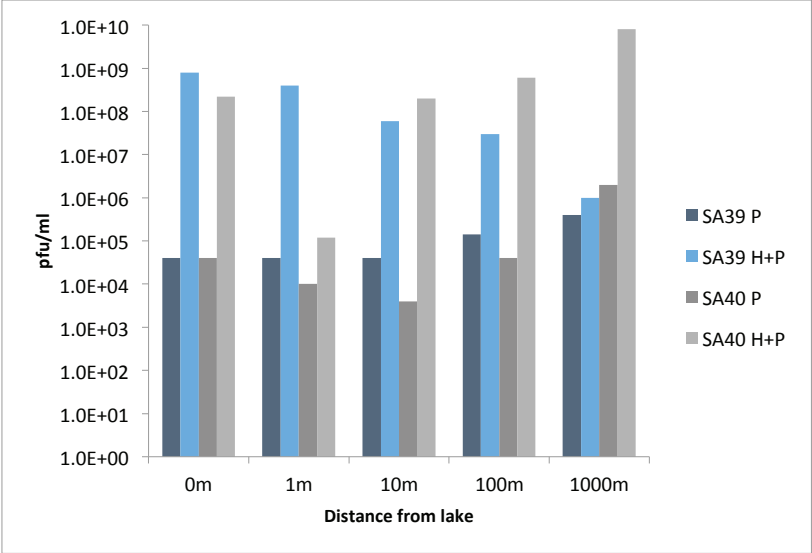


Figure 4. Amplification of SA39 and SA40 phages at different distances from the water measured in pfu/mL. P, phage only; H+P, Host and phage

Determination of Treatments to Reduce Late Gassy Defect in Cheese due to *Lactobacillus wasatchensis* WDC04 Contamination

Isaac Bowen | Mentor: Craig Oberg & Michele Culumber

Abstract

Lactobacillus wasatchensis WDC04 is a newly discovered obligately facultative lactic acid bacterium isolated from gassy Cheddar cheese. Previous research has associated WDC04 with late gassy defect in aged cheese, which causes serious commercial losses from bloated cheese packages and textural defects. Experiments were performed to determine its salt tolerance at pH 5.2 and 6.5, resistance to HTST pasteurization, and pH growth range. Understanding the growth characteristics of *Lb. wasatchensis* WDC04 could allow some manipulation of the cheese environment to control it. MRS with 1.5% ribose (MRS-R) was prepared at either pH 5.2 or 6.5 with salt concentrations ranging from 0.0% to 10.0%. Two ml of the MRS-R test media was added to each well in a 24 micro-well plate and a pre-inoculated absorbance reading was taken at 600 nm. Immediately after, 100 microliters of WDC04 was added to each well and incubated at 25°C for three days (pH 6.5) or two days (pH 5.2). Plates were then placed in a Teacon Infinite 2000 with absorbance readings (A_{600}) taken every four hours for 24 h. Results showed WDC04 grew best in 3.0% salt (pH 6.5) and 2.0% salt (pH 5.2) but showed some growth up to 6% at either pH. Further testing was performed using a narrower salt concentration range (5.25% to 6.75%) at pH 6.5 to determine if a salt concentration used in cheese could suppress WDC04 growth. The same protocol was followed with the micro-well plate incubated for three days before absorbance readings were taken. Above 6.0% salt WDC04 was inhibited and ceased to grow. Using the same methodology, the pH range (2 to 8) for WDC04 was also determined. Results confirmed WDC04 grew best at pH 5 to 6 (cheese pH) but did not grow below pH 4 or above pH 7. A heat shock experiment was performed to model HTST pasteurization. WDC04 was grown in MRS-R broth for two days and diluted, then heat shocked in a hot water bath at 72°C for 15 sec and plated. With an initial count of 108 CFU/ml,

results showed a decrease of 105CFU/ml in survival of WDC04, indicating WDC04 could be contaminating the cheese by surviving pasteurization if it is at high levels in the milk. These results suggest using a higher salt/moisture ratio in cheese and increasing pre-pasteurization sanitation to remove biofilms would decrease the likelihood of *Lb. wasatchensis* WDC04 in ripening cheese, thus, reducing the possibility of late gassy defect.

Introduction

In cheesemaking, there are both starter lactic acid bacteria (SLAB) directly added which contribute mainly by converting sugars to lactic acid, as well as non-starter lactic acid bacteria (NSLAB) that help with the maturing of the cheese and flavor development (Settanni and Moschetti, 2010). NSLAB are not directly added to the cheese but enter during the processing of the milk and cheese, such as through biofilm contamination, from contaminants in the milk itself, from the dairy plant, or from the cheesemaking equipment (Banks and Williams, 2004). As part of this group of NSLAB, there are obligately heterofermentative species (OHF) of lactobacilli that produce lactate, ethanol, acetic acid, and CO₂ in equal amounts (Settanni and Moschetti, 2010; Wood and Holzapfel, 1995). Due to their production of CO₂, OHF bacteria can be a serious problem in cheese production because of gas formation (causing bloating in packaging) and textural defects in the cheese body (Laleye et al., 1987).

Lactobacillus wasatchensis WDC04 is a newly discovered OHF *Lactobacillus* species isolated from gassy Cheddar cheese and has been shown to contribute to gassy, textural, and product defects (Ortakci et al., 2015). The purpose of this study was to determine what treatments could be used to restrict the growth of *Lb. wasatchensis* by looking at tolerance to salt at both pH 5.2 and 6.5, resistance to pasteurization, and growth at various pHs.

Materials & Methods

Media & Bacterium Growth

Lactobacillus wasatchensis WDC04 was grown in de Man, Rogosa, and Sharpe (MRS) broth supplemented with 1.5% ribose (MRS-R). Working cultures were grown for ~24 hours at 25° C in anaerobic incubation jars with GasPak EZ. Agar spread plates were made using MRS-R broth with the addition of 1.5% agar.

Salt Tolerance

MRS-R was prepared at pH 5.2 and 6.5 with varying salt concentrations from 0.0% to 10.0%. Separate runs were made for the two different pH values in transparent, 24 micro-well plates that contained duplicate wells of the varying salt concentrations. Two milliliters were added to each of the 24 wells and an initial pre-inoculated absorbance reading was taken at 600 nm. Immediately after, 100 μ L of *Lb. wasatchensis* (10^7 to 10^8 CFU/mL) was added to the wells and the plate was wrapped and incubated at 25°C for three days for the pH 6.5 plates and two days for the pH 5.2 plates. Absorbance readings were then taken every four hours for a 24 hour period using a Teacon Infinite 2000. Further testing was performed with a narrower salt concentration range from 5.25% to 6.75% at pH 6.5 to determine at what concentration the growth of WDC04 would be inhibited. The same procedures were followed as before and samples were run in triplicate with the micro-well plate being incubated for three days before absorbance readings were initiated.

Thermotolerance

The heat shock experiment was performed to imitate the effects of high-temperature, short-time (HTST) pasteurization to determine if WDC04 could survive thus to see if it was entering the cheese process before pasteurization or after. WDC04 was grown in MRS-R (pH 6.5) for two days and then two mL were transferred to a fresh tube of MRS-R to revive the culture and dilute it down (optical density at A_{600} was 0.148). A dilution series was made and spread plates inoculated from the 10^{-1} to 10^{-6} dilutions were made and colonies were counted to get an initial concentration count. Triplicate tubes containing nine ml of whole milk were placed in a hot water bath and brought up to 72°C. One milliliter of WDC04 was added to each tube and the tubes were left in the water bath for 15 seconds and then removed. Dilution series were made and spread plates at concentrations 10^{-2} to 10^{-7} were used to get a final survival concentration of WDC04.

pH Tolerance

A pH range from 2 to 8 was used to determine optimal growth pH of *Lb. wasatchensis* WDC04. MRS-R broth was prepared and adjusted for the

correct pH by using NaOH or HCl. Two milliliter triplicates were run of each pH in a 24 micro-well plate. An initial absorbance reading at 600 nm was taken and then 100 μ L of WDC04 was added and the plate was wrapped and incubated for two days at 25°C. A final optical density was recorded at A_{600} using a Teacon Infinite 2000.

Results

Salt Tolerance

WDC04 grew best in 3.0% salt at pH 6.5 but between 1.0 and 3.0% salt at pH 5.2 (Figures 1 and 2). With the narrower salt concentration range, it could grow up to 6.0% salt but above 6.0% salt WDC04 was inhibited (Figure 3).

Thermotolerance

The initial concentration of WDC04 before HTST Pasteurization was 10^8 CFU/ml. After the heat shock, colonies were only observed on the 10^{-2} spread plates in very low numbers (Table 1). The final concentration of WDC04 was 10^3 CFU/ml showing a decrease of 10^5 CFU/ml due to pasteurization.

pH Tolerance

WDC04 grew best at pH 5 to 6 (cheese pH) but did not grow below pH 4 or above pH 7 (Figure 4).

Discussion & Conclusion

Lactobacillus wasatchensis WDC04, a recently isolated OHF lactic acid bacterium from gassy Cheddar cheese, has some interesting growth characteristics that can be manipulated to prevent its contamination in cheese. For one, it was shown to grow best in 3.0% salt (pH 6.5) and 1.0 to 3.0% (pH 5.2). WDC04 also grows at typical cheese pH (5 to 6) but can be inhibited if the pH is below 4 or above 7. Finally, the prevalence of WDC04 in cheese can be significantly reduced due to pasteurization processes (a significant reduction of five logs). These results suggest that one significant way to reduce *Lb. wasatchensis* growth and contamination would be to use a higher salt/moisture ration in cheese. If the salt level is increased to 6.0%, which is within productive parameters, then WDC04 can be inhibited in

cheese. Also, due to the effectiveness of HTST pasteurization, there is a greater likelihood that WDC04 is contaminating the cheese pre-pasteurization. It would be important to increase pre-pasteurization sanitation to help remove biofilms from processing equipment. By incorporating these measures, there would be a greater chance of eliminating or decreasing the effect of *Lb. wasatchensis*, in ripening cheese, thus reducing/eliminating the possibility of late gassy defect.

References

- Banks J. M. and Williams A. G. 2004. The role of nonstarter lactic acid bacteria in Cheddar cheese ripening. *International Journal of Dairy Technology*. 57:145–152.
- Laleye, L. C., R. E. Simard, B. H. Lee, R. A. Holley, and R. Giroux. 1987. Involvement of heterofermentative lactobacilli in development of open texture in cheese. *J. Food Prot.* 50:1009–1012.
- Ortakci F., Broadbent J. R., Oberg C. J., and McMahon D. J. 2015. Growth and gas production of a novel obligatory heterofermentative Cheddar cheese nonstarter lactobacilli species on ribose and galactose. *Journal of Dairy Science*. 98:3645–3658.
- Settanni L. and Moschetti G. 2010. Non-starter lactic acid bacteria used to improve cheese quality and provide health benefits. *Food Microbiology* 27:691–697.
- Wood B. J. B. and Holzapfel W. H. 1995. *The Genera of Lactic Acid Bacterium in the Lactic Acid Bacteria*. 2:28–30.

Figures & Tables

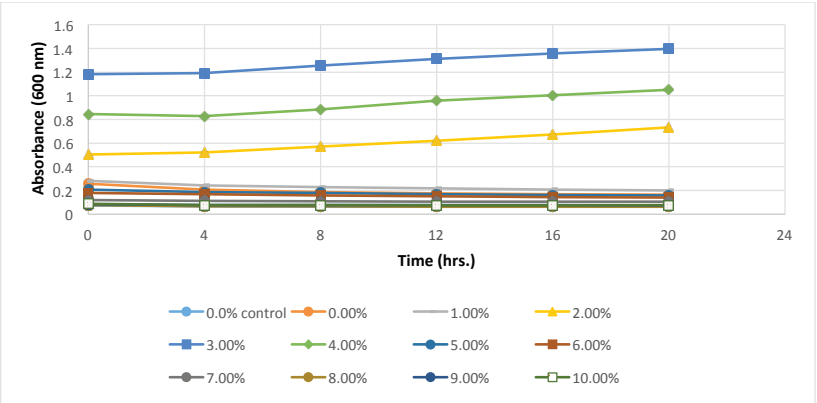


Figure 1. Optical density of WDC04 at pH 6.5 of various salt concentrations (0.0% to 10.0%).

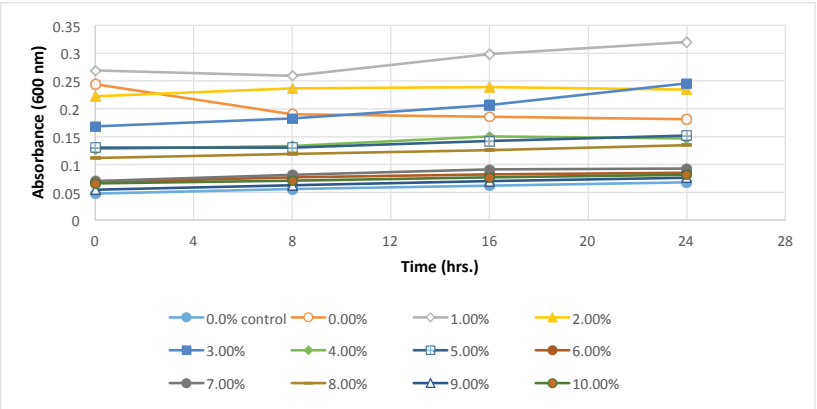


Figure 2. Optical density of WDC04 at pH 5.2 of various salt concentrations (0.0% to 10.0%).

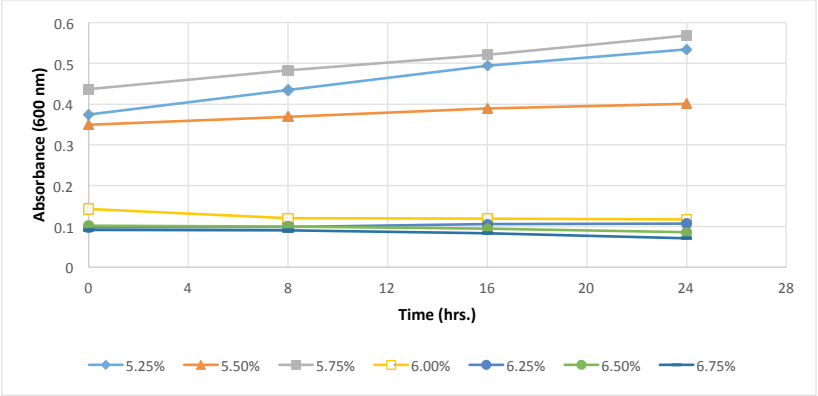


Figure 3. Optical Density of WDC04 using narrow salt concentration range (5.25% to 6.75%) at pH 6.5.

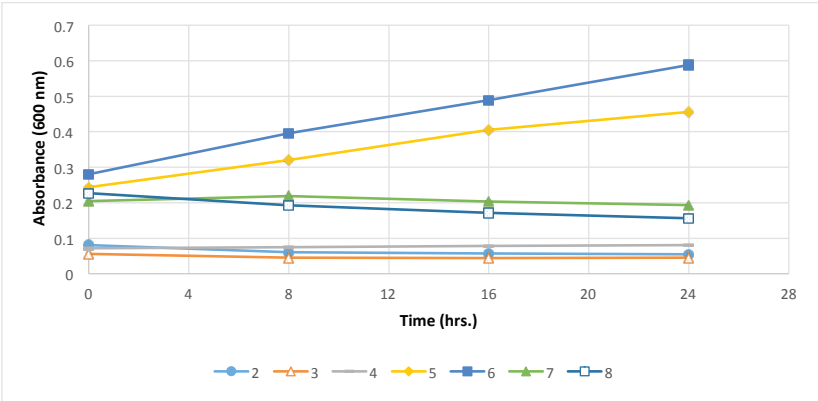


Figure 4. Optical density of WDC04 at pH range 2 to 8.

Dilution Factor	CFU's (After Pasteurization)
10 ⁻²	28.7
10 ⁻³	0
10 ⁻⁴	0
10 ⁻⁵	0
10 ⁻⁶	0
10 ⁻⁷	0

Table 1. Results of spread plate counts after heat shock.

Determination of Antagonism Between NSLAB Strains and *Lactobacillus wasatchensis* WDC04 Using the Agar-flip Method

Marissa Walker | Mentor: Craig Oberg

Abstract

Lactobacillus wasatchensis WDC04 is part of the nonstarter lactic acid bacteria (NSLAB) cheese microbiota, originally isolated from “gassy” cheddar cheese. Recent evidence indicates WDC04 may be an important cause of late gassy defect in aged cheese. Controlling growth of this unwanted organism could be done by incorporation of NSLAB strains into cheese that inhibit its growth. Determination of inhibition between NSLABs and WDC04 was done using the agar-flip method. MRS supplemented with 1.5% ribose (MRS-R) and 4% NaCl and pH 5.2 conditions to mimic the environment of cheese. A lawn of WDC04 was swabbed on this media and incubated anaerobically at 25°C for 2 days or 4 days. The agar was flipped over and NSLAB cultures were swabbed and incubated anaerobically at 30°C/37°C for up to 5 days. Growth of NSLABs on agar without a WDC04 lawn (control plates) was compared. The reverse of this was then performed using WDC04 as a lawn and NSLABs on reverse side. *Lactobacillus curvatus* showed the greatest inhibition by WDC04 while *Lb. F19* and *Lb. rhamnosus* were most resistant. All challenge NSLAB strains showed decreased levels of growth compared to control plates. The second experiment showed *Lb. curvatus* was most inhibitory towards WDC04 while all other NSLABs didn’t show a great difference. In the first experiment, most NSLAB cultures showed more inhibition by WDC04 grown for 4 days compared to 2 days. This probably allowed greater production of inhibitory compounds, especially if produced during the stationary growth phase. Compound diffusion into the media shows that inhibition was due to secretion of inhibitory compounds. In addition, several of the challenge NSLAB strains, while initially inhibited by the 4-day WDC04 culture, slowly grew as the incubation period was extended. This suggests that WDC04 compounds might extend the NSLAB lag growth phase while not completely inhibiting them. Examining the antagonism

between NSLABs and WDC04 allows for selection of NSLAB strains that could inhibit this problematic bacterium during cheese ripening.

Introduction

Lactobacillus wasatchensis WDC04, obligatory heterofermentative (OHF) lactobacilli that is part of the nonstarter lactic acid bacteria (NSLAB) cheese microbiota, was originally isolated from “gassy” cheddar cheese. This cheese defect results in undesirable flavor changes, texture and body defects such as cracking and splitting from unwanted gas production. Obligatory heterofermentative lactobacilli have been identified as a cause in this widespread problem (Mullan, W. Michael, 2000). There is new evidence that indicates WDC04 as an important cause of late gassy defect in aged cheese. This is a recurrent problem in the industry. One way to control the growth of this unwanted organism may be to incorporate other NSLAB strains into cheese that inhibit its growth. Experiments were performed to determine if inhibition occurs between common NSLABs and WDC04 utilizing the agar-flip method. Testing was done to determine if initial WDC04 growth with possible production of inhibitory compounds during the stationary phase would have an effect on common NSLAB growth. The opposite of this approach was also testing to see if NSLABs that were further along in their growth could inhibit WDC04.

Materials & Methods

Media

De Man, Rogosa, and Sharpe (MRS) was used for all tests. The addition of 1.5% ribose to MRS (MRS-R) was done to ensure WDC04 growth (Broadbent, McMahon, Oberg, & Ortakci, 2015), since it has been shown to require ribose to visualize significant growth. Further testing was done using MRS-R with the addition of 4% NaCl and a pH of 5.2 to mimic cheese conditions.

Organisms

Lactobacillus wasatchensis sp. (WDC04) was tested against a variety of common NSLAB cultures that included *Lactobacillus helveticus*, *Lactobacillus rhamnosus*, *Lactobacillus brevis*, *Lactobacillus* F19, *Lactobacillus curvatus*, and *Lactobacillus paracasei* (LiLa). The opposite approach of testing NSLABs versus WDC04 was done using the same organisms.

Agar Flip Method

The spot-on-lawn method has shown to be a previously tested method (Cadirci, H. Bilge and Citak, Sumru 2005) to demonstrate any diffusion of possible inhibitory compounds through the agar. Some modifications were made to this method due to the slower growth nature of WDC04 compared to the NSLABs used. Instead of a spot on the opposite side of the lawn, a single streak of the appropriate culture on the opposite side of the lawn was made. For testing of WDC04 versus NSLAB growth, WDC04 culture was swabbed as a lawn on surface of MRS-R 4% NaCl pH 5.2 agar. Control plates were fully streaked with a sterile swab. After incubation, the agar was then aseptically flipped over and appropriate NSLAB culture was streaked onto back surface. Growth of each NSLAB culture was checked periodically and compared with NSLAB growth on control plates. Testing of NSLAB growth versus WDC04 was done by each NSLAB culture being swabbed as a lawn agar front surface. After appropriate incubation, agar was flipped over and WDC04 culture was streaked onto back surface. Sterile swabs were used for control plates. Growth of WDC04 was checked periodically and compared to growth on control plates.

Incubation

A pure culture of WDC04 inoculum in MRS-R broth was incubated for 4 days prior to testing. For testing of WDC04 versus NSLAB growth, one group of WDC04 lawns were incubated for 2 days and a second group for 4 days prior to agar flip and NSLAB inoculation. This NSLAB growth was tracked over an incubation period of 5 days. All WDC04 incubations were done at 25°C. NSLAB inoculums were incubated for 1 day in MRS broth prior to inoculation onto appropriate agar. For NSLAB growth versus WDC04, one group of a NSLAB lawn was incubated for 2 days and another group for 4 days. WDC04 growth was tracked over a 13 day period. NSLAB incubation temperatures were done at 30°C except for *Lb. helveticus* which was done at 37°C. All incubations were done in anaerobic gas pack jars. Throughout process, quadrant streak plates were performed to ensure pure and viable culture.

Results

Notation of growth was done using a four plus scale. Growth of each NSLAB culture was tracked over a 5-day period and compared to control NSLAB growth (Fig. 1.). A growth ranking scale was used to quantify comparisons of growth. Maximal growth is indicated by (++++), and no growth (-).

The next series of this experiment compared growth of common NSLABs on the front side of agar with WDC04 culture swabbed on the opposite side. Growth of WDC04 for each corresponding NSLAB culture incubated for 2 days (Fig. 2.) and 4 days (Fig.3.), which were tracked over a period of 13 days. Comparisons of WDC04 growth on MRS and MRS-R agar were also made in conjunction with the opposing NSLAB culture.

Discussion

In the first experiment, all NSLABs were more inhibited by WDC04 grown for 4 days compared to 2 days prior to inoculation of NSLABs. This could possibly be due to inhibitory compounds being produced in the stationary phase of WDC04 that diffused through the media to have an effect on NSLABs. The extent of this and determination of what those compounds are would need further analysis. The interesting relationship of *Lb. curvatus* and WDC04 was shown in both experiments. WDC04 had the greatest inhibitory effect on growth for *Lb. curvatus* while in the second experiment *Lb. curvatus* had the greatest inhibitory effects on WDC04 growth. This growth relationship depended on which culture was permitted to grow first. *Lactobacillus rhamnosus* and *Lb. F19* did not have a difference of growth when WDC04 was grown first. *Lactobacillus rhamnosus* also did not have an inhibitory effect on WDC04 in the second experiment while *Lb. F19* had a minimal inhibitory effect. Understanding the antagonistic relationships between NSLABs and WDC04 could be a way to reduce this gassy defect in aged cheese. Controlling the growth of WDC04 could be achieved through the presence of NSLABs that could suppress its growth.

References

- Broadbent, J. R., McMahon, D. J., Oberg, C. J., & Ortakci, F. (2015). "Growth and gas production of a novel obligatory heterofermentative Cheddar cheese nonstarter lactobacilli species on ribose and galactose". *Journal of Dairy Science* Issue 6. Volume 98, 3645–3654.
- Mullan, W. Michael (2000). "Causes and control of early gas production in Cheddar cheese." *International Journal of Dairy Technology* Issue 2. Volume 53, 63–68.
- Cadirci, H. Bilge and Citak, Sumru (2005). "A Comparison of Two Methods Used for Measuring Antagonistic Activity of Lactic Acid Bacteria." *Pakistan Journal of Nutrition* Issue 4. Volume 4, 237–241.

Figures

WDC04 incubation 2d. on front of agar surface. Noted NSLAB growth on backside of agar.												
NSLAB incubation day	Lb. helveticus (LH32)		Lb. rhamnosus ATCC 7469		Lb. brevis ATCC 367		Lb. F19		Lb. curvatus		Lb. paracasei (LiCa)	
	MRS-R (pH 5.2 and 4% NaCl)											
	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.
1	-	-	+	+	+	+	+	+	+	+	+	+
2	-	-	++	+	+	+	++	++	++	++	++	++
3	-	-	++	++	+	+	++	++	++	++	++	++
5	-	-	+++	+++	++	++	+++	+++	+++	+++	+++	+++
WDC04 incubation 4d. on front of agar surface. Noted NSLAB growth on backside of agar.												
NSLAB incubation day	Lb. helveticus (LH32)		Lb. rhamnosus ATCC 7469		Lb. brevis ATCC 367		Lb. F19		Lb. curvatus		Lb. paracasei (LiCa)	
	MRS-R (pH 5.2 and 4% NaCl)											
	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.
1	-	-	+	+	-	-	+	+	+	+	+	+
2	-	-	+	+	+	-	++	+	+	+	++	+
3	-	-	++	++	+	+/-	++	++	+++	-	+++	+
5	-	-	++++	++++	+	+	++++	+++	+++	-	+++	++

Figure 1. WDC04 versus NSLAB growth using MRS-R (pH 5.2, 4% NaCl). Top- 2 day incubation time for WDC04 and NSLAB growth over a 5 day period. Bottom- 4-day incubation time for WDC04 and NSLAB growth over 5 day period. (++++)- Maximal growth. (+++/++)- Intermediate growth. (+)- Minimal growth. (+/-)- Barely visible growth. (-)- No growth present.

NSLAB 2.d incubation on front side of agar surface. Noted WDC04 growth on backside of agar.												
WCD04 Incubation day	WDC04 growth (MRS pH 5.2, 4% NaCl)											
	Lb. helveticus (LH32)		Lb. rhamnosus ATCC 7469		Lb. brevis ATCC 367		Lb. F19		Lb. curvatus		Lb. paracasei (LiCa)	
	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.
5	+++	+++	+++	-	+++	+	+++	+	+++	+	+++	-
6	++++	++++	++++	-	++++	+	++++	+	++++	+	+++	-
7	++++	++++	++++	-	++++	+	++++	+	++++	+	+++	-
9	++++	++++	++++	-	++++	+	++++	+	++++	++	+++	-
13	++++	++++	++++	-	++++	+	++++	+	++++	+++	+++	-
WCD04 Incubation day	WDC04 growth (MRS-R pH 5.2, 4% NaCl)											
	Lb. helveticus (LH32)		Lb. rhamnosus ATCC 7469		Lb. brevis ATCC 367		Lb. F19		Lb. curvatus		Lb. paracasei (LiCa)	
	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.
5	+++	+++	+++	-	+++	+	+++	+	+++	+	+++	-
6	++++	++++	++++	-	++++	+	++++	+	++++	+	+++	-
7	++++	++++	++++	-	++++	+	++++	+	++++	+	+++	-
9	++++	++++	++++	-	++++	+	++++	+	++++	++	+++	-
13	++++	++++	++++	-	++++	+	++++	+	++++	+++	+++	-

Figure 2. Result of initial NSLAB growth for 2 days versus WDC04 growth over period of 13 days total. Top-WDC04 growth using MRS pH 5.2, 4% NaCl. Bottom- WDC04 growth using MRS-R pH 5.2, 4% NaCl. (++++)- Maximal growth. (+++/++)- Intermediate growth. (+)- Minimal growth. (+/-)- Barely visible growth. (-)- No growth present.

NSLAB 4.d incubation on front side of agar surface. Noted WDC04 growth on backside of agar.												
WCD04 Incubation day	WDC04 growth (MRS pH 5.2, 4% NaCl)											
	Lb. helveticus (LH32)		Lb. rhamnosus ATCC 7469		Lb. brevis ATCC 367		Lb. F19		Lb. curvatus		Lb. paracasei (LiCa)	
	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.
5	++++	++++	+++	-	+++	-	+++	-	+++	-	+++	-
6	++++	++++	++++	-	++++	-	++++	-	++++	+/-	++++	-
7	++++	++++	++++	-	++++	-	++++	-	++++	+	++++	-
9	++++	++++	++++	-	++++	-	++++	-	++++	++	++++	-
13	++++	++++	++++	-	++++	-	++++	-	++++	+++	++++	-
WCD04 Incubation day	WDC04 growth (MRS-R pH 5.2, 4% NaCl)											
	Lb. helveticus (LH32)		Lb. rhamnosus ATCC 7469		Lb. brevis ATCC 367		Lb. F19		Lb. curvatus		Lb. paracasei (LiCa)	
	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.
5	+++	+++	+++	-	+++	-	+++	-	+++	-	+++	-
6	++++	++++	++++	-	++++	-	++++	-	++++	+/-	++++	-
7	++++	++++	++++	-	++++	-	++++	-	++++	+/-	++++	-
9	++++	++++	++++	-	++++	-	++++	-	++++	++	++++	-
13	++++	++++	++++	-	++++	-	++++	-	++++	+++	++++	-

Figure 3. Result of initial NSLAB growth for 4 days versus WDC04 growth over period of 13 days total. Top -WDC04 growth using MRS pH 5.2, 4% NaCl. Bottom- WDC04 growth using MRS-R pH 5.2, 4% NaCl. (++++)- Maximal growth. (+++/++)- Intermediate growth. (+)- Minimal growth. (+/-)- Barely visible growth. (-)- No growth present.



PSYCHOLOGY

College of Social & Behavioral Science

A Walk in Someone Else's Shoes: Empathy Through Embodiment

David Sleight | Mentor: Aaron Ashley

Abstract

The purpose of this study was to evaluate the relationship between participant empathy scores and the type of engagement in the acting out of a date rape scenario (using dolls) that is designed to trigger an empathetic repose. Date rape refers to a rape in which there has been some sort of romantic or potentially sexual relationship between the two parties (Picoult 2006). For the experimental groups, participants were asked to read a script of a date rape scenario then asked to act out said scenario using two small dolls and a diorama of the environment where the rape took place as the researcher narrates. Once the scenario was acted out the participants completed a survey consisting of: date rape scenario follow up questions—which assess the participants' opinion of the male and female characters in the scenario; an empathy scale—which consisted of several subscales; and a brief demographic questionnaire. The results of this study are in favor of the researchers' hypothesis, which is that a participant who takes on the perspective of an opposing gender through the reenactment process will then have more empathy for that particular character. Likewise, a participant who takes on the perspective of the same gender will have more empathy for the character that is the same gender of the participant.

Literature

Engaged learning, which is also known as embodied learning, is defined as the degree of attention, curiosity, interest, optimism, and passion that students show when they are learning or being taught, which extends to the level of motivation they have to learn and progress in their education (Glenberg (2006)). The concept of engaged learning has proven to be beneficial on a variety of fronts. Reading and mathematics are among the more rudimentary of practical uses, but engaged learning can prove useful for more complex concepts, such as biology and surgical procedure. Glenberg (2006) provided just such evidence with a study

involving children and reading comprehension. The design of the study allowed for two groups one to manipulate objects related to the story while the story is read and the other to read the story two times and act as a control for the experimental group (Glenberg, et al., 2006). The results of their study concluded that having the young readers manipulate objects to correspond to the characters and actions in a text greatly enhances comprehension as measured by both recall and inference tests (Glenberg, et al., 2006).

Embodied learning is powerful learning tool because it can help make convoluted or abstract concepts become more clear and concrete. Horn and Wilburn (2005) conducted research on the subject of empathy and discovered that embodied learning be both the stabilizing and changing process that sustains order and novelty within learning experience (Horn & Wilburn, 2005). Embodied learning is a type of composite theory that represents work from various disciplines and, in essence, prorates a circumstance of fact that has also been sprinkled with the preferred learning styles that an individual may have developed through personal experiences; however, these values are not always consciously known (Horn & Wilburn, 2005). These preferred learning styles that an individual may develop are not necessarily simple sets of preferences, but for good or bad have an influence on the course of future learning (Horn & Wilburn, 2005).

Niedenthal (2005) conducted similar research to Horn (2005) but with more of a social psychological spin off and centered on previous research done on attitudes, social perception, and emotion. They demonstrate that social information processing involves embodiment, where embodiment refers both to actual bodily states and to simulations of experience in the brain's modality-specific systems for perception, action, and introspection (Niedenthal et al. 2005). The researchers showed that embodiment underlies social information processing when the perceiver interacts with actual social objects and when the perceiver represents social objects in their absence (Niedenthal et al. 2005). Although many empirical demonstrations of social embodiment existed before this study, there were no particularly compelling accounts of them been offered (Niedenthal et al. 2005).

The researchers proposed that theories of embodied cognition, such as the Perceptual Symbol Systems (PSS) account, explain and integrate findings on embodiment, and that they also suggested exciting new directions for

future research (Niedenthal et al. 2005). The researchers also compared the PSS account to a variety of related proposals and showed how it addresses criticisms that have previously posed problems for the general embodiment approach (Niedenthal et al. 2005). With the overall result being, very similarly to Horn's research, that the embodied learning approach is a naturally occurring phenomena in the realm of day to day social interaction and could be very practical for classroom settings.

Expanding more on the concept of empathy that was discussed earlier in this paper, there is little use of concept that could not be put to use in some way. Empathy has proven to be a powerful tool for caregivers in expediting a patient's recovery and treatment. Morse (2006) felt that more research on empathy was needed in the realm of nurses' responses to patients who are suffering. The results being that nurse's level of engagement with the patient is affected by whether the caregiver is focused on him/herself or on the sufferer (in other words, being embodied with the patient) and whether the caregiver is responding reflexively or with a learned response (Morse et al 2006).

The concept of teaching empathy through embodiment is not a very new concept and has been explored on a variety of fronts in the past. Clore (1972) conducted a learned empathy related study involving 76 undergraduates divided into 3 groups: role playing, vicarious role playing, and control (Clore et al. 1972). The role playing consisted of traveling about the campus in a wheelchair for one hour, compared to the control experience, both direct and vicarious emotional role playing led to more positive responses (a) to a specific disabled person, (b) to a series of issues concerning disabled students in general, and (c) to a disguised attitudinal measure given by telephone four months later (Clore et al. 1972). The concept of empathy appeared much more likely to account for the results of the study than extraneous variables. The potential of role playing and vicarious experience for increasing tolerance and social maturity was greatly considered by the researchers due to its practical application and naturally occurring nature.

More recent research has been done on the subject of empathy by Buchholz (2014), who's focus was more on the concept of empathy though the vehicles of cognitive linguistics and conversation analysis. Both of which converge in the analysis of category bound activities and in viewing thinking and talking as embodied activities (Buchholz 2014). The primary goal of Buchholz's research was to outline the

powerful theories of cognitive linguistics and conversation analysis as useful tools for the analysis of enacting empathy (Buchholz 2014). The secondary goal was to outline those theories as useful tools for the analysis of how empathy is co-enacted in clinical conversation documented in transcripts (Buchholz 2014).

Similar to the research done by Buchholz, Hervey (2007) conducted research the subject of embodiment and ethical decision making with the intention being that to introduce research questions and some initial findings about the place of embodiment in ethical decision making (Hervey 2007). The approach that the researcher takes to ethics had yet to really be discussed in the literature of dance/movement therapy, and with few exceptions, had only been hypothesized in the ethics literature of other fields, but because this was a fairly new area of exploration, data were gathered primarily in dance/movement therapy educational contexts, such as graduate classes and conference workshops so there is not very much diversity in the data that was collected, and therefore limits the resolve of a claim for significance (Hervey 2007).

The researcher also took the liberty of drawing from the literature in dance/movement therapy and related fields to help establish the meaning and relevance of three concepts central to the primary discussion of research, embodiment, decision making, and empathy (Hervey 2007). The research findings indicated that ethical decision making can be enhanced with an embodied approach, which is very similar other research that has been done in the field of empathy (Hervey 2007). The researcher also included some questions for future research to develop the practice of embodied ethical decision making and to understand the bases of ethical practices of dance/movement (Hervey 2007). Overall, there is a significant amount of research to suggest that embodiment is an important part of producing empathy and ethical understanding.

There are many ways to teach through embodiment, but King (2014) experimented with an innovative type of engaged learning called role-play based learning (RBL), which was used as a vehicle for teaching psychiatry (King et al. 2014). The aim of this research was to set up a scenario where medical students perform both doctor and patients' roles in an attempt to provide an interactive learning format that engaged students while developing clinical knowledge and communication skills in a structured,

reflective environment (King et al. 2014). The study involved 107 students from three clinical schools of the University of Melbourne (King et al. 2014).

Data were collected using self-surveys and analyzed using descriptive and inferential statistics and thematic content analysis (King et al. 2014). The results of the study were that student evaluations of the RBL sessions were overwhelmingly positive and respondents reported improvements in engagement, confidence and empathy, as well as in their learning, and that the sessions provided good preparation for internship as well as for exams (King et al. 2014). The conclusion being that RBL is unique, flexible, timely, and could readily be adapted for use in other specialty rotations (King et al. 2014). Engaged learning through role playing and acting, or other forms of embodiment, is a widely versatile concept, which has been proven in many scientific and research studies to be ideal for teaching empathy. Can engagement, such as playing with dolls, be used to increase empathy levels, and if so to what degree? We hypothesize that participants will show more empathy toward the character that matches their gender identity, and that following the experimental condition participants will show more empathy towards the character that they played during the reenactment process.

Method

Participants

All of the participants were Weber State University undergraduate students from the Psychology Department subject pool, which was primarily composed of Psychology 1010 students. The only restrictions on the subjects were that they be native English speakers and that they have adequate vision—normal or corrected-to-normal—to read and understand the research materials. The native English speaker requirement was due to the desire of ensuring that the scales and materials used did not involve a translation process, which would be potentially problematic. Furthermore, the good vision requirement was due to the fact that most of the materials will be presented visually via paper and computer screen and the participant would need to be able to read the materials. The total number of participants so far are 74, which is barely enough to be found an adequate representative of the Weber State University population. However, there are intentions to continue this research in hopes of collecting a larger sample size.

Materials

This study's materials include (in order as they appear to participants): a short story adopted from "The Tenth Circle" by Jodi Picoult (2006) portraying a date rape scenario; a male and female doll (measuring just shy of 6 inches in height), as well as a small scale homemade diorama of the date rape scenario (measuring 21 inches in length, 15.5 inches in width, and 10 inches in height); a script summarizing the date rape scenario that the researcher and participants would read from while acting out the date rape scenario using dolls; a follow-up questionnaire, which was designed by Burgess and Burpo (2012), concerning the level of guilt and blame the characters in the scenario are perceived to hold; an empathy measure designed by Caruso and Mayer (1998); and finally a brief demographic questionnaire that will collect information concerning the participants gender, sexual orientation, and other simple response questions. The diorama that participants interact with is kept out of view until the participants who are in the experimental groups are ready to interact with it.

The script summarizing the date rape scenario is broken down into two parts, the females' verbal expressions and the males' verbal expressions, and provided as via hard copy. All of the other materials were accessible via computer and monitor. The instructions for the empathy measure are as follows: R indicates a reverse-scored item and in order to score the scale, change the scoring on the reverse-scored items (1=5, 2=4, 3=3, 4=2, 5=1); add all the scores for the total score and divide by 30. For more specific analysis, add the following items together for each scale, and divide by the number of items: Suffering (3, 5, 6, 8, 12, 18, 24, 28); Positive Sharing (14, 22, 23, 29, 30); Responsive Crying (1, 20, 25); Emotional Attention (4, 9, 13, 27); Feel for Others (10, 15, 16, 21); Emotional Contagion (11, 17); then take the mean of these sub-scales to compute a General Empathy scale" (Caruso and Mayer 1998).

Methods

This study is structured by a 2 X 3 experimental design. The independent variables are the gender of the participant (male or female) and the role the participant plays (none, female, or male), and the dependent variable being the level of empathy the participants have for the male or female characters in the date rape story. One researcher can run two participants at one time, with a little overlap while participants are finishing the survey, but whole

process takes an average of 20 minutes to complete. Participants are asked to sit down at a computer desk and carefully read the informed consent and agree to participate in the study. Once the participants agree to participate through digital signing, the participants are prompted to read the date rape scenario script, then prompted to raise their hands and await further instruction. Before continuing, the researcher asks if the participants feel comfortable with proceeding, and only after a confident verbal “yes” would a researcher continue with the study (some participants were willing to finish the survey, but did not want to participate in the engagement process).

At this point, participants are divided into three different groups. The first being a control group in which the participants will continue on to the survey, which is also accessible on their computer. The second group is one of two experimental groups in which participants interact with the date rape diorama, and the doll that is associated with the gender identity of the participant, for the engagement process; following the engagement process, the participants were then asked to finish the survey on the computer. The third group, or the second experimental group, will do the same as the second group except that they were asked to pick the doll that is opposite of the gender identity (there were no participants that did not identify as either male or female, but if there are in the future then they will be randomly assigned the female or male role). Since a researcher can only run two participants at a time the participants keeps track of the independent variables using a matrix in order to ensure that each group is gaining a similar number of participants.

If two females are participating in the study at the same time, then one would play the role of the female and the other would play the role of the male, and the researcher puts an F under the Same Gender category and the Cross Gender category. Likewise, if there is only one male participates in the study the researcher flips a coin to determine which role the participant plays (although if one group is greater in need of participants then the other the researcher places the participant in that group), and the researcher puts an “M” under whichever roll the participant played. Once the participants have completed the survey, the researcher provides a detailed debriefing as to why particular materials were used as well as the overall direction and hypotheses of the study, then the participants are given one last opportunity for questions and comments before being dismissed.

Results

Mean participant attribution ratings of perpetrator guilt in the presented date rape scenario were subjected to a 2 (Participant gender: Male/Female) X 3 (Role played during scenario reenactment: Male/Female/Neither) Analysis of Variance ANOVA. Results of the analysis showed a significant main effect for participant gender, $F(1,55) = 4.73$, $p = .03$, $p\eta^2 = .08$. Specifically, male participants ($n = 20$, $M = 7.31$, $SEM = .39$) attributed significantly less guilt to the perpetrator (the male) than did female participants ($n = 41$, $M = 8.35$, $SEM = .27$).

Data showed no significant effect for the role participants played during the reenactment of the date rape scenario, $F(2,55) = 1.61$, $p = .21$, $p\eta^2 = .06$. These data suggest there were no differences in attributions of guilt as a function of the role the participant played. Specifically, the ratings of those participants who played the male role in the reenactment ($n = 24$, $M = 7.44$, $SEM = .37$) were no different than those who played the female role ($n = 21$, $M = 8.39$, $SEM = .40$) or those who chose to not participate in the reenactment ($n = 16$, $M = 7.67$, $SEM = .47$). The lack of significant differences across condition is most likely due to a lack of adequate power. The power for the analysis was .33 suggesting that sample size was not large enough to detect the effect. The pattern of data does, however, suggest that participants empathized more with the individual whose role they took in the reenactment.

Additionally, there was no significant interaction between participant gender and the role played during reenactment ($F(2,55) = .53$, $p = .59$, $p\eta^2 = .02$). The pattern of responding by male and female participants was the same across conditions. Males always attributed less guilt to the perpetrator than did females regardless of condition. These data are depicted in Figure 1.

Discussion

Given the nature of the material used in this study we decided that there should be many opportunities for participants to ask questions or make comments, though it was rarely needed. There were about 6 participants who desired not to participate in the engagement process, but were willing to finish the survey. Our initial predictions of the study were met in that participants showed more empathy towards the character that matched

their gender identity and that participants showed more empathy towards whichever role they played during the reenactment phase. The chief concern of this study is the relatively low participant count.

Due to the difficulty of finding participants, we were willing to work with the participants who were unwilling to participate in experimental variables, despite that it may produce a little bias within the data. A similar issue is that the vast majority of our participants were female at a nearly 2 to 1 ratio, despite the fact that ideally we would have had at least 120 participants but we ended up with only had 74. Luckily, as this study continues over the next few months we are likely to overcome this particular issue. Another discussion point of this study is the need for at least two participants for the engagement process, and the inevitable involvement of the researcher when there is only one participant.

An idea for future research is using dolls of different races. Taking the same concept but adding several more variables that could provide insight on how individuals perceive other races and their own, and to evaluate how well they are able to take on the perspective of characters of other races. Along the same thought, changing the script so that it is either male on male or female on female rape, and using same sex dolls for the engagement process. Other ideas could be based on the use of a different type of script all together, and by doing so maybe eliminating the need for dolls and creating a little more appeal for participation. This way the original design of acting out in person may prove to be more applicable, and likely to have even greater effects on post engagement perspective empathy.

References

- Buchholz, M. (2014). Patterns of empathy as embodied practice in clinical conversation: a musical dimension. *Frontiers in Psychology Front. Psychol.*, 5(349).
- Burgess, M., & Burpo, S. (2012). The Effect of Music Videos on College Students' Perceptions of Rape. *College Student Journal*, 46(4), 748 to 763.
- Caruso, D., & Mayer, J. (1998). A Measure of Emotional Empathy for Adolescents and Adults. *Unpublished Manuscript*.

- Clore, G., & Jeffery, K. (1972). Emotional role playing, attitude change, and attraction toward a disabled person. *Journal of Personality and Social Psychology*, 23(1), 105 to 111.
- Hervey, L. (2007). Embodied Ethical Decision Making. *Am J Dance The American Journal of Dance Therapy*, 29(2), 91 to 108.
- Glenberg, A., Brown, M., & Levin, J. (2006). Enhancing comprehension in small reading groups using a manipulation strategy. *Contemporary Educational Psychology*, 32(3), 389 to 399.
- Horn, J., & Wilburn, D. (2005). The Embodiment of Learning. *Educational Philosophy and Theory*, 37(5), 745 to 760.
- King, J., Hill, K., & Gleason, A. (2014). All the world's a stage: Evaluating psychiatry role-play based learning for medical students. *Australasian Psychiatry*, 76 to 79.
- Morse, J., Bottorff, J., Anderson, G., O'brien, B., & Solberg, S. (2006). Beyond empathy: Expanding expressions of caring. *J Adv Nurs Journal of Advanced Nursing*, 53(1), 809 to 821.
- Niedenthal, P., Barsalou, L., Winkielman, P., Krauth-Gruber, S., & Ric, F. (2005). Embodiment in Attitudes, Social Perception, and Emotion. *Personality and Social Psychology Review*, 9(3), 184 to 211.
- Picoult, J. (2006). *The Tenth Circle: A Novel*. Simon and Schuster.

Figures

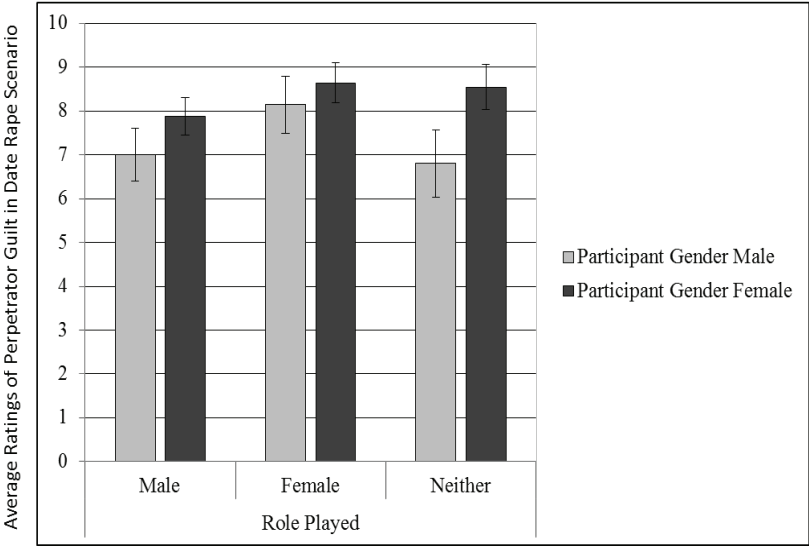


Figure 1. Mean Attribution of Perpetrator's Guilt in the presented Date Rape Scenario as a Function of Participant Gender and the Role Played in the Reenactment.

Note: Error bars represent standard error of the mean. The question of perpetrator guilt was answered on a scale of 0 (Not at all guilty) to 9 (Definitely guilty).

A Qualitative Assessment of Marital Satisfaction in Working Mothers and Stay-At-Home Mothers

Matthew Lefthand | Mentor: Daniel Hubler

Abstract

This study acted as a pilot for further research that is currently being prepared. The goal of the this study was to investigate how work roles impact mother's marital satisfaction. Qualitative designs were used to interview participants and then analyze those interviews. Through this analysis, it was found that work roles were not the real focus. Rather, mothers were more focused on associating with other adults and having a break from their children. However, work can achieve all these if done correctly. The scope of this paper is to discuss current results and explain future directions.

Introduction

Marital satisfaction is one of the most influential aspects of our lives. Recent studies have shown that satisfaction in marriage is associated with levels of partner depression and health (Grames, Miller, Robinson, Higgins, and Hinton, 2008). Similarly, Morawska and Thompson (2009) found that parenting roles and marital satisfaction directly impact child outcomes; such as hyperactivity, conduct problems, emotional symptoms, prosocial behavior, and peer problems. While parenting roles influence child outcomes more than marital satisfaction, it was found that low marital satisfaction is associated with adverse child outcomes. These findings and many more provide evidence that marital satisfaction is a topic that needs further exploration in order to better lives.

While there are a number of explorations to discover what marital satisfaction does to a family (e.g., Robles, 2014) and how marital satisfaction is affected by family contexts (e.g., Kogan et al., 2013), there has been a limited amount of research on how work roles are linked to partner experiences of marital satisfaction. Recently, research in this

area has begun to increase (e.g., Thenmozhi, 2015; Minnotte, Minnotte, & Pederson, 2013). For example, Minnotte et al. (2013) have found that partner perception of gender ideologies impacts marital satisfaction. However, there emerges a need for a closer look at how work tasks, roles, and family structure influence mothers and their marital satisfaction. For the purpose of this study, work roles are defined as work outside the home, and parenting roles are defined as work inside the home. The current research project is a qualitative exploration of how work tasks, roles, and family structure affect marital and satisfaction.

Methods

In order to understand mothers' marital satisfaction and what impacts it, the qualitative paradigm of constructivism was used. As discussed by Creswell (2003), constructivism is the idea that reality is understood by individuals and must be learned from their perspective. Similarly, Crotty (1998) explained that individuals create their world by (a) engaging and interpreting, (b) historical and social contexts, and (c) meaning is mostly found through social constructs. Using this constructivist method, participants were invited to describe their understanding of reality. The following are the demographic makeup of the participants and interview structure.

Participants

Participants were found using social media and then snowballing methods. As individuals were found, they were asked for family or friends that would participate as well. Careful consideration was given to choose participants that were not too close to the researcher, in order to avoid biasing the data. In the end, a fairly diverse group of women were found. Of the nine total participants, all were mothers and currently married. Additionally, at least one of their children was under the age of 18 and living at home. All participants were Caucasian and between the ages of 21 and 48. As for education, five had been to some college, two had graduated with their Associates, and two had graduated with their Bachelor's.

Interview

For the interview, questions were adapted from the Couples Satisfaction Index by Funk and Rogge (2007). In the end, the questions asked to each mother were (a) how generally satisfied they were with their marriage, (b) how interesting their relationship was, (c) what expectations were met and not met in their relationship, (d) how their needs were met or not met, (e) how much they worked, and (f) how working and marital satisfaction were connected for them. Each interview was recorded on an iPhone and the researcher took notes.

Results

The software program known as Atlas.ti was used to analyze data thematically (Markgraf, Michels, Winter, and Steiner, 2013). Voice recordings of the data were listened to and coded for major themes. After the coding process was completed, eleven themes were identified. Eventually, a few themes emerged as the most prominent among the participants. The following three themes were most prominent in the study: (a) adult socialization, (b) break from kids, and (c) the part time work ideal. These three themes were each present in at least five of the interviews, while the other eight themes were each included less frequently. The three most prominent themes will be explained and quoted from the data.

The Need for Adult Socialization

Seven out of the nine women talked about how they either lacked adult socialization from staying at home or experienced enough adult socialization from work. For the purposes of this study, adult socialization was defined as talking to other adults and not just having child-like conversations all day. For example, one 27-year-old mother of 4 stated “I need to be able to interact with other people and... have adult conversations periodically and work does that for me.” This embodies the suggestion that mothers need to be able to talk to other adults.

The Need for a Break

Similarly, five of the nine women described needing a break from their kids. This break was not directly associated to adult socialization, but

was more a need to get out of the house. For example, one 33-year-old mother of four stated "I know it sounds silly, but I mean you got to--you need to have a break from your family life in my opinion; and so it's good for me to go to work, it's good for my mood." This shows that mothers need some time away from their family.

Part-Time Work as Ideal

Lastly, it was found that five out of the nine women would prefer a part-time work situation. For example, one 21-year-old mother of 1 stated that "To feel fulfilled, [she] needed to go to work." Additionally, one 48-year-old mother of five said this about staying at home: "The four walls, as I put it, became a prison." Lastly, a 25-year-old mother of 3 said she would "still not like to work a lot because [she] still would like to be able to go on fieldtrips with [her children] and help in their class." This provides support for the idea that mothers would rather work, but not full-time. These results are evidence that work is good for mothers and more research is needed to understand mothers and their work roles.

Discussion

Findings from this study help shape the direction of further research on working mothers. As mothers work more nowadays, further research is needed to fully understand the implications work has on marriage. The themes of adult socialization, break from kids, and part-time work ideal found here can help researchers decide how to further study work implications. Currently, researchers are putting together more quantitative research to fully understand how work roles impact a marriage. This research will focus on these three main themes, in order to discover how they are linked. The themes of adult socialization and having a break from kids will be directly measured in this next study. Additionally, dyadic data will be collected to see how work role perceptions impact a couple.

Furthermore, direct implications are available now from this study. For therapists and others who help families, it will be noted that marriages can be affected if a mother does not have enough socialization with other adults or enough breaks from their kids. Because of this, more emphasis should be placed on mothers feeling fulfilled in these ways.

Limitations

Because this was a pilot study, there are a few limitations worth mentioning. This was a very small sample size and had no ethnic diversity. All participants were Caucasian and originally from Utah. Also, the interviews were not transcribed but analyzed from audio recordings. However, results are still useful to make hypotheses and designs for future research

Conclusion

Family, marriage, and work roles are a big part of everyday life. The current study found that when mothers stay home and don't work, they are left wanting adult socialization and a break from their kids. Furthermore, mothers desire to work part-time in order to feel fulfilled and still have family time. Further research is being developed to find how work influences a mother's marital satisfaction through adult socialization and a break from kids. As well, research is looking into whether part-time work is the ideal women actually have.

References

- Creswell, J.W. (2003). *Research design: Qualitative, quantitative, and mixed approaches*. Thousand Oaks, CA: Sage.
- Funk, J. L. & Rogge, R. D. (2007). Testing the ruler with item response theory: Increasing precision of measurement for relationship satisfaction with the Couples Satisfaction Index. *Journal of Family Psychology*, 21, 572–583.
- Grames H. A., Miller R. B., Robinson W. D., Higgins D. J., & Hinton W. J. (2008). A test of contextual theory: The relationship among relational ethics, marital satisfaction, health problems, and depression. *Contemporary Family Therapy: An International Journal*, 30, 183–198.

- Kogan, S. M., Lei, M.-K., Grange, C. R., Simons, R. L., Brody, G. H., Gibbons, F. X., & Chen, Y. (2013). The Contribution of Community and Family Contexts to African American Young Adults' Romantic Relationship Health: A Prospective Analysis. *Journal of Youth and Adolescence*, 42, 878–890. doi:10.1007/s10964-013-9935-3.
- Markgraf, F., Michels, S., Winter, M., & Steiner, M. (2013). Atlas.ti (version 1.0.36) [Software]. Available from: <http://atlasti.com/product/mac-os-edition/>
- Minnotte, K. L., Minnotte, M. C., & Pedersen, D. E. (2013). Marital satisfaction among dual-earner couples: *Gender ideologies and family-to-work conflict*. *Family Relations*, 62, 686–698.
- Morawska, A. & Thompson, E. (2009). Parent problem checklist: Measure of parent conflict. *Australian & New Zealand Journal of Psychiatry*, 43, 260–269.
- Robles, T. F. (2014). Marital Quality and Health Implications for Marriage in the 21st Century. *Current directions in psychological science*, 23, 427–432. doi: 10.1177/0963721414549043
- Thenmozhi, S. (2015). Relationship between marital satisfaction, self efficacy and work engagement among male employees in the ITES sector. *Annamalai International Journal of Business Studies & Research*, Special Issue, 69–73.



SOCIAL WORK

College of Social & Behavioral Science

Veterans and the Department of Veterans Affairs

Catherine Stoddard | Mentor: Barrett Bonella & Corina Segovia-Tadehara

Abstract

When military personnel return from their service, they come home with a variety of needs that are supposedly met by the Department of Veterans Affairs (VA). The purpose of creating this research study was to consider what the VA system looked like from veterans' points of views. There was a set of twenty-five questions used stemming from the original topic. The questions addressed the veterans' personal beliefs toward the VA system and the experiences they had with it. Ten veterans were interviewed on Weber State University's campus to find answers to the chosen questions. Issues were identified, such as trust, experiences with the health care system, including positive and negative correlations with all aspects of the agency.

Veterans and the Department of Veterans Affairs

The Department of Veterans Affairs is a government agency which provides benefits and services to the United States (U.S) veterans. There are a variety of services provided to veterans by the VA, such as medical and mental health, education, mortgages, disability, and death benefits. Since the 1930's when the VA was created, there have been scandals based on corruption within its system, resulting in the mistreatment of veterans. To this day, veterans are still struggling to receive deserved benefits from the VA and adequate solutions to these problems have yet to be implemented (Druzin, 2015). It is crucial that American citizens know about problems this population is dealing with in regards to the VA system. The sacrifices made by the veterans for their protection of the county are not being adequately compensated upon returning home.

Literature Review

The results of a study conducted by a team of doctors revealed that perceptions varied between male and female veterans regarding the

mental health services within the VA. That study was based on veterans who served in Operation Enduring Freedom (OEF) and the Operation Iraqi Freedom (OIF) (Fox, AB., Meyer, E.C., and Vogt, D., 2015). Conclusions indicated there was a higher number of males who displayed negative views about the VA's mental health services than females. The researchers indicated that for both male and female veterans' perceived entitlement to VA services increased the likelihood of seeking treatment (2015, p.1).

Hastings, Smith, Weinberger, Oddone, Olsen, and Schmader conducted a study which revealed the VA's emergency services were affecting veterans ages 65 and older. The results of the study revealed that the older veterans tended to have the most severe and chronic health problems, resulting in the VA having difficulties with administering emergency services. The conclusion indicated that the VA does not have enough resources to adequately treat health issues affecting this population. The aforementioned doctors found that at least twenty percent of older veterans get treated and released from emergency services instead of being hospitalized when needed (2013, p.4).

Methods

The paradigm of participatory-action-based research was used for the study. This type of research is based on the concept that stakeholders in the studied population act as co-researchers assisting the principle researcher with all aspects of the project (Yin, 2016). A co-researcher in the study is a fellow student and Vietnam veteran who has been dealing with the VA for most of his life. He is currently an intern at the Department of Veterans Affairs in Salt Lake City, Utah. The method of snowball sampling was used to recruit participants. This method was conducted by interviewing one veteran and then asking them if they knew other veterans willing to participate, leading to additional interviewees (Yin, 2016).

However, despite recruiting efforts on campus, only ten volunteers were found to participate. It was preferred to find about five more participants, however time constraints on the project were a limitation in collecting a larger sample size. The only variable for a participant to qualify as a candidate for the study was service in any branch of the United States military, either previously or currently. Out of ten veterans interviewed, one served in Vietnam and the rest served in Afghanistan.

With the assistance of an academic advisor, the questions created were based on general issues which veterans faced. Interviews were conducted by using an audio recorder and writing field notes. After the transcription process, compiling data from interviews and notes was completed. The data was transferred into the Atlas ti software program designed for organizing research information. The dissimulation procedure required going through responses and notes, therefore attaching analytic memos to them. Designated codes were assigned to the memos. Memos were gathered into themes, therefore leading to an interpretations. The interpretations uncovered underlying messages and meanings which lead to conclusions. Furthermore, conclusions were tied together, creating a hierarchical outline for final analysis.

Results

A dominating theme occurring throughout the study was trust issues. During observations, it appeared veterans were having problems trusting individuals within the VA and they are also cautious in trusting outsiders. Participants were not required to sign their real names on consent forms if they wished not to. Despite assurances, two veterans stated relief in using pseudonyms. The co-researcher implied that veterans' struggle discussing issues about the VA to outsiders. Therefore the colleague's assistance with interviews could have alleviated distrust and increased accuracy of information. It was discovered that war stories were shared in the colleague's presence and it appeared that veterans' comfort level increased and more intimate details were revealed. Veterans were not probed for information about war experiences, stories were freely given when interviews were wrapping up. The reasoning behind the concept of distrust in the VA is that many veterans feel that the VA is looking out for the government's interests and not theirs. Fears are felt about personal information leaking back to the VA, causing repercussions, such as job loss.

Another prominent theme involved negative and positive experiences veterans had with the VA's health care system. During observations, it was noted that veteran's perceptions, either positive or negative, were based on personal experiences or rumors overheard by comrades. Also, it was noted that participants that discussed having satisfaction with the health care system did not speak of personal health issues. One veteran stated, "I don't deal with the VA doctors and I haven't needed

to yet". However, veterans claiming to have a combination of mental and physical health issues expressed the most dissatisfaction with the VA's medical services. Therefore, it appeared as though there was a correlation between decent health or lack of experience with the VA medical services and positive perspectives. On the other hand, there seemed to be a connection between poor health, extensive experience, and negative beliefs about the agency's medical services.

The most prevalent complaints about the VA's health care system were the issues of long waiting lists for obtaining medical care, and it was mentioned by eight of ten veterans as being the worst aspect of the agency's health care system. One veteran exclaimed, "I am waiting to die for the second time." Participants also indicated that during doctor's appointments, they were treated like numbers instead of human beings due to being rushed in and out of the office without a proper diagnosis nor treatment, "One doctor told me to take an aspirin and I would feel better in a few days." Also, it was stated that "VA doctors tended to have a poor bedside manner and they should provide more than two minutes for office visits." Another dilemma mentioned was rising levels of veterans addicted to opiates. One participant claimed, "Veterans are experiencing addiction due to overmedicating." He also indicated that reasons behind abuse were that VA doctors are pushing opiates on to veterans for pain management without thoroughly diagnosing their underlying problems. Another participant stated, "Needed surgeries are not provided in a timely manner." It was discovered that six of the ten veterans mentioned experiencing one or more negative encounters with the health care system. However, two of the ten veterans exclaimed all medical issues were properly addressed.

Additional services provided by the VA include educational and mortgage benefits. The veterans interviewed were all students on campus. They indicated the VA's financial aid benefits were efficiently meeting their educational needs. One participant stated, "despite minor setbacks, the financial aid benefits were worth waiting for." Furthermore, two veterans mentioned they received loans sponsored by the VA to purchase their homes. They had no complaints about their mortgage benefits other than "the VA has strict codes for measuring safety standards for homes, such as proper lengths for hand rails along stair cases." In regards to other financial services, there were complaints about disability benefits and long waiting periods for obtaining approval. This is an issue for some veterans because they cannot work full time due to injuries sustained

during combat. It was indicated by one veteran that he had to rely on public services to have all of his basic needs met, "I had to get help from a food pantry to feed my family while waiting for benefits."

Suggestions were made addressing the desires for change within the VA system. Improvements in the health care system were mentioned, such as shorter waiting lists and a higher quality of treatment. One participant stressed, "The agency's legal system needs to be overhauled." He delved into details about politics within the system exclaiming that positions of governing officials should be rotated more frequently while also creating limits on years in office. He also addressed, "The agency should dispose of old policies which are no longer adequate and create new ones increasing efficacy of existing services." A consistent desire expressed among participants was for more veterans to be employed by the VA. Ultimately, the veterans appeared to hold the beliefs that their comrades will better understand their plights.

Unfortunately, some of these desired changes may not be feasible. However there were suggested solutions provided by participants which could be possible. As previously mentioned, the co-researcher involved in the study is a veteran and intern for the VA. Therefore, he holds some experience with the VA system. He stated a few of his ideas for possible resolutions. It was mentioned that the VA's suicide teams could be expanded by hiring more crisis workers. Another suggestion was the improvement of directives governing PTSD, including a higher quality of counseling for veterans and their families. The reasoning behind this concept related to the fact that veterans come home with a number of trauma related issues. The effects of PTSD on returning veterans often results in issues with marital discord and domestic violence.

Conclusion

Improvements need to be made within the VA system. However, there are underlying issues which need to be addressed before solutions can be implemented. As one veteran stated, "The VA system is functioning to the best of its ability with the resources supplied by the U.S. government." He also mentioned that the U.S military is one of the first government entities cut in times of economic recession." Therefore, it is not surprising that the VA system suffers from those consequences as well. Furthermore, for the VA to increase quality of services, innovative

movements must be processed through a hierarchal government system from congress, descending to the VA.

References

- Druzin, H. (2015). Vets report: VA care hard to get for mental health. Retrieved from: <http://www.stripes.com/vets-report-va-care-hard-to-get-for-mental-health-1.375600>
- Fox, A.B Meyer, E.C. and Vogt, D., (2015). Attitudes about the VA health-care setting, mental illness, and mental health treatment and their Relationship with VA mental health service: *Use among Female and Male OEF/OIF Veterans*. Psychological Services, Vol.12. Issue 1. p. 49–58. Retrieved from: <http://dx.doi.org/10.1037/a003852>
- Hastings, S.N.; Oddone, Z.E; Olsen, M.K; Schmader, K.E; and Smith, V. (2013). Health services use of older veterans treated and released from veterans affairs Medical Center emergency departments. *Journal of the American Geriatrics Society*. Sep2013, Vol. 61, issue 9, p.1515–1521. doi: 10.1111/jgs.124171.
- Yin, R. K. (2016). *Qualitative Research from Start to Finish*, (2nd ed.). New York, New York. The Guilford Press.





ZOOLOGY

College of Science

Suppression of Antimicrobial Resistance in MRSA Using CRISPRs

Karissa Wang | Mentor: Matthew Nicholaou

Abstract

Clustered Regularly Interspaced Short Palindromic Repeats (CRISPRs) are genetic elements that function with CRISPR associated (Cas) proteins as adaptive immune systems in bacteria. CRISPR-Cas systems produce targeted endonucleases that destroy the DNA of invading bacterial pathogens. The catalytically dead version is called the dCas9 system, which blocks expression of genes without destroying them. Methicillin-resistant Staphylococcus aureus (MRSA) is a common bacterium responsible for many human maladies and is especially dangerous due to its antibiotic resistance. MRSA is resistant to many traditional antibiotics because of the mecA gene, which allows MRSA to produce proteins which interfere with the functional ability of these antibiotics. This study tested dCas9 systems as potential repressors to the mecA gene in MRSA. Two dCas9 plasmids were designed to bind to the promoter of mecA and block expression of the gene. Two target sites were chosen; one on the coding strand of mecA and the other on the noncoding strand. The plasmids were electroporated into MRSA. The transformed MRSA were then plated with cefoxitin disks to test for beta-lactam antibiotic resistance. The target on the noncoding strand did not affect susceptibility, as its p-value relative to the control group was 2.1×10^{-1} . The target on the coding strand had a p-value of 8.5×10^{-5} , showing that it did significantly affect MRSA's antibiotic resistance, although not enough to confer susceptibility.

Introduction

CRISPR-Cas9

Two systems traditionally used for genetic engineering are Zinc Finger Nucleases and Transcription Activator-Like Effector Nucleases, which both introduce double-stranded breaks at target sites to modify genes. Gene editing is often used to add new information to a genome or to remove or repress a gene. An example of this is editing human stem cells

to take on the characteristics of a certain organ, rather than letting it naturally progress. However, the sequence-specific proteins required for these systems are time-consuming and expensive to engineer. A newer piece of biological technology, Clustered Regularly Interspaced Short Palindromic Repeats (CRISPRs), works with CRISPR-associated (Cas) proteins to edit genomes more efficiently (Barrangou, Boyaval, Moineau, Romero, & Horvath, 2007). Though they are native to prokaryotes, CRISPRs can be used in the cells of any organism, even humans (Merkle et al., 2015).

CRISPR systems occur in nature as bacterial immune systems. They help bacteria degrade foreign DNA from viruses, bacteriophages, or plasmids by creating proteins that splice and integrate invader genomic sequences into the CRISPR locus. These sequences, called spacers, help Cas proteins recognize the gene they are programmed to cleave – the target. Each spacer, around 30 basepairs long, is separated by equally short palindromic sequences. Downstream from the spacer is the Protospacer Adjacent Motif (PAM), a 3 basepair sequence which is essential to target recognition. When the PAM is tampered with, the CRISPR system fails to function (Bikard et al., 2013). Elsewhere in the bacterial genome are trans-activating CRISPR (*tracr*) genes, which also aid in target recognition (see Figure 1).

The CRISPR locus and *tracr* genes are transcribed. A Cas9 endonuclease is produced, but it is not complete until it joins with the *tracr*RNA and transcribed spacer sequence. Each endonuclease binds to a single spacer sequence and therefore a single target site. Upon recognition of the target sequence and PAM, Cas9 binds to and cleaves the gene (see Figure 2).

dCas9 System

This study used a modified version of the CRISPR-Cas9 system – the CRISPR-dCas9 system, which is the catalytically dead version of Cas9. The only difference in the dCas9 system is that the endonuclease binds, but does not cleave the gene. It blocks expression of the gene by preventing transcription (Bikard et al., 2013).

MRSA

Methicillin-resistant *Staphylococcus aureus* is a strain of bacteria that has developed resistance to traditional beta-lactam antibiotics (Klevens

et al., 2015) such as penicillin and methicillin. MRSA has picked up the *mecA* gene, which confers resistance to these treatments.

MRSA has become public health risk, often leading to fatal complications. MRSA infections are common in hospitals where patients have open wounds, but also occur in community settings.

A previous study used a CRISPR-Cas9 system to target the *mecA* gene in MRSA, but this killed the bacteria (Bikard et al., 2014). With the bacteria dead, it cannot be confirmed that the CRISPR affected the bacteria's resistance to methicillin.

This study designed a CRISPR-dCas9 system to repress the *mecA* gene in MRSA. It was hypothesized that by blocking expression of the gene rather than cleaving it, the bacteria might stay alive, offering an opportunity to confirm that the *mecA* gene was affected and to introduce a gene drive.

Methods

Plasmid Design

The *mecA* gene of MRSA ATCC 43300 was scanned for potential target sites. The region was scanned for ~30 basepair sequences upstream from a PAM, which is a sequence essential to target recognition (Bikard et al., 2014). A previous study showed that target sites on the coding strand typically work better than those on the non-coding strand (Bikard et al., 2013). Two sites were selected to further test this theory: site 43 and site 46. Site 43 was located on the coding strand of the gene and site 46 was located on the non-coding strand. Both target sites were incorporated into separate plasmids and used for testing.

A BLAST search was run to ensure that the chosen target sites would not unintentionally bind to genes other than *mecA*. Three plasmids were produced by a CRISPR core facility using a dCas9 backbone vector: a plasmid with the site 43 target (S43), a plasmid with the site 46 target (S46), and a mock plasmid that contained a CRISPR locus with a nonsense target (pdCas9).

Each plasmid contained dCas9 genes, *tracr* genes, a target sequence flanked by repeats, and a chloramphenicol resistance gene for selection purposes.

Plasmid Amplification

Plasmids were amplified in a specialized *Escherichia coli* strain, SA30B, which is modified so that it does not add methyl tags to DNA, which is critical to plasmid incorporation into *S. aureus* (Monk, Shah, Xu, Tan, & Foster, 2012).

The SA30B cells were made electrocompetent, then transformed with CRISPR plasmids by electroporation. There were 3 batches of SA30B cells: one transformed with S43 plasmids, one with S46 plasmids, and one with the pdCas9 plasmids. Each batch was separately transformed, plated, and incubated. Plasmids were extracted from *E.coli* cells.

MRSA Transformations

The plasmids were transformed into MRSA by electroporation and then incubated. Three batches of MRSA underwent electroporation: one with S43, one with S46, and one with pdCas9.

Susceptibility Testing

The bacteria were plated with 30µg cefoxitin disks, the standard for methicillin-resistance disk diffusion testing. Each batch of MRSA was plated twice, with two cefoxitin disks on each plate. In this way, each test was run in quadruplicate.

Because the cefoxitin disk is covered in antibiotics, bacteria will not grow in the area surrounding it, creating a bacteria-free circle around the disk, whereas the rest of the plate is covered by a bacterial lawn. The diameter of the bacteria-free circle is measured and used to determine whether the bacteria are susceptible or resistant to the antibiotic. For cefoxitin, a diameter of less than or equal to 21 mm means the bacteria is resistant and a diameter of 22 mm or greater shows the bacteria are susceptible to the tested antibiotic.

Statistical Analysis

Two-tailed t-tests and a one-way ANOVA were run between the control group and each target site to see whether the differences between the zones of inhibition were statistically significant.

Results

The plasmids were successfully designed, transformed into SA30B *E.coli* cells, cloned in and extracted from *E.coli*, and transformed into MRSA.

The zones of inhibition for the control, pdCas9, yielded an average of 14.1 mm and standard deviation of 0.25 mm. Average diameter for the S43 plates was 18.75 mm with a standard deviation of 0.96 mm. The S46 plates had an average diameter of 13.86 mm and standard deviation of 0.25 mm.

These zones of inhibition still fell within the resistant range. The S46 plasmid had a similar diameter to that of the pdCas9 control plate, suggesting that the site 46 target did not repress *mecA*. However, the site 43 plasmid had a visibly wider diameter, indicating that this target site affected the *mecA* gene more.

The p-value between the control and S46 was 2.1×10^{-1} , meaning that the S46 plasmid did not yield a significant difference in the antibiotic resistance of MRSA. The p-value for S43 was 8.5×10^{-5} , which shows the target on the coding strand did significantly alter the antibiotic resistance qualities of MRSA. An ANOVA test between the control and CRISPR plasmids yielded a P value of 1.31×10^{-6} , confirming that the difference between the control and S43 plasmid was significant, not a false positive.

Discussion & Conclusion

Target site 43 was more effective in suppressing antimicrobial resistance in MRSA than site 46, possibly because it was on the coding strand.

A potential reason that the system was not fully effective may be because the *mecA* gene may not be the sole contributor to methicillin resistance in MRSA. Further studies could be conducted to determine whether this is the case. If so, the CRISPR-dCas9 system could be modified to target all of the genes which code for MRSA's resistance traits.

CRISPR-dCas9 plasmids were successfully designed to target the *mecA* gene in MRSA. The site 43 plasmid did significantly affect the antibiotic resistance properties of MRSA. The suppression was insufficient to confer susceptibility to beta-lactam antibiotics, but it did suppress the *mecA* gene.

Future studies will focus on target site optimization to increase effective disruption of resistance genes in MRSA, then introducing a gene drive (Dance, 2015). With a gene drive, the CRISPR-dCas9 genes targeting *mecA* could be passed among bacteria with almost no human intervention. The plasmid containing the CRISPR-dCas9 system could be modified to make its way into the host chromosome of bacteria, meaning all of the future bacteria produced would be susceptible to methicillin and other traditional antibiotics, potentially eliminating MRSA as a threat.

References

- Barrangou, R., Boyaval, P., Moineau, S., Romero, D. a, & Horvath, P. (2007). CRISPR Provides Aquired Resistance Against Viruses in Prokaryotes, (March), 1709–1712.
- Bikard, D., Euler, C. W., Jiang, W., Nussenzweig, P. M., Goldberg, G. W., Duportet, X., ... Marraffini, L. a. (2014). Exploiting CRISPR-Cas nucleases to produce sequence-specific antimicrobials. *Nature Biotechnology*, (October), 1–6. <http://doi.org/10.1038/nbt.3043>
- Bikard, D., Jiang, W., Samai, P., Hochschild, A., Zhang, F., & Marraffini, L. a. (2013). Programmable repression and activation of bacterial gene expression using an engineered CRISPR-Cas system. *Nucleic Acids Research*, 41(15), 7429–7437. <http://doi.org/10.1093/nar/gkt520>
- Dance, A. (2015). Core Concept: CRISPR gene editing. *Proceedings of the National Academy of Sciences*, 112(20), 6245–6246. <http://doi.org/10.1073/pnas.1503840112>
- Klevens, R. M., Morrison, M. A., Nadle, J., Petit, S., Gershman, K., Ray, S., ... Fridkin, S. K. (2015). Invasive Methicillin-Resistant *Staphylococcus aureus* Infections in the United States, 298(15), 1763–1771.
- Merkle, F. T., Neuhausser, W. M., Santos, D., Valen, E., Gagnon, J. A., Maas, K., ... Egan, K. (2015). Efficient CRISPR-Cas9-Mediated Generation of Knockin Human Pluripotent Stem Cells Lacking Undesired Mutations at the Targeted Locus. *Cell Reports*, 11(6), 875–883. <http://doi.org/10.1016/j.celrep.2015.04.007>

Monk, I. R., Shah, I. M., Xu, M., Tan, M., & Foster, T. J. (2012). Transforming the Untransformable: Application of Direct Transformation To Manipulate Genetically *Staphylococcus aureus* and *Staphylococcus epidermidis*, 3(2), 1–11. <http://doi.org/10.1128/mBio.00277-11>. Editor

Figures

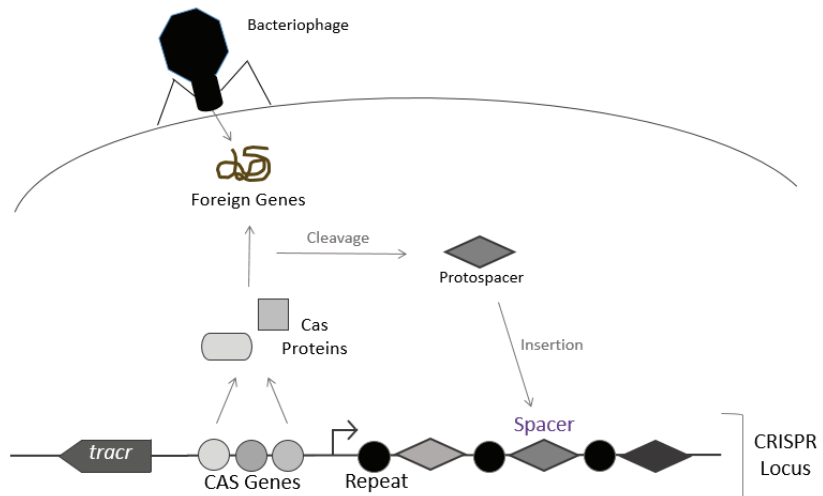


Figure 1. Integration of Invader Genes into CRISPR Locus. *Cas* proteins cleave foreign nucleic acids into ~30 bp segments and insert them into a CRISPR locus as spacers. Between each spacer is a short, palindromic repeat of the same length. Also on the locus are *tracr* genes, which aid in target recognition.

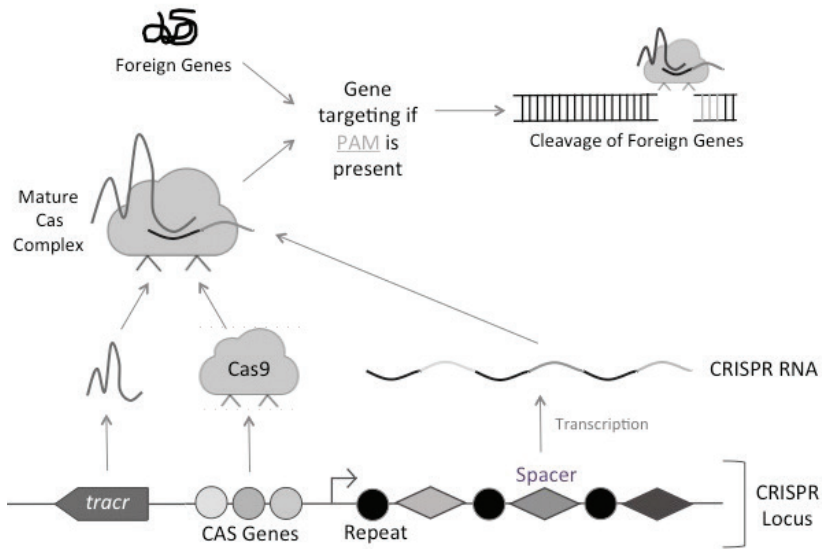


Figure 2. Transcription of CRISPR Locus and Cleavage of Foreign Genes. The CRISPR locus is transcribed, creating tracrRNAs with sequences complementary to the spacers. Each tracrRNA binds to a repeat-spacer sequence and a Cas endonuclease, forming a mature Cas complex. If the PAM is present, the complex binds to and cleaves the gene.





TRAVEL ABSTRACTS

Jerry & Vicki Moyes College of Education

A Picture Paints a Thousand Words: Understanding Camper's Experience of Nature at Camp Using Photovoice

Stacie Baker | Mentor: Cass Morgan

American Camp Association's National Convention
Atlanta, Georgia (February 9–12, 2016)

Abstract

Research has shown that time spent in nature aids in short and long term physical, mental, cognitive, and socio-emotional health and development in youth (Mainella, Agate & Clark, 2011). Despite these benefits youth are increasingly disconnecting from the natural world (National Wildlife Federation, 2010). Summer camps, however, can serve as an important environment where youth can experience and 'connect' to nature (Dressner & Gill, 2010; Schmillen & Jacobs, 2011). Yet, little is known about how youth view and experience nature while at camp and the specific aspects of the outdoor environment that affect a campers' experience in nature. Understanding the aspects of nature that campers may enjoy or find unpleasant can be useful to determine ways to create positive changes in camp programming that facilitate a connection rather than a disconnection to nature. This study used a photovoice method to better understand the aspects of the camp environment that contributed to the campers experience in nature. The campers identified specific natural camp features that contributed to their overall experience. They were able to express their positive and negative feelings, as well as express their desire to spend more time in structured and unstructured outdoor activities. Campers also indicated their awareness of the effects of technology in their everyday lives. The findings from this study illustrate how the natural environment of a camp setting can impact the camper's overall experience and can provide an important context in which campers can benefit from the positive outcomes of being in nature. Allowing campers to share their perspective on their experience with the natural environment opens a door for more effective planning and implementation of programs.

Overcoming Misconceptions about Depression: The Effect of Perspective-Taking

Denny Bessire | Mentor: Eric Amsel

Convention of the Rocky Mountain Psychology Association

Grove Hotel - Bosie, Idaho (April 9–11, 2015)

Abstract

The current study explored promoting perspective-taking as a method of promoting conceptual change to overcome students' ontological misconceptions about depression. The study measured the responses of 179 Introductory Psychology students who viewed a short video about depression and then provided responses to three control questions and the seven-item Depression Conceptualization Questionnaire (DCQ), which assesses individuals' views of depression as either a mental weakness or mental illness. Students were placed into one of five instruction conditions when responding to the DCQ (1) without additional instructions, or based on (2) what they believe, (3) what they learned, (4) what they know now that they didn't before, or (5) by thinking like the psychology professor in the video. Results suggest that, despite equal exposure to the ideas, students more strongly endorsed the scientific-based account of depression in the Professor condition than the other conditions. These results were sustained a month later. The Professor condition encourages students to adopt the perspective of the professor, allowing students recognize scientific concepts about depression as unique and alternative to their own beliefs and misconceptions and promoting conceptual change in their views and understanding of depression.

A Speed Measure Assessing the Validity of Religiosity

Auburn Binette | Mentor: Aaron Ashley

Convention of the Rocky Mountain Psychology Association

Grove Hotel - Boise, Idaho (April 9–11, 2015)

Abstract

Religion has been prevalent in many cultures for millennia, suggesting that religion has a large impact on cultural, social, and personal aspects of an individuals' life. Religion can be seen as a spectrum of content, practices, and beliefs. For those who have integrated religion into daily life, religious thinking can largely impact their approach to decision-making. Those who have more religion in their lives have more access to religious beliefs, which can be quickly accessed and used as tools for effective decision making (Cohen, A., Shariff, A., Hill, P., 2008). Current conceptualizations of religiosity propose that religiosity includes three factors: extrinsic, intrinsic, and quest (Batson & Schoenrade, 1991). The validity of observable measures such as determining the number of times per week an individual attends church is not a subjective measure, and is easily assessed. However, assessing the validity of measures of religiosity, as a decision making influence, is more difficult since people are not typically aware of all the variables influencing his/her decisions. This study represents an attempt to provide validity for the measurement of this construct using a speeded lexical decision task.

We hypothesized that if an individual is high in religiosity, then he/she may be naturally primed for religious items. Individuals self-reporting a high degree of religiosity should be faster to recognize religious items. For this study, participants were randomly presented three types of stimuli (religious words, non-religious words, and non-words) and were asked whether each stimulus presented was a word or non-word. Response times and accuracy were measured for each trial. After finishing the experiment, participants completed the Religious Life Inventory (RLI: Batson & Schoenrade, 1991). Participants' scores on measures of religiosity were correlated with response time measures. Data collection is ongoing.

Dignity as Resultant from Valuation

Preston Carter | Mentor: Robert Fudge

Undergraduate Conference on Philosophy

Eastern Michigan University - Ypsilanti, Michigan (March 6–9, 2015)

Abstract

*With a reading of the major ethical theorists and other philosophers and the book *Dignity: Its History and Meaning* by Michael Rosen, I evaluate the concept of dignity utilizing specific elements from Adam Smith's *The Theory of Moral Sentiments*, Nietzsche's historical critiques of morality, and Foucault's critiques of discourse. I specifically target Rosen's interpretation of Kantian ethical theory finally working towards adjudicating another conception of dignity, that integrates elements of these three individual theorists, subtracting the idea of intrinsic, universal value and instead identifying moral value in the interplay between the person and their valuations. This argument for dignity finally solves the major problem of valuing non-ends through a Kantian framework posed by Rosen in his book, a problem which he found devastating and spent a large amount of time discussing. I then spend some time discussing potential objections to this view. All of this is to demonstrate that a conception of dignity devoid of intrinsic value, resultant from valuation, is a much more flexible and sensible position to take on dignity, and perhaps morality as a whole.*

The Influence of a Religious Icon on Decisions Regarding Morality

Brandi Christensen | Mentor: Aaron Ashley

Convention of the Rocky Mountain Psychology Association
Boise, Idaho (April 9–11, 2015)

Abstract

The present study examined the effects of implicit priming on influencing the responses to decisions regarding morality in regards to an ethical dilemma. First, participants were primed with either a picture of Jesus Christ or a blank screen. They were then asked a set of demographic questions about their gender, ethnicity, religious affiliation, and age. Participants were then presented with a preview moral dilemma, which was later accompanied by six appropriate responses to the dilemma, in order to prepare the individuals for the actual dilemma they were to evaluate. Then, participants were presented with the experimental dilemma. This ethical dilemma was about the moral permissibility of requiring brain scans for various purposes such as criminal intent and guilt, disease diagnosis, maturity level for admittance to college, etc. They were then asked to rank a list of rationales or appropriate moral responses that were coded according to three philosophical ethical theories: Egoism, deontology, or utilitarianism. It was predicted that those in the primed group would rank responses coded for deontology higher than the other responses because religious morality is deontologically based. Data suggest that there is no relationship between prime types (religious vs. none) on rationales. What is interesting is that those who were primed with the religious icon provided more egoist responses than those in the control group. Further investigation into this interesting fact would provide more information about what effect a religious icon has on decisions about morality in general.

Etiology and Susceptibility of Canine Otitis Infections

Cristie Cothran | Mentor: Jason Fritzler

American Society for Microbiology 115th General Meeting
New Orleans, Louisiana (May 29–June 3, 2015)

Abstract

Both acute and chronic otitis externa (OE) is a common and troublesome infection in the canine population. It has been found that the yeast, Malassezia pachydermatis, and many types of bacteria most commonly cause these types of infections. It is widely known that antimicrobial resistance to antibiotics is a growing problem in regards to treatment of these bacterial infections. While there is evidence that the etiology and susceptibility profiles differ among geographical regions, there are no published surveys on either of these in the northern Utah region. Many practitioners in this area treat OE based on clinical impressions and an examination of a simple stained smear. If the smear shows bacilli, they usually consider that they represent P. aeruginosa. Samples from 55 dogs over a four-month period exhibiting symptoms of unilateral OE infection were analyzed. Exudates from each infected ear were obtained using sterile swabs, bacterial organisms were isolated following standard microbiological techniques, and all isolates were validated via 16S rDNA sequencing. Bacterial growth in 52 of the 55 animals (95%) was present. Of these, 42 (76%) were polymicrobial infections, with Pseudomonas sp. being isolated in only two (4%) of the samples, but other bacilli being isolated in 37 (71%). A wide variety of susceptibility profiles resulted when each isolate was tested against 20 antibiotics, which is in agreement with previous reports. While OE can be treated using a variety of antibiotics, we conclude that proper species identification is crucial for a successful outcome.

Overcoming Misconceptions about Physics: Generalizing the Effect of Perspective Taking

Alexandra Daniels | Mentor: Eric Amsel

Convention of the Rocky Mountain Psychology Association
Boise, Idaho (April 9–11, 2015)

Abstract

Students hold preconceived false beliefs or misconceptions about the discipline they study. One physics misconception is the belief that electromagnetic induction (EI) works in a manner that violates the law of the conservation of energy. That energy is neither created nor destroyed. Students assume that an electrical current is spontaneously created by the close proximity between a magnet and a conductor (wire) rather than the movement of one within the range of the other.

The present study assesses and promotes the revisions of the EI misconceptions by using an assessment method and revision technique proven effective with psychology students' misconceptions about depression.

The assessment method involves an Electromagnetism Conceptualization Questionnaire (ECQ) consisting of six pairs of statements about EI. Students rate their degree of agreement with, either the scientific view (Scored of 7), or the misconception (scored as 1). Before completing the ECQ students in an Introduction to Physics class watched a 3-minute video on the principles of electromagnetism. Participants were randomly assigned to complete the ECQ by either focusing on their beliefs or thinking like the physicist in the video. Consistent with the psychology findings. ECQ scores were reliable and were significantly lower in the belief than professor condition.

Irene Ryan Competition

Seth Foster | Mentor: Jenny Kokai

Kennedy Center American College Theatre Festival

University of Hawai'i at Manoa and Chaminade University of Honolulu -
Honolulu, Hawaii (February 10–15, 2016)

Abstract

I have been selected as a nominee and competitor for the Irene Ryan Scholarship Competition for my performance as Gus/Augustus Coverly in Arcadia. This competition will aid immensely in my growth as an artist, as it will require me to work independently to select and prepare material to perform at the Kennedy Center American College Theatre Festival. I will exercise discipline and dedication so that I may best represent WSU. At the Festival, I will perform for a variety of theatre artists, including undergraduate students and professionals. Watching other competitors will be a valuable experience, as it will help me discover what works well in an audition setting. Because the competition takes place in Hawaii, I am requesting funding for my airfare and festival registration.

Similarities and Differences in Individual Perceptions of Spiritual and Religious Beliefs

Jennifer Ghan | Mentor: Pamela Payne

*2015 Conference for National Council on Family Relation
Canada - Vancouver, British Columbia (November 17–30, 2015)*

Abstract

Personal aspects of religion may look similar to the broader notion of spiritual beliefs, but are often informed by doctrine from an organized religious group. By viewing spirituality in a way that encompasses both organized and personalized religious and spiritual beliefs, individuals are allowed to express the ways in which their beliefs exist. The goal of the current study acknowledges the complexity of spiritual beliefs for individuals and couples by allowing participants to define how they see themselves in terms of religion and spirituality.

The Role of a N-Acetylgalactosamine in Celiac Disease

Zachary Gibson | Mentor: Janet Oja

American Society for Clinical Laboratory Science Annual Meeting
Atlanta, Georgia (July 27–29, 2015)

Abstract

Research shows that certain lectins found in wheat can bind to specific monosaccharides in the intestinal mucosa contributing to intestinal damage in Celiac disease (CD). The N-Acetylgalactosamine (GalNAc) structure found on type A and AB red blood cells (RBCs) is one of such monosaccharides. The hypothesis of this research was that the prevalence of CD is greater in individuals with type A and AB blood due to the GalNAc structure present on their RBCs and in bodily secretions due to a positive secretor status. After IRB review and approval, 40 subjects, 14 with CD and 26 healthy controls, were recruited through a local gastroenterologist. Blood type and secretor status, through Lewis antigen typing, were determined for all subjects through direct agglutination method. When comparing the prevalence of CD in A secretors to B and O secretors and non-secretors, an odds ratio of 0.40 (95% CI 0.10-1.6; $p = .1966$) was obtained and was not statistically significant. Although the odds ratio was statistically insignificant, it suggested a protective effect with A-secretors being less than half as likely to have CD than non-secretors with B or O blood types. However, further research is needed to validate this association.

Gathering Baseline Data on Healthy NCAA Athletes: Post Concussion Care

Sara Gralitzer | Mentor: Valerie Herzog

National Athletic Trainers' Association 66th Clinical Symposia and Athletic Training Expo

Eastern Michigan University - St. Louis, Missouri (June 22–27, 2015)

Abstract

Context: Post-concussion treatment in the NCAA setting minimizes symptoms through rest. Common concussion symptoms are presented with visual disturbances, headaches, difficulty sleeping and/or experiencing poor quality of sleep. Limiting activity and increasing rest are common practices of symptom resolution.

Objective: Determining baseline data in healthy NCAA Division 1 student athletes includes average daily activity on a college campus, average activities, average sleep quality, and average sleep quantity within 14 days. This data will aid in developing a post-concussion treatment protocol by quantifying “rest” as step count and the ability to monitor sleep quantity and quality.

Design: Observational, gathering daily activity and sleep patterns.

Setting: College campus, Ogden, Utah.

Patients or Other Participants: Thirty-two (26 females; 6 males) healthy NCAA Division 1 student athletes (19.78 \pm 1.45yrs; 176.21 \pm 11.24cm; 76.3 \pm 18.17kg) with no current concussion used for step counts. Twenty-eight (22 females; 6 males) healthy NCAA Division 1 student athletes (19.78 \pm 1.475yrs; 176.21 \pm 11.24cm; 76.33 \pm 8.17kg) used for sleep patterns.

Interventions: Independent variables: gender and sport. Six different sports were included in this study. The Fitbit Flex was utilized to collect activity data and patterns.

Main Outcome Measures: Dependent variables: average step count, average step count per credit hour, actual hours asleep, sleep quality. Average daily activity and average activity while on campus, measured by step count. Sleep quality, measured by restlessness or number of awake times during the sleeping bout, sleep quantity, measured by total hours asleep in the bout.

Results: Mean daily activity for NCAA student athletes 5981.01 1601.53 steps, step count per credit hour 403.40 118.92 steps, credit hours 15.06 1.69, sleep quantity 468.09 64.36 min or 7.8 , restlessness at night 12.90 6.15. No significant differences found for mean step count between sports, Welch's $F(4,4.756)=2.569$, $p=0.170$, between sports for total average step count per credit hour, Welch's $F(4, 4.756)=3.510$, $p=0.106$, or for actual time slept between sports, ($F_{2,27}=7.62$, $p=.587$). No significant differences between genders for average step count, $t(30)=1.269$, $p=0.214$ or between genders for actual sleep time, $t(28)=1.42$, $p=.166$. There was a significant difference in average step count per credit hour between males and females $t(30)=2.668$, $p=0.012$ with females having lower step counts than males.

Conclusions: Understanding typical activity levels and sleep patterns of student athletes are important step for developing a comprehensive post-concussion care protocol. Having gathered baseline data on student athletes, should a concussion occur, activity levels could be furthered modified by wearing the Fitbit Flex watch. The Fitbit Flex watch can alert the student-athlete when a certain number of steps have been taken through a vibration alarm, and letting the student-athlete know more rest is then needed if symptoms are still present. Monitoring the quantity and quality of sleep that the athlete is achieving post-concussion may also prove useful in determining the resolution of concussions.

Devised Performance

Elizabeth Hernandez | Mentor: Tracy Callahan

Kennedy Center American College Theatre Festival

University of Hawai'i at Manoa and Chaminade University of Honolulu -
Honolulu, Hawaii (February 10–15, 2016)

Abstract

I am a Musical Theatre Major at Weber State University in the Department of Performing Arts. This is my last year here and I have been selected to be a part of the Devised Piece of Theatre that will go to the Kennedy Center American College Theatre Festival. This chance was only given to 9 students and we will be mentored by Tracy Callahan the Acting/Director Professor at Weber. The devised pieces were introduced four years ago at KCACTF and are completely created by the cast chosen based off a prompt. This year's prompt is "The Past and Present Collide". We have already started rehearsals and will continue on until we perform at the Festival in February in Hawaii.

This is a valuable experience for me because it will give me an opportunity to express myself and grow in a different way than what is usually taught here. We are exploring how to make a piece of theatre from nothing and doing that will help our acting abilities in other pieces of performance. Doing this piece will also help me learn how to discuss theatre and the choices we are making. It is important to feel confident about your choices and being able to create them from scratch and make them grow will give me the ability to gain that confidence. The last thing that makes this project stand out is the sense of community and trust this will give us. In a devised piece you need to trust the rest of your ensemble. We are all working together to create this piece of theatre and we need each and every one of us to do that. I am requesting this money because I think this is a much needed experience before I graduate. I feel that it will give me that extra push to be comfortable in my performance skills before I go out and start my career as a performer.

A Qualitative Study Exploring Perceptions of Partner Media Use

Mark Homer | Mentor: Cass Morgan

National Conference on Family Relations

Canada - Vancouver, British Columbia (November 11–14, 2015)

Abstract

Over the last decade the use of media and technology has become commonplace in most households (U.S. Bureau of the Census, 2014). Romantic couples frequently use media to connect and communicate with each other (Coyne, Stockdale, Busby, Iverson, & Grant, 2011). However, little is known about the influence of media-use on romantic partners' relationship quality. The present study aims to explore how relationships are impacted by respondents' perceptions of their partners' media use including video games, Facebook, computers (both desktop and laptops), smartphones and tablets.

My purpose and objective in going to NCFR is to present and expound newly developed research on romantic relationships and families. This research, titled "A Qualitative Study Exploring Perceptions of Partner Media Use On Romantic Relationships: Positive and Negative Views of Technology" explores how media use in romantic relationships impacts relationship quality and overall relationship satisfaction. What we, the researchers, discovered was that it is not necessarily the quantity or amount of time spent on media use that impacts relationship satisfaction. Rather, it is the perceptions of the other partner (viewing their partner who uses media) that impacts overall relationship quality. If a person perceives their partner to be using media for unnecessary reasons (sometimes independent of the amount of time spent using media) then that has the most significant impact on the partner's feelings toward the romantic relationship.

This research and knowledge is critical for couples and families to know and understand when approaching a new or already existing relationship. It helps us understand that both partners should have open communication regarding the purpose of media use, so as to set boundaries regarding time

spent using media, when to engage in media use, and when to stop. There is no better convention other than NCFR to present this research to help other researchers nationwide understand this concept as well as to act as a catalyst for future researchers to expound upon.

Is the Bookstore an Efficient Market?

Mengqi Hua | Mentor: Rong Rong

American Camp Association's National Convention

Eastern Michigan University - Atlanta, Georgia (February 9–12, 2016)

Abstract

Research has shown that time spent in nature aids in short and long term physical, mental, cognitive, and socio-emotional health and development in youth (Mainella, Agate & Clark, 2011). Despite these benefits youth are increasingly disconnecting from the natural world (National Wildlife Federation, 2010). Summer camps, however, can serve as an important environment where youth can experience and 'connect' to nature (Dressner & Gill, 2010; Schmillen & Jacobs, 2011). Yet, little is known about how youth view and experience nature while at camp and the specific aspects of the outdoor environment that affect a campers' experience in nature. Understanding the aspects of nature that campers may enjoy or find unpleasant can be useful to determine ways to create positive changes in camp programming that facilitate a connection rather than a disconnection to nature. This study used a photovoice method to better understand the aspects of the camp environment that contributed to the campers experience in nature. The campers identified specific natural camp features that contributed to their overall experience. They were able to express their positive and negative feelings, as well as express their desire to spend more time in structured and unstructured outdoor activities. Campers also indicated their awareness of the effects of technology in their everyday lives. The findings from this study illustrate how the natural environment of a camp setting can impact the camper's overall experience and can provide an important context in which campers can benefit from the positive outcomes of being in nature. Allowing campers to share their perspective on their experience with the natural environment opens a door for more effective planning and implementation of programs.

Teaching Superheroes to a Home-Schooled Child with ASD

Brigette Hunter | Mentor: Patrick Leytham

17th International Conference on Autism Intellectual Disability & Developmental Disabilities

Waikiki, Honolulu, Hawaii (February 19–23, 2016)

Abstract

The Superheroes Social Skills Program is one evidence-based strategy to improve the social performance of children with ASD. This session will report results from a current study to determine the effects of implementing Superheroes with a primary-aged home-schooled child. Results indicate that children who are homeschooled lack the settings conducive to help them acquire these skills. Our findings also indicated that these skills can be learned in different settings by implementing the Superhero Social skills game. The child was able to learn and apply the basic foundations being taught to everyday scenarios. We also introduced social settings once a week to see how successful the student would be once out of their element, in remembering and using the skills that were previously taught. Further research needs to be conducted to determine the success rate of integrating previously homeschooled children into classroom environments.

Stage Management for Smokey Joe's Cafe

Korey Lamb | Mentor: Catherine Zublin

Kennedy Center American College Theatre Festival

University of Hawai'i at Manoa and Chaminade University of Honolulu -
Honolulu, Hawaii (February 10–15, 2016)

Abstract

While serving as stage manager for Smokey Joe's Café throughout the rehearsal process I work closely with the director. Together, provide everyone with the tools needed for rehearsals in which little time is wasted and a great deal can be accomplished. I find that the most effective means for this is being an active participant in the scheduling and progression. I achieve my goals by having my prompt script in order, being aware of what the director wants to accomplish, arriving early, and providing the cast with sufficient scheduling and rehearsal schedules in advance.

Even with planning, problems still arise that could not be anticipated. Being flexible, task oriented, and a problem solver are skills that I utilize to solve the problems as quickly and painlessly as possible. When a more difficult situation arises I approach the situation as levelheaded as possible by using diplomacy. I judiciously approach difficult situations where job quality is an issue and correct the issue in a way that is best suited for the success of the show.

When our production reaches performance, I take over the reins of the project, giving care to remember that continued communication with the director and production staff is vital. When adding new members to the process I make sure they are given all the information needed to understand their responsibilities and have the proper paperwork to succeed in their backstage tasks. I find that keeping the perspective of the show being a group effort, combined with good communication and preparation, help me to avoid being overwhelmed by being heavily responsible for the organization and smooth flow of technical rehearsals and performances.

As a stage manager, I affirm that positivity breeds productivity. Maintaining a positive attitude in spite of setbacks, or any troubles can significantly contribute to a successful theatre experience for all involved. I believe that the success and happiness of the company is dependent on the stage manager and their attitude. The stage manager is who all look to, so if the stage manager cracks it can make the entire company suffer. My goal is to remain as positive as possible, while still maintaining control over the show and expecting professional behavior from my cast and crew.

Dependability is important in all situations. I do what I say I'm going to do, and I am where I say I'm going to be, even if honoring these later becomes less convenient. I am young and don't have as much experience as some in stage management, I am using my educational experience to become an excellent stage manager. However I know that my cast, crew, directors, and design team have come to trust and rely on me when I say I will take care of something. Being a strong dependable member of the collaborative effort that is a production assists the design team to work with the highest efficiency. As the head of communication in a production, I ensure that collaboration is clear and precise. Being dependable and positive is a major part of my stage management approach.

I am looking forward to the opportunity to learn from the experience of presenting my work. I am grateful for the opportunity to have my script looked over and to gain experience and knowledge from it. The experience offered at KCACTF will increase my knowledge and proficiency as a stage manager, and enable me to become a professional stage manager.

I look forward to any and all opportunities presented to me as a stage manager. I believe that all venues and show types have valuable educational opportunities, which has proven by my educational experience here at Weber State University. My passion resides in stage management and I will do what is necessary to achieve my goals.

Electronic Predictors of Communication Patterns and Relationship Satisfaction in Romantic Partners

Amberly Lambertsen | Mentor: Daniel Hubler

National Conference on Family Relations

Canada - Vancouver, British Columbia (November 17–20, 2015)

Abstract

The prevalence of technology in recent years has impacted the way that individuals and families communicate. Individuals often have positive (or negative) attributions of their partners based on past experiences and interactions with those partners. Also, communication patterns (including criticism-defensiveness patterns and demand-withdraw patterns) often shape those attributions that impact a couple's relationship satisfaction and stability. This study surveyed 190 romantic partners to explore how perceived problematic media use (PMU) impacted a partner's report of communication patterns and level of relationship satisfaction. We also tested for potential mediators between PMU and relationship satisfaction. As expected, PMU was negatively and significantly correlated with relationship satisfaction. Also, significant and positive correlations were found between PMU and criticism-defensiveness patterns and between PMU and demand-withdraw patterns. Using regression tests and Sobel's test for mediation, we also found that the criticism-defensiveness patterns and the demand-withdraw patterns were partial mediators between PMU and relationship satisfaction. This provides evidence of a link between some forms of media use and predictors of relationship stability and satisfaction. The results also provide evidence for the importance of identifying communication patterns as potential reasons for media use becoming a problem in romantic relationships.

MTNA Southwest Division Young Artist String Competition

Shi Pong Lee | Mentor: Shi-Hwa Wang

MTNA Southwest Division Young Artist String Competition

Arizona State University - Tempe, Arizona (January 8–10, 2016)

Abstract

I am Shi Pong Lee, a junior student majoring in Violin performance. On the 23rd October, I competed for the Music Teacher National Association Young Artist String competition and won the first place. I will be representing Utah State to compete for the next division competition in Arizona from Jan 8–10, 2016. I will be playing two technically demanded pieces, including the devil's trill by Tartini and Glazunov violin concerto, sum up to the length of a 35 mins program.

For the division competition, I am bringing my piano accompanist to Arizona to play for my repertoire. Through this proposal, I am able to pay off some of the expenses for myself and also my pianists. As this is my first time to compete in other states, it will be a valuable experience to me to broaden my horizon gain more experience from other peers and judges. I also feel honored to be the representative of Weber State University, in order to compete in the division competition in Arizona.

Competing in the Southwest Division of Music Teacher National Association Steinway Young Artist Collegiate Competition

Ling-Yu Lee | Mentor: Yu-Jane Yang

Music Teacher National Association Southwest Division Competition
Arizona State University - Tempe, Arizona (January 8–10, 2016)

Abstract

My name is Ling-Yu Lee, a WSU senior majoring in piano performance. On November 7th, 2015 I participated in the Music Teacher National Association (MTNA) Steinway Young Artist State of Utah Collegiate Piano Competition and won the first place. As a winner of the MTNA State of Utah Piano competition, I have been asked to represent Utah and Weber State University to compete in the MTNA Southwest Division Competition, which will be held at Tempe, Arizona from January 8th to 11th of 2016.

I will be performing a program of 40-minute repertoire including pieces written by composers from various time period including Bach, Beethoven, Chopin, and Balakirev.

This proposal seeds fund for the soloist, me, Ling-Yu Lee to participate in the Southwest Division Competition of MTNA Young Artist Piano competition. It is my honor to represent Weber State University to compete in the division competition in Arizona here at Weber State University.

Effectiveness of Vacuum Cleaners: Microbial Extraction on Household Surfaces

Marcus Matson | Mentor: Michele Culumber

American Society for Microbiology Tri-Branch Meeting
Durango, Colorado (April 24–25, 2015)

Abstract

The microbial environment of the home is an important source of microbial exposure with many uncontrolled variables. Home hygiene is an important industry, but requires an understanding of how microorganisms move throughout a home. Carpet has the potential to harbor a large diversity of microorganisms which may be a source of infection. Understanding how well household vacuum cleaners extract microorganisms from household surfaces is unknown and valuable information. In the early stages of this research, Glo-Germ, a fluorescent powder used to model microorganisms, was used on different carpet samples and a hard concrete floor to observe the amount of Glo-germ removed by vacuuming. After ten passes (back and forth is one pass) with a standard household vacuum, we observed each carpet sample and the concrete floor. We observed that the amount of Glo-germ was reduced but not completely eliminated. It was apparent that the Glo-germ on the top surface of the carpet fibers was extracted but remained deeper in the carpet. Glo-germ on the concrete surface was extracted more efficiently than the carpet, but was not completely eliminated. It was interesting to note that the wheels of the vacuum spread Glo-germ outside of the vacuumed area which show that microbes could be spread from the vacuum. In our next experiments, we will use a fluorescent plate reader to quantify the amount of Glo-germ extracted from each surface after vacuuming. The Glo-germ experiments allow us to safely visualize the potential distribution of microorganisms in the environment. However, we will also test how well vacuuming removes microorganisms by quantifying culturable microorganisms before and after vacuuming using the most-probable-number assay. This research will help us, and others, understand whether household vacuum cleaners extract microbes or just spread them. From early findings, it seems that microbes will be extracted

from the superficial surface of carpet but can be spread via the wheels. This research is currently being conducted and will be completed within the next month and a half, well before the conference in April. Because this study is being conducted this semester, I will miss other current opportunities to present this research. In addition, due to my medical school application requirements and senior year schedule, I will not have the opportunity to present this research at any other conference.

Incarcerations Inequities of African American in Black vs White States

Celeste McClannahan | Mentor: Joe Horvat

Convention of the Rocky Mountain Psychology Association
Boise, Idaho (April 8–11, 2015)

Abstract

During recent years, there has been an increase in the concern over the obvious disparities between majority (White) and minority (particularly Black) penal incarcerations (Political Research Associates, 2005; Bartol & Bartol, 2014; NAACP Criminal Justice Fact Sheet, 2013). Perplexing is the fact that approximately 70% of all imprisoned people in the United States are people of color while people of color currently make up only 37% of the US Population (U.S. Department of Justice, 2012; U.S. Census Bureau, 2012). That rate of nearly two-to-one is disturbing from many viewpoints.

The racial inequities of the adjudicated are harshest for African Americans. It is an established fact that African Americans are represented approximately six times more frequently compared to their white counterparts in prison (Federal Bureau of Investigation, 2011; NCAAP Criminal Justice Fact Sheet, 2013; U.S. Department of Justice, 2012) and it is further estimated that one in three black males can expect to spend time in prison at some point during their life (Bureau of Justice Statistics, 2013; Center for American Progress, 2010; The Sentencing Project, 2013).

Blacks are inordinately and uniformly incarcerated at significantly higher rates in all states represented in this study. When comparing Black states with White states the results are startling. It appears that familiarity does breed more fairness in the criminal justice system, but familiarity does not rid these injustices. It is obvious that injustices in the criminal justice system are prevalent. Prejudices, whether subtle or overt, are active and prevalent in relation to Black incarceration, particularly in White states. There is an obvious need to educate criminal justice workers so these injustices can be minimized, and eventually eradicated altogether.

Overcoming Misconceptions about Depression: The Role of Persuasion

Luke McEntire | Mentor: Eric Amsel

Convention of the Rocky Mountain Psychology Association
Boise, Idaho (April 8–11, 2015)

Abstract

Students hold misconceptions about depression as a mental weakness that are based on deeper misunderstandings of the mind as a non-material entity which controls the body. The current study explored the role of persuasion and perspective-taking as methods for students to overcome misconceptions about depression. Students may come to adopt the belief that depression is a mental illness by being subtly invited to entertain such a position even if it conflicts with their stated position.

Introductory Psychology students viewed a short video about depression and completed the seven-item Depression Conceptualization Questionnaire (DCQ), which assesses individuals' views of depression as either a mental weakness (scores as 1) or mental illness (scored as 7). Students randomly assigned to complete the DCQ by focusing on their own beliefs, the best argument about depression, or the thinking of the professor in the video. They again completed the DCQ a month later in the Belief condition. DCQ scores in the Argument and Professor compared to the Belief condition overall, but the condition effect only applied to women. The results support the power of persuasion and perspective taking on inducing conceptual change at least for women.

Effectiveness of Oral Health Education Courses for Low-Income, Prenatal Women

Leticia Murillo | Mentor: Frances McConaughy

American Dental Hygienists' Association Center for Lifelong Learning 92nd Annual Session

Nashville, Tennessee (June 16–19, 2015)

Abstract

Objective: This research study was designed to evaluate the effectiveness of educational classes on the oral health knowledge of low income, pregnant women from a community health clinic.

Background & Problem Statement: Periodontal disease is one of the most common chronic infectious disorders. The prevalence of this disease varies depending on the definition of infection and the population being studied. Although contradictory findings exist in the literature, periodontal disease has been associated with many adverse pregnancy outcomes such as pre-term and low birth weight infants (Kumar, et al, 2013, Offenbacher, et al., 2001; Jeffcoat, et al, 2003). Further, there is some evidence that suggests economically disadvantaged women may be at higher risk for periodontal diseases and adverse pregnancy outcomes but this topic needs additional support in the literature (Alwaeli 2005).

Methodology: Research participants included a convenience sample of 20 women who were medical patients at the Midtown Community Health Clinic in Ogden, UT. The design of this study was a pretest-post experimental design with a series of three oral health educational programs as an intervention. These courses were designed by the authors of the study and were approximately 30 min in length. The content of the courses focused on periodontal disease and its effects on pregnancy, infant and child oral health care. The education programs and pre-posttests (5 multiple choice items) were provided in English and Spanish. The pretest served as baseline data. Institutional IRB was obtained prior to data collection.

Results: Twenty pregnant female patients, who were also identified as low income, participated in the study. Data were entered into an Excel spreadsheet and a t-test for dependent means was calculated to assess the impact of each education program on the participant's knowledge level. Results from the first educational program indicated a significant difference was found between pretest1 and posttest2 scores ($p = .05$; Pretest $M = 13.1$; Posttest $M = 20.95$). Results from the second and third educational course test scores were not statistically significant, but did show improvement in mean test scores (pretest2 $M = 21.7$, posttest2 $M = 24.4$; pretest3 $M = 17.5$, posttest3 $M = 20$).

Conclusion: The initial results suggest a positive impact of the oral health education program (first program) on the participant's knowledge level. This may not be an unexpected finding given the proximity of the timing of the educational program with the pre-posttest data collection (immediate). Nevertheless, these results suggest the participant's oral health knowledge did improve as a result of their attendance at the educational program. Future studies should follow this cadre of women long term (to delivery and post partum) to assess their periodontal health and overall health, including the delivery/infant's health and any adverse pregnancy outcomes.

Morphological Differences in Capsid Structure of Halophage in the Great Salt Lake

Brent Nelson | Mentor: Matt Domek

American Society for Microbiology Tri-Branch Meeting
Durango, Colorado (April 24–25, 2015)

Abstract

*Halophilic bacteria are ubiquitous within the Great Salt Lake. Playing an important role within the ecosystem are various families of halophage. As phage must attach to the host in order to infect the bacteria, shape is believed to play a very important role. TEM imaging was used to determine phage morphology. Images were taken of samples retrieved from two locations. These locations were direct sampling from the water at the shore, and from soil near to the shore. Phage infecting *Salinivibrio costicola* hosts SA-39 and SA-40 were harvested from the samples. Morphology of phage harvested appeared to be conserved to the host being infected. Phage infecting SA-39 and SA-40 were found to be icosahedral and tailed respectively. This study is still in the preliminary stages. A tailed phage such as that found infecting SA-40 has not been characterized using cryo-EM. This study will be continued to determine the characterization and identification of this phage, and a paper will be submitted to a ERGO as well as a journal of virology for publication. Presentation of the current findings at the conference this April will give us a great opportunity to present information already compiled in preparation for the paper to be submitted.*

DNA Barcoding of Great Salt Lake Invertebrates

Son Nguyen | Mentor: Jonathan Clark

Annual Meeting of Sigma Xi and Student Research Conference
Kansas City, Missouri (October 22–24, 2015)

Abstract

*Great Salt Lake (GSL), in northern Utah, is one of the largest lakes in the United States, with a total surface area of 4400 square kilometers. Arthropods constitute the most conspicuous and abundant animals inhabiting the waters of GSL. These include two principle species of brine flies (abundant in littoral areas); the corixid *Trichocorixa* (found in bays and along island margins); and the pelagic brine shrimp, *Artemia franciscana*. In addition, we have identified other invertebrates whose ecology and distribution have not been examined previously. The dynamic of interactions among these invertebrates is poorly studied and yet is an important influence in the community structure of this saline lake. DNA barcoding is the international recognized standard for species identification based on DNA. The results of this organized effort are freely available and are described at www.barcodinglife.org. A number of studies have shown that DNA barcodes are useful for species classification and are able to discriminate closely related species. This study uses the cytochrome c oxidase gene to establish DNA barcodes for several invertebrates associated with the GSL ecosystem. Data on intraspecific and interspecific sequence variation is considered for selected species and the utility of cytochrome c oxidase for examining phylogeny is discussed. These results provide genetic information that can be combined with traditional taxonomy to enhance our understanding of the biological diversity of this important ecosystem.*

Almost, Maine Sound Design

Lydia Oliverson | Mentor: Catherine Zublin

Kennedy Center American College Theatre Festival

University of Hawai'i at Manoa and Chaminade University of Honolulu -
Honolulu, Hawaii (February 10–15, 2016)

Abstract

One of the main priorities of my education is to take what I learn from my university classes and apply it as I build my career in the technical theatre field. By working with professors who themselves keep up with the industry standard, I can become a more marketable technician. Encouragement from professors and my own drive to continue learning as much as I can has motivated me to take courses so as to be well-rounded and knowledgeable as I begin to work in the professional field. Composing and sound designing for "Almost, Maine" was a great opportunity to take the specialized knowledge I had gained and produce a design with a collaborate team. The invitation to present at the Kennedy Center American College Theatre Festival is an incredible opportunity to represent Weber State University and the level of excellence expected from its students. It is also a way to network with others in the western United States – connections that will be vital as I move into the professional realm of theatre. This experience will help prime me for success and contribute to my education at Weber State University.

Petrology of Eocene Rocks of Antimony and Dry Canyons, Southwestern Utah

Ashley Provow | Mentor: Jeff Eaton

National Athletic Trainers' Association 66th Clinical
Symposia and Athletic Training Expo

Eastern Michigan University - St. Louis, Missouri (June 22–27, 2015)

Abstract

*Stratigraphic sections were measured and petrographic samples were analyzed from three stratigraphic units which unconformably overlie deformed Jurassic Carmel Formation. These units were previously mapped as Flagstaff Formation. The lowest unit, A, is approximately 84 m thick, is stained red by iron oxides that transect bedding planes low to midway through the unit, and consists of layers of calcareous sandstones, siltstones, and conglomerates. Sandstones low in the unit contain fine, sub-angular and sub-rounded quartz grains, with calcite cement—contrasting with the calcareous mudstones found higher in the unit. Unit B, approximately 117 m thick, has a conglomerate of varying thickness downcutting into the top of unit A. Unit B includes layers of siltstones, silty carbonates, sandstones, and conglomerates. The sandstones are fine grained, well-sorted, quartz arenites with calcite cement. The contact between unit B (a quartzite conglomerate) and the base of the uppermost unit (C) is often covered by white, sandstone talus. Unit C, of which only the lower 38 m were measured, generally coarsens towards the northwest with layers of sandy limestones, siltstones, and conglomerates. To the south, it is more carbonate-rich and locally contains fossils including the planorbid gastropod *Biomphalaria* sp. and the pluerocerid (?) *Elimia* sp. that are both common in the lower to middle Eocene. The petrology of these units are very different from those of the type area of the Flagstaff Formation but do have lithologic similarities to the lower part of the Claron Formation, which is present approximately 28 km south of Antimony Canyon.*

Stratigraphy of Middle Cenozoic Strata near Hatch, Utah

Kevin Rafferty | Mentor: Jeff Eaton

Geological Society of America - Rocky Mountain Section Meeting
Casper, Wyoming (May 21–24, 2015)

Abstract

Recognition of Cenozoic stratigraphic boundaries and units on the Markagunt Plateau is perplexing, but volcanoclastic strata of both the Eocene Brian Head Formation and the Miocene Limerock Canyon Formation have been identified on the south slope of Hatch Mountain near Hatch, Utah. Although fieldwork has reduced the overall thickness of the Limerock Canyon Formation to 53 m, previous radiometric dates of early Miocene (20 Ma) are likely valid and confirm the presence of the unit. Ages derived from invertebrate and vertebrate micro-sites indicate that the late-middle Eocene Brian Head Formation locally underlies the Limerock Canyon Formation in Limerock Canyon. Petrologic studies have helped constrain the actual stratigraphic boundary between the formations, however the Limerock Canyon Formation sits with an unobvious paraconformity on the Brian Head Formation. Locally, missing volcanic strata of the regionally present Wah-Wah Springs Formation, Isom Formation, and Quichapa Group supports a paraconformable relationship that represents more than 10 million missing years. Positive field identification of the units remains difficult, but the lithostratigraphic boundary is placed at the first appearance of volcanic rock fragments sourced from local and regional units that post-date the Brian Head Formation. The regional extent of the Limerock Canyon Formation is unknown, and has only been identified near Hatch Mountain and adjacent areas. Vertebrate fossils were recovered from the Limerock Canyon Formation, but they were undiagnostic of age.

Damn Yankees: Dramaturgy & the Kennedy Center American College Theatre Festival

Janessa Richardson | Mentor: Catherine Zublin

Kennedy Center American College Theatre Festival

*University of Hawai'i at Manoa and Chaminade University of Honolulu -
Honolulu, Hawaii (February 10–15, 2016)*

Abstract

“Damn Yankees” is the story of Joe Boyd, an avid Senators fan who strikes a deal with the devil in order to lead his team in defeating the Yankees and winning the pennant. However, Joe begins to learn that the fame and success he has gained isn’t worth losing the life that he left behind.

As the dramaturg for the production of “Damn Yankees,” it was my job to work with the production team to ensure that the world established by the playwright was accurately understood by the audience. After reading and analyzing the script and score, I did the necessary historical research on topics covered in the play. I then made packets for the production team as well as the actors to help them better understand the history of the time period.

This project was a great learning experience for me, in which I had the opportunity to collaborate with a team to create a cohesive final project that could be enjoyed by the audience. I was able to learn a lot about the 1950’s, as well as the history of baseball, the legend of Mephistopheles, and many other topics discussed in the play. I learned how to separate and condense my research into what was most important for each individual designer. As a team we were able to bring life to the script, and take the audience on a journey to the 1950’s.

I am very excited to represent Weber State University by presenting my work at the Kennedy Center American College Theatre Festival Region VIII. This grant will provide the funds necessary for travel and for participation in the festival where I will be able to present my work alongside other artists from the western United States and learn from professional artists in various workshops.

Costume Design for Damn Yankees

Katie Rogel | Mentor: Catherine Zublin

Kennedy Center American College Theatre Festival

University of Hawai'i at Manoa and Chaminade University of Honolulu -
Honolulu, Hawaii (February 10–15, 2016)

Abstract

What is the purpose of an education? My purpose for pursuing an education is to take what I learn and be capable to apply it in reality, to make a career out of gained knowledge. That's what I'm doing here at Weber State University, taking things taught or discussed in a class room and making use of it. After taking classes such as Costume Design and Costume Construction and developing my construction skills by working in the on campus costume studio for two years I had developed skills in Costume Design. Because I had taken the classes and expressed interested I was given the opportunity to try my skills out and go out and develop new skills on my own.

Designing the costumes for a main stage show, Damn Yankees was an incredible opportunity to explore my skills and interests. I learned specialized skills, design skills and how to collaborate with a production team to create something to share with the community. I now I want to know how my work and skills I've gained stand up to other designers around the United States. I want to represent Weber State University as a place where students learn can reach their highest level of potential. By taking my work to the Kennedy Center American College Theatre Festival, I can fulfill those goals I've made. Throughout my design process I have learned design and construction skills that are valuable and marketable. In order to reach my full potential with this knowledge I need to be able to present my work. Attending the Kennedy Center American College Theatre Festival will only further my success and education I gain from Weber State University.

Costume Design: Icarus Mother & the Kennedy Center for American College Theatre Festival

Geoffrey Rosenberg | Mentor: Catherine Zublin

Kennedy Center American College Theatre Festival

University of Hawai'i at Manoa and Chaminade University of Honolulu -
Honolulu, Hawaii (February 10–15, 2016)

Abstract

I am excited to be representing Weber State University by presenting my designs at the Kennedy Center American College Theatre Festival. This grant will provide the funds needed for travel and to be a participant in the festival. This will present me with an opportunity to showcase my work with fellow designers from schools all around the western United States and not only learn from their creations as well as participate in workshops.

Assessing Ontological Misconceptions about Depression

Kayla Soelberg | Mentor:Eric Amsel

Convention of the Rocky Mountain Psychology Association
Boise, Idaho (April 8–11, 2015)

Abstract

Students hold preconceived false beliefs or misconceptions. Which can be classified into factual and ontological. Factual misconceptions are due to misinformation or ignorance and are relatively easy to overcome. Ontological misconceptions are based on underlying misunderstandings, which require conceptual change for the misconception to be corrected.

The current study, explores whether students hold ontological misconceptions about depression which they believe to be a mental weakness rather than a mental illness. Introductory psychology students completed the Depression Conceptualization Questionnaire (DCQ), comprising of seven pairs of statements about depression.

Students rate their degree of agreement with, either the scientific view (scored as 7) or the misconception view (scored as 1). Students were also assessed for their dualistic beliefs (DB) and belief that psychology is a science (PAS) beliefs to tap their understanding of the mind as a physical entity that can be studied. We also assessed their stigmas toward depressed people, approach to treatment, and ability to identify depression. Confirming its ontological status, higher DCQ scores correlated with higher PAS scores and lower DB scores. PAS and DB also were negatively correlated. Participants with lower DCQ scores tended to hold stigmatizing attitudes, were mistrustful of treatments, and poorly identified depressed people.

Fiber Composition and Tail Muscle Function in Birds

Kyle Spainhower | Mentor: Ron Meyers

Society for Integrative and Comparative Biology

Portland, Oregon (January 3–7, 2016)

Abstract

*The avian tail is used to facilitate locomotion and perform specific behaviors. For example, woodpeckers use their depressed tail as a prop to increase stability while climbing and drilling on trees. We used immunohistochemistry to quantify fast and slow fiber types in eight tail muscles from five Northern Flickers (*Colaptes auratus*), three Rock Pigeons (*Columba livia*), three Yellow-headed Blackbirds (*X. xanthocephalus*), two Red-winged Blackbirds (*Agelaius phoeniceus*), four Black-billed Magpies (*Pica hudsonia*), and one Western Scrub-Jay (*Aphelocoma californica*) to ascertain a relationship between fiber composition and behavior. Muscle fiber types differ in contraction speed: fast fibers are best suited for dynamic (i.e., locomotor) action while slow fibers are associated with postural functions. *M. levator caudae* (tail elevation) contained fast and slow muscle fibers in all species. *M. depressor caudae* (tail depression) was entirely fast in adult blackbirds, jays, and magpies; in flickers it contained a population of slow fibers. We believe that the slow fiber populations found in *depressor caudae* and *levator caudae* are correlated with distinct behaviors in these species. Birds generally maintain an elevated tail position against gravity implying, a postural function for the slow fibers in *levator caudae* in all species. Woodpeckers rely on their tail for support during climbing and maintain it in a depressed position. Slow fibers in this muscle would facilitate isometric contractions of sustained tail depression associated with this behavior in flickers. Study of additional species of woodpeckers to validate the structure/function relationship is warranted.*

Hidden in this Picture Costume Design

Tia Taylor | Mentor: Cass Morgan

Kennedy Center American College Theatre Festival

University of Hawai'i at Manoa and Chaminade University of Honolulu -
Honolulu, Hawaii (February 10–15, 2016)

Abstract

Furthering my education has always been important to me. Higher education is a way to explore new and wonderful knowledge and opportunities that will open up doors when pursuing interests and career possibilities. The classes I have taken have pushed me to become better student as well more prepared for what life will bring after. I have gained and develop a strong set of skills and knowledge that I can draw upon long after leaving Weber State.

It was a truly wonderful opportunity to work as a costume designer for Hidden in this Pictures. I was able to apply and strengthen skills in design, work as a part of a production team working towards the end goal of creating something to share with the other Weber State students and the surrounding community. It was an invaluable opportunity that has assured me that I am capable of taking on important task and seeing them through to the end. As well as the importance and problem solving and working with others. I now want to be able to share my hard work and dedication in being able to represent Weber State University among other designers at the Kennedy Center American College Theatre Festival. And in doing so I will be able to see this design project to the very end. Attending the Kennedy Center American College Theatre Festival will be a valuable opportunity to present my work and share what I have learned through my dedication to my education as well as to be able to share and represent the education offered here at Weber State University.

Smokey Joe's Cafe: Projection Design

Alex Thedell | Mentor: Catherine Zublin

Kennedy Center American College Theatre Festival

University of Hawai'i at Manoa and Chaminade University of Honolulu -
Honolulu, Hawaii (February 10–15, 2016)

Abstract

Smokey Joe's Cafe is a musical revue that reflects and transports the audience back to the world of the 1950's. It is a collage of moments or vignettes that are set to some of the most popular and memorable music of the 50's. The characters perform numbers in Act I with a more young and neighborhood feel, but as the show progresses to Act II, there is a more adult and city feel to it.

As the projection designer for this production, I was asked to create spectacle, information to the audience, and moments of beauty. The idea that propelled my design for Smokey Joe's Cafe is that the musical is like a photo album that the characters guide the audience through. With each page turn of the album, the audience finds themselves in a new themed memory of a character(s) past life. I accomplished this challenge by finding images of unknown individuals, mostly teenagers and young adults, during happy moments of their lives and projected these images during show numbers like "In the Neighborhood".

However, sometimes storytellers will excite their audience with a little more flair to the story, and that is where I felt projection could reflect that idea. One example was during the number "Trouble", which was themed to fire and ice, I projected onto two screens video backgrounds of fire and ice to give the dance more heat and mystery. From complex green screen filming of video to simple images of post cards from a road trip I feel that this projection design tested my limits and challenged my skills in Multimedia and Theatre Arts.

The Effect of Religiosity on Beliefs about Acceptance of Virtual Immortality

Blake Tubbs | Mentor: Aaron Ashley

Convention of the Rocky Mountain Psychology Association
Boise, Idaho (April 8–11, 2015)

Abstract

Participants responded to a Religious Orientation Scale assessing religiosity and an assortment of evaluated statements regarding technology, medicine, human enhancement, robotics, and virtual immortality. This novel idea of virtual immortality is on the precipice of knowledge, so a novelty bias may be at work in these results, as participants may be unwilling to accept its reality as a function of their lack of knowledge about it. 3 religiosity groups were found, split between high, medium, and low religious devotion/orientation based on the answers participants gave us on the survey. Pre/Posttest design failed to show major time effect for information presented about technology advancement between the two assessments. Differences were observed between religiosity groups and types of statements assessed. A difference was also found between acceptance of normalized technology and virtual immortality as a function of a persons' level of religiosity, as assessed in part by the survey. Utilizing a Likert scale, participants were shown several sets of statements. These statements were then evaluated statistically to find a relationship between them. Statements included information about technology in general, virtual immortality, which is the idea of uploading a consciousness to a super computer, prolonging life indefinitely, as well as statements on robotics, medicinal technology and human enhancement technology. This research aimed to find interaction effects between religious devotion and beliefs about technology, which is what was accomplished. The original design to detect a difference in the pre and post test answers failed to show significance, but conclusions drawn from the research promote ideas for future research as well as give interesting insight to what the interaction means to both the scientific community and religious community.

Nutrient and Demographic Characteristics of Sagebrush Preferentially Foraged on by Pygmy Rabbits

Amber Young | Mentor: Michele Skopec

Ecological Society of America

Baltimore, Maryland (August 9–15, 2015)

Abstract

Background/Question/Methods: The pygmy rabbit (Brachylagus idahoensis), the world's smallest rabbit, has a limited distribution due to its year round dependence on sagebrush (Artemisia tridentata) for food and shelter. As much as 99% of the pygmy rabbit diet consists of sagebrush. With such a specialized diet, obtaining the full spectrum of needed nutrients can be difficult. In this study, we sought to determine whether pygmy rabbit foraging patterns were driven by the nutritional quality of sagebrush. Sagebrush samples were taken from burrow areas at 5-20m in 5m increments. Demographic data (height, major and minor crown) was collected for each sagebrush sampled, and sagebrush were labeled as foraged or non-foraged based on evidence of herbivory by pygmy rabbits. Sagebrush samples were then analyzed for nutrient content using near-infrared spectroscopy for percent dry matter (DM), crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), and total digestible nutrients (TDN). The area of study is on U.S. Bureau of Land Management (BLM) land near Woodruff in northeastern Utah. This study was initiated in winter 2013 and is ongoing.

Results/Conclusions: Pygmy rabbits preferentially foraged on sagebrush that was closer to burrows (5.8+1.4m from burrow for foraged vs 15.8+1.1m from burrows, $p < 0.001$). Foraged sagebrush was 38% taller than non-foraged sagebrush ($p = 0.004$) and provided more than twice the amount of cover ($p = 0.002$). Also, analysis of the protein and the % neutral detergent fiber (NDF) content in relation to the distance from the burrow showed a significant positive correlation between % NDF and distance from the burrow ($R^2 = .4001$, $p = 0.0002$) and a significant negative correlation

between total protein content and distance from the burrow ($R^2=0.1318$, $p=0.04$). Results of the study suggest that proximity and size of sagebrush are important drivers of the foraging patterns of pygmy rabbits. The fact that sagebrush closer to burrows were higher in protein and lower in fiber may indicate that pygmy rabbit burrows promote the growth and nutrient density of sagebrush. Further research is currently underway to determine if the burrowing habits of pygmy rabbits may be increasing the nutrient content of sagebrush in close proximity to burrow sites.

