The McNair Scholars' Journal

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Message from Provost and Vice Chancellor Patricia A. Kleine

At many public comprehensive universities, faculty are primarily expected to teach with little or no expectations for conducting research or engaging in creative activities. This does not, however, describe expectations for faculty at UW-Eau Claire. Since 1988, UW-Eau Claire has been recognized as the University of Wisconsin System's *Center of Excellence for Faculty and Undergraduate Student Research Collaboration*. In 2016, UW-Eau Claire received the National Council on Undergraduate Research's campus award for *Undergraduate Research Accomplishments*. No program exemplifies the institution's commitment to opportunities in undergraduate research for students than UW-Eau Claire's Ronald E. McNair Post-Baccalaureate Achievement Program. Because of the high academic quality of students' studies, McNair scholars have been named Fulbright, Goldwater, and Rhodes Scholars.

This journal presents the culmination of two years of students working with their faculty mentors on critical questions in their disciplines and preparing their research for professional publication and presentation.

To the students, congratulations on the completion of your research projects and best wishes for continued success in graduate school.

To my faculty colleagues, thank you for mentoring these remarkable students so well. I continue to celebrate your exceptional commitment to student success.

To the reader, I hope you enjoy reviewing this journal and the wealth and breadth of research within it.

Patricia A. Kleine
Provost and Vice Chancellor for Academic Affairs
September 24, 2018

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- Dr. Jeffrey Janot, Professor, Kinesiology
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- Dr. Melissa Bonstead – Bruns, Professor, Sociology and Women's Studies
- Ph. D. David Lewis, Professor, Chemistry
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Sensorflow: Learning Through Motion

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Abstract—Learning the grammar and syntax of a new language has always proven to be challenging for most students taking courses through a traditional classroom or by autodidacticism. This has lead to these scholars feeling a sense of boredom and disconnection from their learning process which leads to putting their attention on other subjects whether it relates to their learning or some other inquiry. In the unique case of self-learning students, they can only rely on learning from dictionaries, books that have repetitive tasks in order to memorize sentence structure and grammar, or software that regurgitates the same sentences until the scholar remembers the exact sentence being taught. With today's advancements in technology with a plethora of sectors like the medical, retail, and business fields, there aren't that many innovations within the education system. Using internet-connected devices and new subjects like machine learning, there are opportunities to implement unique ways to engage students in classrooms and add some physical component into their learning that would allow them to acquire new knowledge that is applicable in real-life situations; thus, making a connection between the student and the real-world that would be retained for the future to come.

I. Introduction

There are many different ways to teach a language to a scholar, but with the advancements in today's technology, we haven't taken full advantage of innovative ways into integrating these resources in learning. With a new language, scholars have two main environments in which they participate while learning:

- In an institution where mentors are set up to aid and teach the different grammar and syntax rules of a languages.
- On their own time at a place where the student feels comfortable learning the different syntactic properties of a language through a medium like an online course or a book.

But as these are popular among current scholars, it is difficult to keep the student's interest towards the material being taught as there are minimal to no connections with real-life examples where they can make associations with the new knowledge and the outside world. [1] In order to migitate the problem, games have been used as a middleman between the student and the knowledge being learned in order to let the students create new experiences with hypothetical situations created in the game. [2] This along with the concept of game theory has been used to enhance the scholar's learning process, but there is a greater potential in using the classroom and technology available today. Using devices that are IoT (Internet of Things) related like your mobile device could prove to supplement learning in a classroom or a setting created by students of all types: especially autodidacts. [3] There is research being performed where machines simulates the process of learning by using different mathematical functions and data to identify similarities or patterns discovered in the dataset given called Machine Learning. [4] It is common for IoT devices to have sensors that can communicate with its environment. Using a smart phone as the intermediary between the students and their learning experience, these devices include sensors that can detect motion. They can play a major role with our research idea in being able to simulate writing a letter on paper, but using gestures and the mobile device in order to record the letter being drawn by the user. This would take many years in order to achieve such concept where each letter of an alphabet would be recorded and a general average would need to be extracted from the letter. But with Machine Learning, we can take the arduous tasks and assign it to a machine while anyone who wants to use the application created in the project can put their attention on other important aspects.

In this paper, we will give a quick synopsis of what Machine Learning is and a deeper look into the development of this research project. Later, it will go into the actual results and what occurred during the process of creating the software. Lastly, we will talk about possible improvements in the future and the next steps with the project. The overall goal of this paper is to set up the future of this project to being implemented within classrooms in hopes of making a greater impact with students and their engagement in classrooms as well as motivation to keep on educating themselves anywhere.

II. Overview of Machine Learning and the Project

A. Machine Learning

In the book written by Murphy (2012) [5], he states that people in the field define machine learning as a multitude of methods that can automate detecting patterns discovered in data to later use those new discoveries for future predictions or other kinds of decision-making under a level of certainty. Basically, machine learning takes in a dataset given by the user which discovers unknown patterns due to the relationship from one data point to the other.

There are a variety of different types of machine learning algorithms that can simulate learning, but this paper will focus on supervised learning. Supervised learning is where the developer gives an input (usually the dataset) and the mapping from the inputs to the outputs (a certain label that defines the unique inputs). In other words, the goal of the machine learning algorithm is to learn what a particular instance of some input looks like. [5] Some examples where supervised learning excels in are predictive tasks where the algorithm abstracts unique identifiers from the dataset and puts the similar data into their own category or bucket. Specifically, one of the algorithms used in order to perform supervised learning is a model named a neural network.

A neural network can be summed up as a bunch of interconnected values, called neurons, which are activated when there is a close approximation to the data being passed as an input. [6] These neurons are aligned in a group to find other types of featuresunique values that define a certain abstraction of the datain order to combine the newfound discoveries called a layer. It is then given to the next layer which is connected to the neurons from the previous layer. This allows for the neural network to create higher abstractions from the dataset with the end goal being to reach a higher level of confidence in giving a label to a specific instance of the cluster of datapoints given. Some good examples of this process is image classification, where the data given to the neural network is a multitude of pictures of different categories (like dogs, cats, trees, flowers, etc) and the outputs are the specific labels for each picture in the dataset (the category itself).

How it identifies the differences between each pixel is by the unique shapes of a picture that depict it. In terms of images, pixels (a form of measurement for a color dot on an image) near each other have a stronger relationship than pixels that are far away. The neural network takes this and learns what simple line strokes (lines and curves) look like. Later on, this knowledge is used as input for the next layer and creates a higher abstraction of what is sees until it arrives at the end of the network where it uses its knowledge and predicts what type of picture it saw. This is iterated multiple times with different kinds of pictures from the dataset and adjusted whenever the network identifies the image incorrectly through backpropagation. [7] After the network is done training, it usually performs the whole process again where the images are randomized in order to eliminate the network learning the order versus the label of the image. One of the benefits in using machine learning models like the one explained above is how you can use the same software, but with a different dataset with labels which eliminates any redundancies between similar problems. Our project is similar to image classification, but instead of giving the network pictures, we give it a set of sensor data collected from the letter drawn and the label of the letter.

B. Sensorflow

The way this project obtains the sensor data is through a mobile application, which records data given from the sensors after a certain amount of time. This can be edited in the source code, by manipulating the number of times the application looks at what data is being generated from the sensor at a specific timeframe (e.g. once every 5 milliseconds). The sensor data that the project stores is related to the accelerometer, gyroscope, and magnetometer sensors. These sensors are important to keep a record at a specific time because we can simulate ”writing” where the accelerometer acts stores the changes in the vertical space and the gyroscope stores the horizontal space. In other words, as a user moves their device, the application is storing the movement at an interval, and it combines this data in order to get a visualization of what shape was drawn in a 2D-space. The magnetometer takes the depth space into account, where it can start to learn 3D shapes like spheres or cubes.

After the user creates a letter, they store the label of the letter and the sensor data to a nonrelational database through Amazon’s AWS services. What is meant by a nonrelational database is a type of storage place where data can be stored without having to have any sort of structure inside the depository that is scalable and useful for large datasets. [8] This data is then downloaded locally into a iPython Notebook, which is an interactive environment where code can be executed and displayed in blocks using the Python programming language. The project uses a framework that eases defining how the neural network operates and outputs its answer combined with iPython–Tensorflow. Tensorflow is one of the most popular frameworks currently being used in the machine learning community. The benefits of using Tensorflow as opposed to a ”plug-and-play” library like Keras is to have more control on the model’s efficiency and efficacy.

Lastly, in the iPython Notebook, it uses a model that has been trained to identify the letters using sensor data and makes a prediction according to what was most similar with previous examples. The hope for the future of this project is to be able to deploy the model into the smartphones in order to do all of the predictions inside the application without the need for an iPython Notebook. This way, the application can be used by other people, and more research can be done dealing with optimizations and comparisons with other Machine Learning models like Long-Term-Short-Memory models or Convolutional Neural Networks. In the next part of this paper, we will dive into what progress has currently been made with the project and the results it produced with predicting the letters drawn.

III. Progress of Sensorflow

A. The Application

In order to use the concept of a machine learning model being able to predict letters, we needed a medium where it could gather data and send it to a database in the cloud once the application retrieved everything it required. So, we used the most popular mobile platforms (iOS and Android) to create an application where it would allow the user to log in to the application locally, and store their unique information concerning how they draw letters in the session and send

the data once the user is done recording it (See Fig. 1 for the main screen). The reason why we have different sessions for different users is the idea that not everyone has the same handwritting and gestures. Person A's letter "Z" will be different to person B's letter "Z" because of how they learned to write, which hand they use, and whether they have a steady or shaky hand. After the user closes the application, it will save any data about their specific writing style, amount of letters sent to the database, and other preferences so that when they reopen the application and log in, their previous session will persist.

Fig. 1. Sensorflow's Main Menu where a user can log in and store their session. (iOS version)

When a user logs into the application, it currently brings them to the recording screen where they can type the letter that will be drawn in order to record and gather data for future training. In this screen (See Fig. 2a), it displays the number of times the user has created a letter at the top as a counter in order to remind the user of their current number of posted sensors to the database. The user can reset this counter if they need, so it can prove useful for a person that is keeping track of how many instances of a letter was submitted to the database before starting to post a new letter. At the bottom are three groups that display the current X, Y, and Z values for each sensor. Below, we will explain why the sensors are separated into these categories:

Accelerometer

1) X Value - This axis displays the acceleration in the x-axis; When the device is twisted, it reports that change depending on the direction on how it's twisted.
2) Y Value - This axis displays the acceleration in the y-axis; The axis is changed when the device get tilted backwards or forwards.
3) Z Value - This axis displays the acceleration in the z-axis; The z-axis with accelerometer determines the change in the vertical space.

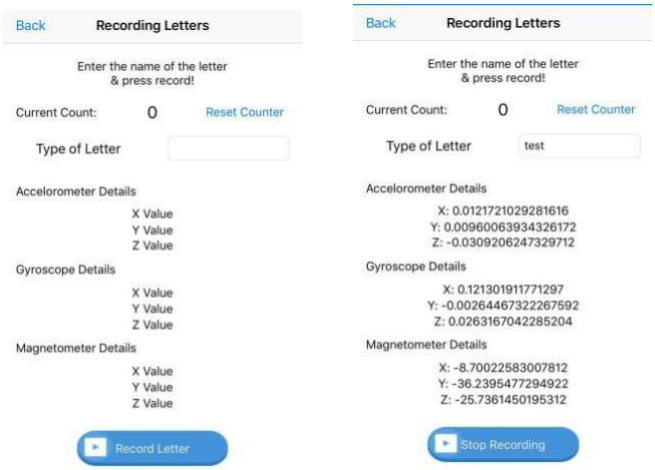
Gyroscope

1) X Value - This axis displays the spin in the x-axis.
2) Y Value - This axis displays the spin in the y-axis.
3) Z Value - This axis displays the spin in the z-axis.

All of the axes related to the gyroscope deals with the spin of the device, so it can sense the rotation. This is useful in determining what the orientation of the device is, and in the project, figuring out a spatial area where the application can determine the position and movement of the device in order to simulate writing in the air.

Magnetometer

1) X Value - This axis displays the displacement in the x-axis; It represents the strength of the magnetic field roughly to the direction of the North Magnetic Pole.
2) Y Value - This axis displays the displacement in the y-axis; The y-axis in a gyroscope is similar to the x-axis, but it looks 90 degrees from the north.
3) Z Value - This axis displays the displacement in the z-axis; For a gyroscope, this is the most interesting one, where it gives the magnetic field strength where it points vertically down.



(a) App Before Recording (b) App During Recording

Fig. 2. The recording page displaying both states when user (has/has not) pressed the record button.

At the bottom of the screen is a button that indicates the user to press on it in order to start the recording process of a letter. Once this action is performed, it will give the user three seconds to prepare for the writing process, and then the x, y, and z values of each group in the page start updating with real values from each sensor (See Fig. 2b). The message in the button transforms to indicate that the user can press on it again to stop the recording. These axes updates can happen according to what the developer wants, but it is more for the user to look at if they are curious as to what kind of values are being produced while drawing the letter. When the user is done writing the letter, the application prompts the user to choose whether they desire uploading the letter to the database. After

they made their decision, it displays a method whether it was successful in uploading the letter to the database according to what the user decided and any potential networking issues.

B. Results

The model was successful in predicting values with an accuracy level of 90%. The model used in order to get these results was a Densely Neural Network with four hidden units. Each hidden layer has 120 neurons, 60 neurons, 30 neurons, and 15 neurons in that order. The number of classes in our example was six, and to prove that this can be used with any alphabet, we made our own alphabet with labels. There were 120 feature columns that were taken as inputs (30 instances of each axis in each sensor). The reason for taking this many features is to see if the neural network could learn from each input and optimize the network depending on where the user is according to the time it took them to draw a letter. Each feature is divided into 30 units from the whole time it took them to draw the letter in order to not make it computationally intensive, but at the same time having sufficient data in order to classify a letter.

We checked if there was any overfitting, and there was a 10% margin. This displays that the data is still generalizing to new data, so it can still work with other individuals who use the application, but there is some room for improvement where dropout could prove to be beneficial in this case to reduce the overfit. Also, the 90% accuracy isn't the best according to the standards with machine learning and classification (aout 95%), but the whole reason for this project is to demonstrate the possibility of using machine learning in things like learning to stimulate new research in the education system with the technology available today.

IV. Conclusion and Future Work

The end to the project is not near yet, as we still have the analysis part of it where we can set apart the precursor to formatting the data into the Machine Learning models for image prediction. In this case, we are not sending pictures as the data, but sensors with an X, Y, and Z axes which will apply the same concepts of a Convolutional Neural Network and let it learn what a letter looks like. We are currently in the analysis part and soon, in the testing phase where we can start to test the application with real-world users and learn on what we can improve to have a more reliable model which can predict letters at a higher accuracy level while still being general for anyone to use. Once we get to the testing, we plan to look at the data that is available and look at the differences and similarities between other letters to find if its viable to use Convolutional Neural Networks for optical character recognition. Some future projects that could stem out of this project is testing different machine learning models like a Recurrent Neural Network where the network remembers what is saw previously and stores it into memory to more accurately predict letters or use a different optimization algorithm like Adam or Stochastic Gradient Descent which use the same concept of trying to minimize the error of the model predicting a set of letters, but using exponential decay in order to have a more stable learning process where the model converges the error to the minimal error for a particular letter. I would like to thank the Office of Research and Sponsered Programs for giving me the opportunity to work on this project during the summer and the McNair Postbaccalaureate Achievement Program for supporting me in the preparation of gradudate school with research experience and mentoring. I would also like to thank my research mentor, Dr. Chris Johnson, who was able to offer insightful ideas throughout the research project and mentoring me with this research project

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Effect of Two Equipment Load Bearing Strategies on Low Back Discomfort in On-Duty Police Officers

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Abstract

The main purpose of this study is to determine whether using a load bearing police officer vest while on duty is more effective at decreasing low back discomfort compared to the standard police belt. A second purpose of this study is to create a current biometric profile of active duty officers in the Eau Claire area in order to determine health status for an occupation such as this. A third purpose of this study is to draw comparisons between biometric screening data and physical activity/sedentary behavior of active duty police officers to discover relationships between these variables. Lastly, a fourth purpose is to use biometric screening data to determine any underlying issues or causes related to any patterns of discomfort that favor one load bearing device over the other. A sample of 15 officers from the Eau Claire Police Department will be recruited to answer these questions. They will wear the standard belt for the first three months of the study and the vest for the last three months of the study, totaling a six-month time period. At the end of each shift, the officers will self-report/self-record any discomfort and rate the level of any low back discomfort using a visual-analog scale (administered to each officer at the start of the study to keep). The paper reports will be picked up at the end of each week at the police department and new sheets will be dropped off in exchange. Additionally, a small activity monitoring device (accelerometer) will be worn by each officer during their work shift for a 1-week period to determine the level of activity/sedentary time spent while on duty.

In addition to the study above, biometric testing will be done on an additional 15 police officers in order to increase the population size in order to create a clearer picture of the biometric profiles of active duty police officers. A variety of tests will be completed to analyze the individual fitness status of officers. A DXA scan will be used to take the body composition of the officers. Flexibility will be tested with the double inclinometers technique, specifically measuring spinal mobility, and core endurance will be tested with various static abdominal assessments. Aerobic fitness will be tested with a submaximal treadmill jogging (TMJ) test. In this test, officers will walk the first three minutes then jog at a self-selected speed of 4.3-7.5 mph until they have achieved a steady-state heart rate. An upper body endurance (push-ups) test will be administered in addition to a lower body strength test using leg press machine.

To our knowledge, there is no research done on whether an officer wearing a vest is less prone to low back discomfort than an officer wearing a belt. Underlying factors such as fitness status and lifestyle may be at fault for the low back discomfort or issues that are experienced. Gaining insight on officers' health and equipment will help determine whether the Eau Claire Police Department should invest in the vests or possibly implement any further measures to prevent work related low back problems.

Introduction

Low back discomfort is any chronic or acute pain of the lumbosacral, buttock, or upper leg region of the body[1]. It is a very common and reoccurring disability among individuals in the world today, with 70% of adults experiencing the disability at any point in their lifetime[1]. According to the Global Burden of Disease[2], low back pain has a global disability rank of 1 out of 291 other conditions mentioned. In 2010, low back pain was also ranked as the 6th highest burden out of 291 conditions, compared to its ranking of 105 out of 136 conditions six years prior. These rankings exemplify the prevalence and severity of the disability among individuals all around the world.

There is no single, underlying cause for low back pain. A variety of factors can play a role in the development of the pain. Occupational factors, or what one's job entails, can lead to low back pain, such as heavy lifting and sitting for prolonged periods of time[1]. Non-occupational related factors could also play a role in low back pain, such as age, physical fitness, lumbar mobility, strength, medical history, and anthropometric measures like BMI[1]. Some other potential causes can be psychosocial factors and poor posture, lack of exercise, and being overweight[3].

When it comes to the workplace, low back pain is the most common cause of job-related disability and missed work days[4]. There are a few different factors that contribute to LBP in the workplace[1]. One is any heavy, physical work. This type of work requires high energy demands and strength, which some individuals do not have. Lifting and forceful movements like moving something from a lower level to a higher level may also be a factor contributing to LBP in the work place. Excessive bending and twisting like flexion of the trunk, usually in the forward/lateral direction, trunk rotation/torsion, awkward postures like kneeling/squatting/stooping could all contribute to LBP. The final factor that may contribute to LBP in the workplace is whole body vibrations, which are mechanical energy oscillations that are transferred to the body as a whole. According to Webster and Snook, 33% of total insurance claims are LBP related and 16% of worker's claims are LBP related[5]. A large amount of money is being used because of employees experiencing LBP.

In the Eau Claire area, police officers are going to doctors and expressing the pain they are experiencing from their job. Doctors believe it is a cause of the standard, load bearing utility belt the officer wear around their waist and should switch to wearing a loadbearing vest on the upper part of the officer's body. To our knowledge, there has been no research done on whether a load bearing vest would cause less pain than the standard belt, which led to the purpose of the current study. An investigation is being done on whether a load bearing belt or load bearing vest causes less or more pain compared to the other method. The study also looks at the biometric profiles

and physical activity time of Eau Claire police officers to determine if there are any possible underlying causes/contributors to any low back discomfort experienced.

Methods

Participants:

An experimental group of 15 active duty officers from the Eau Claire Police Department are participating in the current study. There are 13 male officers and 2 female officers, all ranging in a variety of work shifts.

Instrumentation:

A variety of tests were used to develop a biometric profile of the officers. The GE Healthcare Lunar Prodigy, a dual-energy x-ray absorptiometry (DXA), was used to measure bone mineral density, total body mass, fat, and lean tissue mass, as well as specific areas of distribution of body composition. The GE Healthcare Lunar Prodigy DXA has a very high degree of precision and accuracy[6]. Individuals were told to lay on the bed of the DXA scanner and remain still as the arm of the machine scanned over their body. The process is very efficient, only taking a maximum of 10 to 15 minutes. With this information, a thorough evaluation was made to help determine the biometrical makeup of each officer.

Various anthropometric tests were performed to develop an even more in-depth profile of each officer. Blood pressure was measured using a sphygmomanometer, a blood pressure cuff, and a stethoscope. Abdominal circumference was taken at the level of the belly button with a standard tape measure. Blood lipids, cholesterol, and glucose were all measured through the use of a blood analyzer. A small sample of blood from a prick in an officers' finger was inserted into a cassette tape and put into the analyzer to be read. Each officer also performed the single stage treadmill jogging (TMJ) test to predict their VO_2max. The officer selected a pace between 4.3 to 7.5mph where they were comfortably jogging, and jogged for 3 minutes at that speed. HR must be monitored to make sure it does not exceed 180bpm. Values for weight, speed, and HR were all plugged into an equation specific to the TMJ test to calculate their VO_2max. The TMJ test provided an accurate predicted VO_2max and was a great alternative to doing an actual maximal exercise test[7].

To measure some low back functionality, a spinal flexibility test was performed. The double inclinometer technique was used to measure the range of motion (ROM) in the lumbar spine. During one set of measurements, one inclinometer was placed on the spinous process of the T12 and a second inclinometer was placed on the spinous process of the S1. Officers, unequipped, were then instructed to bend over as far as they could without bending their legs. During the second set of measurements, officers put their load-bearing vest on and an inclinometer was placed on the C7 spinous process and that S2 spinous process. These sites were used due to the lack of ability to get placement on the T12 and S1 when the officers put their vest on. These same sites were used for the officers to do another round of bending over,

but without the vest on. These measurements allow a simple comparison of ROM and whether the vest would restrict them or not. The last test used associated with LBP, is McGill's torso muscular endurance test. This test consisted of three different core tests that assessed core strength, which is a key predictor of potential LBP[8]. A flexor, extensor, and side bridge test were all performed by each officer. Officers were instructed to hold each isometric position for as long as possible. The ratio of this number resulted in whether one is at high risk of CAD or lower risk.

To track activity time, the Activpal and Actigraph activity monitors were used by officers for a timespan of seven days. The Activpal was placed on the mid-thigh and tracked specific postures of the officers. It specified time spent sitting, standing, and moving. The Actigraph was worn around the wrist and tracks time spent being sedentary versus active. Each officer was given a log sheet where they would write down the time that they started and ended wearing the monitors each day. There was also a portion where they could write down if they took it off for a period of time, for reasons such as showers or very vigorous exercise. The officers would wear each device for seven days, including during their work shift, and would take them off when they went to sleep.

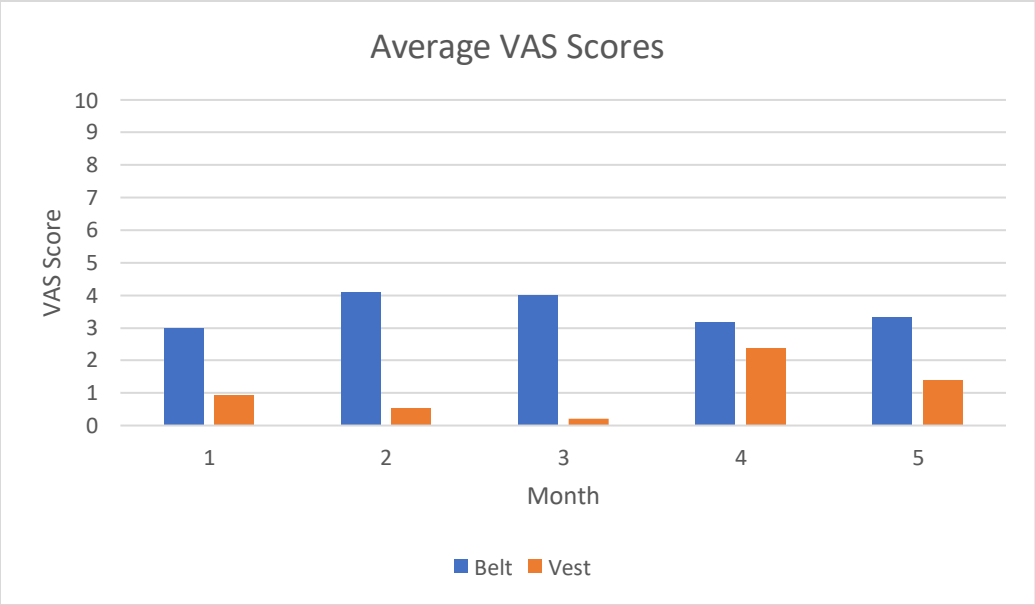
Data for the Vest-Belt portion of the study was collected using a self-report Visual Analog Scale (VAS) survey. Officers used the VAS to rank any pain they experienced immediately following their shift on a scale of 0 (no pain) to 10 (severe pain). The Oswestry Low Back Pain Disability Questionnaire was also distributed to measure an individual's functional disability. This test is the "gold standard" of determining low back dysfunction[9].

Study Design:

One portion of the study is looking at the vest and belt issue. For the first three months, half of the officers wore the load bearing belt while the other half wore the load bearing vest. Once the first three months are over, the officers in each group switched to the other form of equipment they weren't wearing for the first half. To determine functional disability with activities of daily living, an Oswestry Low Back Pain Disability Form was filled out by each officer at the very beginning of the study and at the end of each month. A visual analog scale was given to the officers to fill out right away after their shifts to determine any pain they are experiencing.

Another part of the study involved biometric profiling and physical activity monitoring. Each officer underwent activity monitoring for a week time period, wearing an Activpal leg monitor and Actigraph wrist monitor. Each day, the officers filled out a log form citing when they put the device on and off and indicated their shift times. Blood pressure, blood cholesterol/glucose, and abdominal circumference were all used to establish biometric data. A DXA scan was performed on each officer to get a specific reading of their body fat and density percents, as well as their distributions. George's treadmill jog test was used to find aerobic fitness, McGill's test was used to test core endurance, and the double inclinometer technique was used to measure back flexibility. Each of these variables were tested to develop an overall biometric profile for each officer, to see if there was any relation to LBP.

Results



VAS Scores after 5 months

The scores on the Oswestry low back pain disability forms remained relatively consistent throughout the process, and each officer remained at minimal disability.

Discussion

The main purpose of this study was to determine whether the loadbearing vest would cause more or less low back discomfort compared to the standard utility belt in on on-duty police officers. A second purpose was to develop a biometric profile of each officer, as well as track their time spent being active versus sedentary. The study is still in progress at the moment, so there are no final conclusions to make yet. However, there has been a distinct difference in which load-bearing mechanism causes less pain. After analyzing VAS surveys up to this point, there has been a continuous trend of significantly lower VAS pain scores for officers wearing the vest as opposed to those wearing the utility belt.

A similar vest-belt study was done in Sweden, looking at the effects of the two loadbearing types on gait[10]. They found that the vest was associated with a small reduction in range of motion at the trunk, pelvis and hip, but as time progressed, officers adapted to wearing the vest and regained normal range of motion. The study distributed surveys to their officers to fill out, and also found that the majority of the officers were more comfortable wearing the vest, compared to the belt. The officers wearing the vest also reported less low back pain compared to those wearing the belt. Despite these preferences in the Swedish study, they concluded that body size is a big factor on which equipment strategy is best, for some officers preferred to not wear the vest. A study done in Australia looked at the level of discomfort while sitting in a squad car, wearing either a load bearing vest or a belt[11]. They also found that the belt resulted in greater discomfort than the vest while sitting in their squad car. This data is very similar to the officers that participated in the current study and came as no surprise.

Conclusion

The study is still in progress, so we are not able to conclude anything at the current time. From the results seen so far, it is predicted that the lower VAS scores will continue in the vest group compared to the belt group. It is also believed that sedentary time will be higher in the officers compared to activity time.

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How the Perceptions of African American Males Affect the Educational Achievement at a Predominately White Campus

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Abstract

African Americans' participation in higher education has experienced growth, but the achievement gap between the White majority and African American populations persists. This research will bring attention to the underperformance of African American university students by providing an overview of the dominant cultural, learning, and communication styles practiced at predominately White universities. By not drawing from a diversity of perspectives and communication styles, professors may be unintentionally setting some students up for frustration and potential failure. The premise of this research builds on the notion that unsuccessful transmission of dialect (e.g., language) is a significant factor limiting the success of African American students. To reduce the achievement gap and retain African American students, we argue that universities must train faculty and staff to articulate the purposes of education, the benefits of diversity, and the need for cultural competence. With successful practices from the university, the task will become more natural as the minority student population increases.

Question

What is it about the campus climate that makes it hard for an African American male to succeed?

Literature review

In recent years, many studies have been conducted concerning the disparity among students in regards to academic achievement. Many theories have presented on the topic of the

perception-to-achievement relationship. Among these are the Self Determination Theory and the Human Ecological Theory. Both of these theories investigate perception and how it relates to goal achievement. The two approaches were chosen after extensive research in the area of academic achievement and through the experiences as an African American male at a Predominately White Institution (PWI). When we looked at academic achievement, we looked at two theories: Self Determination Theory and the Human Ecological Theory.

Self Determination Theory

Self-determination stems from the satisfaction of one's merit (i.e., valued goals, quality). Being that academic achievement is extremely exclusive, the self-concept of achievement varies amongst students, which makes academic success and goal setting more significant. Self-concept of achievement significantly influences a student's motivation, engagement, and ultimately achievement for personal attributions (Haywood, et. Al., 2008). However, these practical perceptions are not influenced by mistakes, but rather by the choices an individual innately makes through a range of external factors. We examined the motivation of the participants with the question(s) such as, what's their drive? What's their purpose of pursuing an education?

These questions measured their internal motivating factors. In contrast, we also asked questions that measured their external motivating factors by examining their intangible purposes. We asked the participants what external connections are these students using to fulfill these goals? (i.e., hang out on the weekend, football). Research indicates that student achievement has been examined from two different components to satisfy one's psychosocial needs: intrinsic motivation and extrinsic motivation (Haywood, Kuespert, Madecky, & Nor 2008). Intrinsic motivation attributes to one's eagerness to learn, solely for its gratification of academic achievement (Linnenbrink & Pintrich, 2002). For example, students shouldn't overexert their abilities to achieve a goal; instead, they should be confident in their approach. Extrinsic motivation, moreover, attributes to engagement for intangible purposes related to achievement. For instance, a student performs at maximum potential to attend a conference or sporting event. Consequently, this study explores how a student's achievement (e.g., behavior, attendance, or grades) are influenced by their desire to fulfill his or her goals once they have successfully made the connection between the ability to accomplish those goals and the education process. This study also explores how students articulate motivation in the context of whether students were externally or intrinsically motivated or whether students exhibit a combination of both.

Human Ecological Theory

Research has shown that academic progress is significantly bleak, while the number or underrepresented students persist (Bubolz & Sontag, 1993). The human ecological theory evaluates one's environment and its impact on academic achievement. Factors that have directly impacted academic performance in students have identified as (a) social; (b) physical; and (c) biological factors. These factors could be seen as protective measures of border life events that influence the student motivation. Specifically, these three factors explored the environment of the home and school that provided many opportunities for practical application regarding academic achievement and motivation. Similarly, most of the student interview questions

inquired about students' values and beliefs on education, whether education emphasized in the home in any way, and whether this emphasis or lack thereof serves as a driving force in the students' motivation to engage in the academic process.

It is essential to recognize the similarities and the differences that occur in the creation and the function of the individual on-campus and off-campus. This notion was critical to explore the similarities and the different perceptional and achievement outcomes that occur at home versus in the school environment. It may provide valuable information about the factors that affect student motivation and success. In short, we look at the Human Ecological Theory in which we examine the environment and hope that may significantly influence the attitudes and practices of academic achievement. The impactful factors that affect academic performance include social, physical, and biological (i.e., hereditary) considerations. The perception of the environment in which students engage may significantly influence the attitudes and practices of achievement. For example, what are the similarities and differences that occur in the creation and the function of an individual on- and off-campus? We asked a list of various open-ended questions as follows: What inspired your decision to attend college? Do you feel the university provides the resources you need to achieve your academic success? Explain what you think faculty and staff can do to help African American male students realize their academic potential? What type of things may hinder African American male students from achieving academic success on this campus? Do you think race has been a factor affecting your ability to learn in the classroom at UWEC? What should successful educational outcomes for an African American male look like at UWEC? Another critical issue that has played a significant role in academic achievement for African American males is the different learning environments, whether it's at home, in the neighborhood, or at school.

For example, motivation may be hard to come by with no positive examples of how to obtain success. It is important because these students are coming from neighborhoods where their safety threatened on a daily basis. The lack of adequate resources puts them in the situation where aspirations are not merely as important as survival. On another note, students who come from more affluent communities are more likely to not only achieve but rather emulate success due to having prior examples of successful figures and adequate resources (i.e., structured home, funded school programs, community resources, etc.).

The Human Ecological Theory can contribute to learning outcomes of the faculty, staff, and students to maintain the high expectations for achievement and behavior that embraces inclusivity at a "high achieving" institution. The theory takes all aspects of the human environment into consideration and analyses the interactions of humans with their environments. Often a student's background plays a vital role in their development; whether it be socially, physically, or even biologically. Again, these elements are explored through the Human Ecological Theory; however, it could be used to explain why underrepresented students fail academically in comparison to their more privileged peers.

For example, prior sections attest that students with lower socioeconomic backgrounds do not perform as well as their more affluent peers. This phenomenon can attribute to the fact that students from lower income families have to struggle with daily challenges that wealthy children

do not face (i.e., emotional and social difficulties, health and safety issues, and other stressors). Cognitively they've adapted to conditions in a way that undermines achievement and thus makes academic achievement even more of challenge (Jensen, 2013). Most realities don't make educational attainment impossible, but it is critical that faculty, staff, and students understand the facts affecting students who are low-income as well as the circumstances affecting other underrepresented students to make academic success a possibility (Jensen, 2013).

Using the Human Ecological Theory as a foundation, and providing faculty, staff, and student's education on cultural relevancy, would make it possible to educate at high levels in spite of their varied backgrounds. In fact, research suggests that it is possible for schools to take action in offsetting the detrimental effects of achievement for underrepresented students (Hanushek, 2005). We have to accept the concept that students, better yet human beings, can resist submission to cultural patterns, demographic trends, environmental pressures, and constraints. Some institutions have already managed to do so, providing evidence that the possibility of change exists. Behavioral patterns such as these could be vital to altering the direction of negative trends and increase the academic outcomes for underrepresented students (Freire, 1972).

Additionally, the influence of perceptions on academic achievement has been examined along with the self-determination and human ecological theory. Perceptions play a vital role in student's attitudes and performance (Zimmerman, 1994). Perceptions of student engagement and achievement cannot underestimate. For example, students can't possibly buy in to a system that doesn't compensate their abilities or have faith that the students could excel in an educational setting. Therefore, students are less likely to engage in fruitful academic practices, whether at home or school. In turn, students who know what they want out of life seem to be motivated or more likely to participate in successful academic practices at home or school. This study provided a dimension for understanding the students' perceptions that influence their belief about and ability to engage in fruitful educational practices.

Have you experienced racial bias or stereotypes in the classroom? The perceptions of the African American male student can adversely affect their self-esteem and belief in their academic abilities, resulting in academic disengagement, or even worse, academic failure. Institutions must seek reforms to raise student expectations if institutions wish to deplete the dilemma that's plaguing underrepresented students, who come from lower socioeconomic urban settings. "If this is a dilemma for African-American schoolchildren, particularly if they experience discrimination in both school and society without the benefit of environments or institutions offering rituals, practices, and orientations that are intentionally organized to develop and sustain effort optimism" (Young Gifted and Black, 2003, pg.77; Obgu (1983)).

Hypothesis

Throughout the development of our research project, we were able to form two hypotheses: Theoretical Hypothesis and Operationalized Hypothesis. The theoretical prediction states that the more African American male students can adjust to external motivating factors (such as climate), the more they can sustain internal motivating factors (such as purpose or

personal goals). Whereas the Operationalized Hypothesis examines the statement that African American male students who feel more engaged across campus are more likely to persist at the University and adapt to the college climate without losing their purpose.

Method

Initially, we wanted to conduct one-on-one interviews and focus groups to provide depth and meaning to our research by providing participants with opened questions. However, we utilized a qualitative approach where we collected data through an online Qualtrics survey raising questions that were both qualitative and quantitative. Due to the lack of funds and time to transcribe all of the data, the distribution of the Qualtrics survey was readily accessible. In turn, we thought that the survey would give us the same information. Friere (1972) advocates that flexibility to adapt to current research to incorporate new report provides an in-depth of understanding of socialization of academic achievement for underrepresented groups (i.e., African American males). In conjunction, Freire (1972) claims it's understanding the institutional context on socialization that has a significant impact for underrepresented (i.e., African American males) college students (Hanushek, 2005; Jensen, 2013).

The participants consisted of 13 African American male students who study or studied at the UW-Eau Claire. Participants ranged in the age of 19 – 21 years or older. Examples of qualitative questions: How would you define academic success? What type of things may hinder African American male students from achieving academic success on this campus? Another set of questions were quantitative: Do you think race has been a factor affecting your ability to learn in the classroom at UWEC? Have you experienced racial bias and stereotypes in the class? Based on the data and responses gathered from a pilot study, the questionnaire was edited. We distributed the survey in the spring of 2017 to all UW-Eau Claire students who identified as potential participants. Strategies to increase response rate included initial notification message and numerous follow up notes.

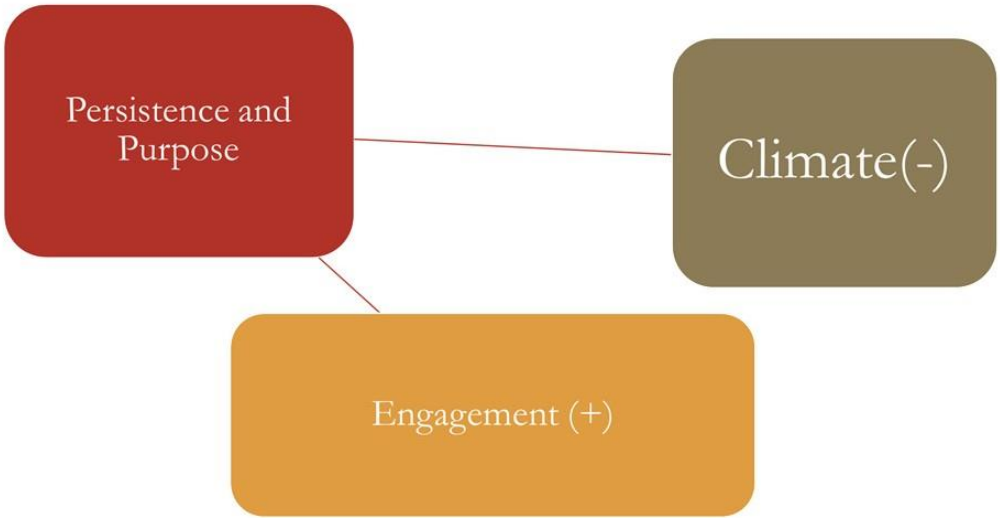
The sample size as the UW-Eau Claire students had to possess the characteristic of 13 African descent at a predominately white institution. The sample didn't include UW-Eau Claire students who had graduated or non-UW-Eau Claire students. The research was approved by the UW-Eau Claire Institutional Review Board for the Protection of Human Subjects. The participants, who provided information with consent, were informed that the information shared within the survey would not link to their names, responses would be anonymous, and search engine protocol addresses would be removed from the dataset. Descriptions and narratives were used in this study to provide in-depth information about the socialization experiences of underrepresented (i.e., African American) college students (Hilliard III, Perry, Steele, 2003). Responses were systematically and independently content analyzed by each researcher and coded into relational categories. The open-ended data were further analyzed and organized, which allows users to classify, sort and arrange information, find meaning in unstructured data, uncover trends and examine relationships, and create visualizations to gain a new perspective.

Limitations

Throughout the development of our research, we experienced some limitations with the access to a population that's fairly disproportionate throughout the University. In turn, our research lacked the variance it needed.

Results

The results of this study makes it clear that training and practices for cultural competency and relevancy are necessary for all faculty, staff, and students. In turn, we thought that the survey would give us the same information. Friere (1972) advocates that flexibility to adapt to current research to incorporate new report provides an in-depth of understanding of socialization of academic achievement for underrepresented groups (i.e., African American males). In conjunction with Freire (1972), it's understanding the institutional context on socialization that has a significant impact for underrepresented (i.e., African American males) college students (Hanushek, 2005; Jensen, 2013). Students' perceptions of academic achievement during or after their experience at UW-Eau Claire gives not only a voice but an opportunity to establish or reestablish their identity. However, the purpose of this study is to look at students' perceptions as a factor in academic success. The responses that our participants provided indicated four themes of opinion that were interconnected, such as persistence and purpose, climate, and engagement. The following two tables helped us state perseverance (i.e., Persistence) and ambition (i.e., Purpose). Table 1 indicates that the Climate has a negative impact on the student participants Persistence and Purpose, whereas their engagement could increase the intensity to preserve, thus creating high –achieving students.



Raising persistence levels through addressing critical issues and focusing on more commendable practices should be the universities objective, as it relates to the mission of UW-Eau Claire. A majority of the students reported that their demographics affected their academic achievement, including working multiple jobs, neglecting some of the aspects that cater to the traditional college experience, and displays the difficulty of matriculating through the college experience. The Participants were provided with a list of 50 questions, which were derived from the literature about the Self Determination theory, as well as the Human Ecological Theory

(Noguera, 2003; Bubolz & Sontag, 1993; Haywood, Kuespert, Madecky, & Nor, 2008; Linnenbrink & Pintrich, 2002; Derald, Wing, & Sue, 2007; Kearsley & Schneiderman, 1998; Schneiderman, 1994; Jensen, 2013, Hanushek, 2005; Freire, 1972, Zimmerman, 1994). Students were asked to identify where they lived. The results are shown in Table 2.

Table 2. Demographic experienced as reported by African American male participants

Demographics
(N=13)

Academic Status:	
Junior	10
Super Senior	1
Hometown size:	
Large City (over 400,000)	8
Medium City (100,001-400,000)	3
H.S. Graduating class size:	
< 200	3
200-400	4
> 400	3
Diversity of H.S.	
Diverse (large number of different racial, ethnic, gender, and sexual identities)	6
Somewhat diverse (homogeneous in some categories but diverse in others)	2
Not very diverse (mostly homogeneous across categories)	2

Age:	
19	2
20	5
21	4
How do you pay for college:	
Student loans	9
Scholarships	8
Pell Grants	9
Family assistance	2
Working 1 or mor jobs	7

Demographics

Perceptions defined for the participants (n = 13) as a strategy for helping students, staff, and faculty identify adverse effects of intercultural practices. Specifically, students, staff, and faculty are asked to seek, identify, and explore their cultural practices, as well as the cross-cultural methods in expectation to achieve their goals in the immediate future. One's perception isn't the only educational practice, but also a practical tool that can assist in altering one's own cognitive and motivational processes. Institutional environment is one of the utmost importance, as it relates to helping underperforming or disengaged students because of the effect perceptions have on students (Noguera, 2003). Institutional environment identifies:

- What made your decision to attend a predominately white institution
- What information does the institution neglect
- What information should the institution address
- What information does the institution embrace
- What aspects of knowledge does the institution activate
- What criteria for cultural competence are applied

Concerning achievement for the African American male, the explanations that involve failure or success can analyze two sets of characteristics: First, the cause of failure or success may be

governable or unmanageable. A governable issue is one that we believe that we can change if we request to do so. An unmanageable problem is one that we have no hope of improving. Second, the cause of failure or success may be intrinsic or extrinsic. That being said, we fail to succeed due to aspects that we believe have originated from within or from other elements of our environments.

***Note that this factor is distinct from the previous two categories. A governable issue can be intrinsic (we can alter our beliefs by making change within; effort) or extrinsic (outside forces of basic intellect form most opinions). Likewise, an ungovernable issue can be intrinsic (an individual failing because failure, thus is internalized) or extrinsic (if society structured for failure, then failure is inevitable).**

Engagement

The indication that underlies the engagement process is that students must be profoundly engaged in learning activities through interaction with others and valuable tasks. Although such engagement could occur without the use of technology in principle, technology can aid engagement in ways that are challenging to accomplish otherwise. In turn, the engagement process is intended to be a conceptual framework for technology-based learning and teaching (Shneiderman, 1994). Although the process of engagement is not directly derivative from other theoretical frameworks for learning, it has much in common with many contexts. Due to the emphasis on important knowledge, it gives a model of consistency with a constructive approach. The engagement can be aligned with sited learning theories because it emphasizes collaboration among peers and a learning community. Shneiderman (1994) conferred that it also focuses on experiential and self-directed learning, it is similar to theories of adult learning (i.e., andragogy). According to the results, a majority (approx. 80%) of the respondents reported that their race affects their ability to learn from their current environment. Table 2 indicates the given aspects.

Table 3. Popular perceptions of the campus climate that affects engagement reported by survey participants

Do you think race has been a factor affecting your ability to learn in the classroom at UWEC?

Yes, race is frequently a factor	25.0%
Yes, race is sometimes a factor	58.3%
No, race is not a factor	16.7%

n=12

This perception indicates that when all student activities involve cognitive processes such as creating, problem-solving, reasoning, decision-making, and evaluation, this is known as

"engaged learning." Besides, students are intrinsically motivated to learn due to the essential nature of the learning environment and activities. However, when students are not in an environment that's conducive to their learning they experience the following. Students were asked to respond to a question that investigated their perception of campus climate: Have you experienced racial bias or stereotypes in the classroom? 11 of the 13 participants who met to the problem, the majority (80%) reported that yes, they had experienced racial bias and stereotypes either frequently or occasionally. Also, have you ever opted to miss class as a result? The majority (75%) reported that yes, they have decided to miss class as a result. Lastly, we asked, have these experiences made you feel less comfortable participating in class as a result? All (100%) respondents reported that their experiences made them feel less comfortable in participating in class. Results are indicated on Table 4.

Table 4. Reactions to perceptions of identity

Have you experienced racial bias and/or stereotypes in the classroom?

Yes, frequently	18.2%
Yes, occasionally	54.5%
No	27.3%

n=11

Have you ever opted to miss class as a result?

Yes, frequently	75.0%
No	25.0%

n=8

Have these experiences made you feel less comfortable participating in class as a result?

Yes, frequently	62.5%
Yes, occasionally	37.5%
No	0.0%

n=8

This is a clear indication that there is declination in significant relationships at the university between the two variables. The more negative experiences the students had on campus, the less their engagement changed. Other factors of the engagement theory are based on the notion of creating whole collaborative teams that work ambitiously to complete projects that are meaningful to someone outside the classroom. These three modules, summarized by "Relate-Create-Donate," imply that learning activities (Kearsley & Shneiderman, 1998):

1.) Occur in a group context (i.e., collaborative teams)

2.) Are project-based, and

3.) Have an outside (authentic) focus.

As Dorothy Holland states, "Identities are the stories we tell ourselves and the world about who we are, and our attempt to act accordance with these theories." This concept of identity explored due to the pervasive decline of academic achievement in our society. Subsequently, predominately white institutions across the country are developing and implementing reform measures to address the decline. Among the reform is a close examination of the student engagement. In fact, according to an EDI Implementation report, success has been amid struggle in efforts to diminish the opportunity gap between students of color and the majority here at the University of Wisconsin-Eau Claire (UWEC). The Equity, Diversity, and inclusivity (EDI) Implementation plan document a methodical approach to the evaluation of as previously stated targeting the "opportunity gap." The institution anticipates that the methods p presented will serve a population that has been over time disproportionately engaged in equitable experiences. A majority of the participants in this study reported that although the EDI Implementation fosters its focus on recruitment, retention and educational equity among students of color, diverse demography of students with one fundamental characteristic, in common: these students still shoulder the impact of racial discrimination, past, and present.

Discussion

The results of this study support the university's understanding that there are consequences of privilege and oppression within many social societies in the United States, and how these systems are reflected in day-to-day experiences of students of color at UWEC, who continue to feel the impact of assumptions that they are racially inferior to majority peers. The lack of member engagement; the need for meaningful; equitable; and a transition to anti-racist campus conversations with current students of color on the UWEC campus for respectful culturally relevant dialogue. The university anticipates that such talk provides more applicable information than the words on the reports. Although UWEC advertises a commitment to diversity as the university-wide value, there's still an alarming increase of systematic racism (i.e., microaggressions) occurrences over the last decade that discloses the seriousness of improving access to culturally relevant curricula and equitable opportunities.

Microaggressions are small and ordinary daily verbal, behavioral, or environmental indignities, whether intentional or unintentional, that communicate hostile, derogatory, negative racial slights and insults toward people of color (Derald Wing Sue, 2007). This also contributes to the low persistence rates and graduation rates of students of color that this university is experiencing. The report also indicates that compared to their white peers, opportunities to engage in high-impact practices (i.e., undergraduate research, internships and immersions/study abroad) are less likely to occur. Further data highlighted that the university has entities that dedicate its practices towards students of color, such as Blugold Beginnings, University Honors, Office of Research and Sponsored Programs and several other academic departments. However, as previously stated, the need to increase and embrace equitable experiences are measured through actions formed to create a shared commitment to an anti-racist campus. Unfortunately, many of these same reports indicate goals of campus inclusivity amongst student, faculty, and staff. This is assuming all students would admit to wanting a stable career and finances as well as the ability to take care of their families. Thus, the campus' current state doesn't support or align with these goals based on behavior or, more to the point, the value they place on the education process (i.e., classrooms, dormitories, and other locations) amongst students of color, compared to their majority white peers.

This is not to say that perceptions or engagement of students, faculty, and staff are the only influence on students of color performance. Several multifaceted influences are interrelated, including poverty, social deprivation, institutional environment, low faculty and staff morale, lack of faculty and staff of color, inadequate teacher knowledge and skill, and crime infested neighborhoods. These findings from this study should lend evidence to the knowledge base on motivation and academic achievement. This method gave us an opportunity to explore our participants' perceptional outlook for gaining access to their professional, social, cultural,

recreational, spiritual, and community service interest (Shneiderman, 1994), with some limitations. Although the self-reporting data was autonomous, some responses could be presented as participants being socially acceptable and/or troubles recollecting those experiences.

As previously stated, we initially distributed the survey to 18 to 20 participants; however, only 13 (i.e., small population, access) completed it. Their responses still provided us with significant information. Most of the results are perception based, rather than face-to-face interaction. Lastly, the lack of variance amongst the university's student population, the questionnaire recorded responses from a small community of males (Black Male Empowerment (BME)) See appendix. The results of this are direct and indirect experiences of mostly men that are 19 to 21 years of age. Our findings indicate a correlation with the lineage of significant responses that provide a stronger case. Recommendations for future research emerge from this study. First, this study suggests that after much research on the topic of perceptions, participants still feel that the university doesn't foster their experience. In this study, 85% of participants' perception indicates an urgent response to what the University is currently doing to motivate academic success through methods of retention and campus inclusivity for students of color. It appears that the University offers everything needed for students of color to succeed. However, the numbers are not where the University would like to be.

It's evident that University is seeking change, the task will become easier as a critical mass of students of color increases, and the University institutionalizes successful practices (Blankenship, Platt, and Read (2017). I realized throughout my college experience that the demographics and environment I was from affected my ability to learn. As mentioned earlier, the many existing definitions and terms only contribute to the confusion of one's perception of academic success. With the support of the University, faculty, and staff, I believe this will be a successful practice which will ultimately attract more students of color and support their development of academic achievement. This research has the potential to heighten the admissions process, administrative practices, as well as creating an inclusive environment for students from all demographics. Lisa Friedman, manager of Social Media and Alumni Networks at The New York Times (2015) said it best "Inclusion is opening our minds to new possibilities, making room for different perspectives and enriching the experience for everyone along the way." Most of the participants in this study are from communities that are highly populated areas (I.e., inner city, urban), so there more prone to utilize their instincts to survive, rather than the knowledge learned in a textbook. There is a saying "educating others, educates you." It will take a measure of commitment over a period of time for the University to realize secure positive results. However, the choice to create an inclusive environment is much greater and more rewarding. With a lot University faculty, staff, and students, "Education is a precondition to survival in America today" (Marian Wright Edelman, 2004). Future research should explore engaging framework and institutional strategies that have the potential to be most efficient. Additionally, more research needs to be conducted on the motives of professional staff (i.e., faculty, staff). What are the best practices for faculty and staff to help a student? What type of interaction could make this happen? How do we identify the tools needed for a successful outcome? I anticipate to further this study upon my entry in graduate school.

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At-Risk Students' Academic Achievement and Self-Efficacy

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Abstract:

Achievement inequality in the United States is an ongoing concern for scholars and educators. Among the many factors that have been explored within the context of achievement inequality is self-efficacy. Self-efficacy, or one's belief in the likelihood of successfully completing a task, is likely to play a key role in academic achievement. This literature review examines various studies on self-efficacy as it relates to academic achievement in students of color. More specifically, this review summarizes what is currently known about the link between self-efficacy and academic achievement, particularly the ways in which self-efficacy impacts the academic performance of students of color. While academic achievement is a complex process and various factors contribute to academic achievement, it is likely that the self-efficacy levels of students of color are playing an important, and potentially inhibitory role, in their academic achievement.

Background:

Self-efficacy, a term coined by Albert Bandura in 1977, is defined as a person's belief in his or her ability to succeed in or accomplish a specific task. One's self-efficacy is shaped by multiple factors such as previous experiences and accomplishments, other people's persuasion, and one's physiological responses to certain tasks. For example, a student who has previously struggled with multiplication problems and currently feels his or her heart racing while completing a math task may end up having a low sense of self-efficacy for math. On the other hand, a student who has received good grades on previous multiplication tests, has people telling him or her that they can do well in math, and feels calm when completing math tasks may end up having a high sense of self-efficacy for math. Bandura believed that outcomes of certain events or behaviors serve to shape our predictions and emotions towards any similar future performances. Prior to his research on self-efficacy, many psychologists believed that behavior and motivation were controlled only by natural responses to external stimuli. The idea of individuals engaging in the cognitive process of interpreting their own successes and failures and using interpretations to predict future experiences wasn't addressed in detail. A shift in this psychological perspective occurred, however, when researchers began to understand that the behaviors and motivation underlying success or failure may be partially due to the interpretation

of memory from past experiences. Behavior and motivation are likely products of the interactions of previous experiences, consequences for actions, positive reinforcements, and the interpretations of these experiences (Bandura, 1977).

As stated above, self-efficacy can be shaped through successful performance experiences, vicarious experiences (i.e., observing others engage in behaviors), suggestions or exhortation through verbal persuasion, or physiological responses (Schunk & Bandura, 1991). Through these various modes of acquisition, Bandura believed that students develop efficacy expectations. Efficacy expectations are the belief that an individual can produce the necessary behavior which will produce the desired response. These expectations determine how much effort people will exert, as well as how long they will persist in the face of difficulty. Efficacy expectations are acquired through performance accomplishments, particularly through "mastery experiences." A mastery experience can be described as a situation in which one has learned a skill and then generalized that knowledge to other challenges within that same domain. Students who have mastery experiences are able to repeatedly perform tasks successfully, as well as think critically about how to solve similar challenges (Bandura, 1977). Both mastery experiences and self-efficacy can be transferred across similar tasks. If students have mastery experiences in one specific area, they are able to transfer that knowledge to other tasks within the similar context. Self-efficacy operates in the same way such that when students have high levels of self-efficacy in an area, they are able to generalize it to other skills within that same domain or subject area (Bandura, 1977).

Self-efficacy is thought to be a predictor of academic achievement, in addition to serving as one of the key components of students' academic success. It is thought to be acquired in a step-by-step procedure as proposed by Bandura (1977). First, modeling can create foundational skills and understanding of the specific process required for successful completion of a task. Once the student has witnessed consistent success by the model and has had sufficient exposure to the skillset and process, external aids that were used to assist the student can be removed. In the third step, the individual uses a self-directed mastery process to solidify understanding and lead the person to believe in their own ability to accomplish the given task.

Consider the task of learning to ride a bicycle: first, one watches his or her parent or older sibling ride a bicycle, and the desire is ignited to be able to participate in that activity. Next, a person tries to ride a bike with someone holding onto the back of the seat, while they pedal along with training wheels. Eventually, after enough practice, those assisting mechanisms can be removed, leaving the individual to attempt to ride the bicycle on their own. While there are inevitable crashes in store, the person has had enough previous support and understands the process by which they will successfully master the bicycle at some point in the future. The same goes for education specific tasks in that students are bound to have comprehension errors or experience failures at some point, but if they have received the necessary feedback and support from their teacher, they will continue to try until they experience success.

Self- Efficacy and Academic Performance:

Self-efficacy is a predictor of academic performance because it is linked to students' intrinsic motivation and persistence. In Bandura's initial study, he found that individuals were more likely to successfully complete a task when they displayed strong efficacy expectations, (Bandura, 1977). Students with high levels of self-efficacy view difficult tasks as challenges rather than threats, have higher levels of commitment to their goals, and put forth more effort

rather than quitting in the face of failure (Long, 2007). Increased self-efficacy is also linked to success because students who have high levels of self-efficacy are more persistent and more likely to rework problems.

While self-efficacy is very task-specific and a student can have a high level of self-efficacy in one area (e.g., writing) but a low level of self-efficacy in another area (e.g., reading), there is also a general self-efficacy for learning that may explain the way students are able to generalize prior knowledge (Pajares, 1996). Pajares (1996) found that students who have high levels of self-efficacy for learning understand that their brains are capable of growth in the face of new challenges. When teachers explicitly teach a growth mindset to their students, explaining the formation of dendrites and new pathways in the brain upon challenge and acquisition of knowledge, students are more likely to pursue a growth mindset. When students who have a growth mindset and high self-efficacy for learning are in a situation they have never encountered before, they are likely to interpret the challenge as an opportunity for growth rather than a possibility for failure. Consequently, they are more likely to persevere in the face of challenge.

Long (2007) studied this general concept of self-efficacy for learning, particularly as it relates to goal orientations. Long described four types of goal orientations including learning, performance, performance avoidant, and work avoidant. Students who have a learning goal orientation will work towards mastery of academic tasks and understanding of new concepts. Performance goal orientations involve emphasizing the outcome (e.g., grade) rather than the process of learning. These types of students will be reluctant to ask for help, and desire to have others perceive them as smarter than their peers. Students who have a performance avoidant goal orientation don't necessarily want to be perceived as smarter than their peers, but rather, just don't want to be perceived as 'dumb' Finally, students who are work-avoidant simply desire to finish a task with the least amount of effort, which is detrimental to the learning process.

It is thought that goal orientations are linked to self-efficacy such that students who have lower levels of self-efficacy may put more emphasis on the performance and outcomes than the mastery. Student who don't feel confident in their abilities to complete tasks may be worried about the possibility of failure, and in turn, be more concerned about how they appear to others than mastering the content (Long, 2007). Likewise, students who don't feel confident in their abilities to complete tasks may simply desire to finish the task with minimal effort since their primary goal may be task completion rather than mastery. Through goal orientation, self-efficacy is likely impacting academic motivation such that students who have high self-efficacy are more likely to have learning goals and students who have low self-efficacy are more likely to have performance or work-avoidant orientations. These goal orientations, in turn, are related to students' persistence.

Self-Efficacy and Students of Color:

An interesting development in the self-efficacy literature is the acknowledgement of the self-efficacy disparity that exists between students of color and white students. More specifically, multiple studies have revealed lower levels of academic self-efficacy in students of color compared to white students (Johnson-Reid, 2005).

Many academic researchers have agreed that in order for students to learn, activation of prior knowledge, as well as development of a pre-existing schema must exist. This way, students are able to apply new knowledge to content they already have a foundation for, or experiences to which they can relate (Ausabel, 1962). When students lack prior knowledge and experiences,

they may lack the pre-existing schema that play a facilitative role in learning. It is thought that public school curriculum in the United States is skewed to favor white, middle-class students, their family and life experiences, and vernacular, which begins to put white students at an inherent advantage and disadvantages students of color simply because the students of color have fewer pre-existing schema to connect with this curriculum (Stevenson, Chen, Uttal,1990). These minority groups of students don't necessarily lack knowledge, but rather, may have a *different* set of knowledge than mainstream white students stemming from their experiences, languages, and family. Since their background knowledge may differ from what mainstream educational curriculum requires, they may have fewer opportunities to experience academic success in the classroom, thereby negatively impacting their self-efficacy.

While it is completely impossible for teachers to design lessons and use manners of speech that will directly relate to every part of each students' culture and prior knowledge, teachers can use methods such as experiential teaching processes to provide students with a shared experience together as a class and instruct based off of that experience. Teachers can also be intentional to include literature, math problems, and even science experiments that draw from a variety of cultures – reaching beyond what is provided in the curriculum. When teachers intentionally create lessons and activities that provide connections for students of color, they are helping develop opportunities for academic success and higher levels of academic self-efficacy in those students. Self-efficacy can be produced and fostered in students through modeling and vicarious experience, however, students of color lack the volume of models and mentors that white students have built into their curriculum. In providing in-group role models, real life situations, and personal connections to activate prior knowledge, teachers can begin to help students of color develop self-efficacy in the classroom as well (Stevenson et al.,1990).

Similarly, Long conducted a study that examined the effects of interest on student success and learning. In the end, she discovered that the underlying factor that initiates student motivation is interest and the fact that students have a sense of how the material relates to their personal lives. When students perceive content to be irrelevant, they report less interest in learning that content. In addition to perceived relevance, student motivation and learning may be impacted by instructional strategy. Students of color often respond more favorably to instruction through inference rather than formal logic. Similarly, students of color have reported a higher preference for visual and global learning styles rather than verbal or analytical ways of learning. In education, the concept of a "compelling why" is a term that teachers are often taught to provide their students with a long-term, practical application of whatever material is being instructed. A compelling why will be different for every student, but it will especially vary across racial groups. If teachers can find ways to connect their content material to a compelling why, and they teach in ways that students perceive effective, it will help students identify more personally with the information being taught. When students feel personally connected to the material, they are more motivated to learn because of an intrinsic desire to understand. With that intrinsic desire, if the teacher continues to encourage and challenge the students, helping them believe that they have the power to change their circumstances or their academics, or their home environment through education, self-efficacy will begin to grow in those students.

Academic Disidentification:

Academic identification is a process through which students create a positive self-regard, through their own self-perception of their adequacy (Wasserberg, 2014). Students will then continue to assess their own judgements of the possibility and plausibility of future success. Academic identification is one of the goals that educators have for their students, meaning that students would be able to look at school material, and feel personally connected and capable of accomplishing the tasks. However, something seems to happen overtime that systematically convinces both African Americans and women to dis-identify with academics. Students in minority or at-risk groups (lower -ses Black families, women of color) might increasingly identify with a negative stereotype about their own group, rather than identify with their own interest or capability in the subject. It is commonly misunderstood that stereotype threat only affects low-achieving students of color, but Wasserberg's (2014) study found that this phenomenon actually affects high achieving students as well. When students are presented with a task that is framed as being indicative of ability, those who are already aware of negative racial stereotypes about their groups will perform at a lower level than they typically do. Therefore, if a student places a high level of importance on school and academic achievement, their anxiety will increase on top of the already existent performance anxiety, causing their performance to decrease exponentially.

Among students of color, there are often negative connotations associated with high academic achievement because academic success is said to be "acting white." African American students in particular often face isolation and loneliness if they desire to excel in academics because of the disdain that their community may express towards academic behavior (Long, 2007). In addition to experiencing negative connotations associated with high academic achievement, African American students may also struggle under the burden of stereotype threat, starting around early middle school all the way through graduation of high school. Stereotype threat is defined as a "self-realization of a negative stereotype about one's own group through a personal experience" (Wasserberg, 2014). Steele also describes this threat as "a situational threat that can have a psychological effect on any members of a group in which there exists a negative stereotype" (Steele, 1997). Students develop an awareness of stereotypes through the following process: students experience a negative, anxiety filled experience of "integration" into a majority white culture or school, students hear rumors of inferiority, students become intimidated by majority students' rumors or attitudes, the students internalize the negative stereotype, which finally leads to low levels of self-efficacy for minority students (Steele, 1997; Wasserberg, 2014). For students who already have an awareness of the negative stereotypes that exist about their race in the field of academia, fear of failure and confirming those stereotypes often causes students to distance themselves from academic pursuits. This process of emotionally, mentally, and academically withdrawing from school is known as academic disidentification (Osborne, 1997).

It has been found that African American students experience a significant continual decrease in self-esteem and academic identification throughout the course of high school (Osborne, 1997). Both self-esteem and academic achievement scores decreased between grades 10-12 in every subject in African American males. African American males may be the most susceptible to misidentification (attaching identity to other pursuits, such as sports, music, or social conquests) especially in grades 10-12. However, disidentification appears to be a struggle particularly specific to African-American students. Hispanic female students experienced decreases in academic achievement throughout high school, but their self-esteem and academic identification remained stable throughout school. Interestingly, in every ethnic group, girls were more strongly

identified than boys in both mathematics and science. Across the board, both black and Hispanic male students experienced decreases in academic performance and increases in disidentification throughout grades 10-12, with African American students displaying the most dramatic decreases in these two areas. Wasserberg (2014) found that for African Americans, the intensity of stereotype threat towards black male students in academics causes them to disidentify most strongly, and then in turn identify with areas such as friendship, sports, or even identify with a disdain for academics (Wasserberg, 2014). The longer a student has been exposed to a stereotype threat, the more keenly aware that individual becomes of the negative beliefs about their group. The longer the student sits under this pressure, the more they tend towards disidentification as a means of emotional and mental protection from the stress of confirming a negative stereotype (Wasserberg, 2014).

When students cannot identify with academics and cannot envision themselves in an academic scenario in which they are successful, they both pull away from academics and decrease in self-efficacy in that area. If a person is never able to imagine a future in which he or she will achieve the goal set before him or her, that person has no reason to believe in themselves. For students of color, the absence of persuasion, accomplishments, and/or previous experiences (the main catalysts to self-efficacy) inhibits their development of self-efficacy throughout high school.

Conclusion:

In light of this understanding that many different factors can affect students' academic self-efficacy, John Steele (1997) developed a format of education called "Wise Schooling." Wise schooling aims to see a person for more than the negative stigma attached to his/her group. Teachers must grow to understand students in their full humanity, as multifaceted, complex, sensitive learners. Steele urges educators to purse optimistic relationships between student and teacher, given that feedback from a person in power has a profound effect on students' self-concept (Steele, 1997). Mentoring programs, where at-risk students are paired with adults who are of a similar skin color or socioeconomic status, are an effective way to encourage students and build self-efficacy through vicarious experience and persuasion.

Additionally, teachers can challenge students who are deemed "at-risk" rather than assigning remedial work (Steele, 1997). As discussed above, interest and motivation both support a student's academic self-efficacy, so teachers must resist the desire to let students slide by and should instead assign work that will be intellectually stimulating and challenging. This will not only help students to view difficulty as a normal, acceptable part of their educational journey, but will also show them that their teacher respects their intellectual ability.

This concept of "Wise Schooling" provides a helpful framework in which researchers can continue to study classroom interventions in the field of self-efficacy. Many questions still remain, such as the subconscious root of stereotype threat, the source of academic disidentification in high school, or the reason Latina girls maintain self-efficacy while failing in school. While there is a considerable amount of research published in the area of general, academic self-efficacy, there is still a considerable need for research specific to students of color and African American students. Future researchers should continue to analyze what effects self-efficacy in high school African American males, as well as look for generalizable classroom interventions that teachers can be taught to incorporate in their classrooms.

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The State Dominated Labor Movement in Mexico

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Abstract

The historical development of Mexico offers great insight to the current relationship between the labor movement and the Mexican government. It is crucial to understand the overall state dominated labor movement and the nondemocratic system prior to 2000 to understand the current and future direction of the Confederation of Mexican Workers (CTM). Ultimately, due to the state dominated system by a nondemocratic one-party regime, the CTM has been largely ineffective.

Background

Mexico was governed by a one-party regime from 1929-2000 by the Institutional Revolutionary Party, or the *Partido Instutucional Revolucionario* (PRI). During this time, there were no effective checks on the president's power, thus Mexico was classified as a nondemocratic regime. As a nondemocratic state, the PRI skillfully utilized co-potation, inclusion and corruption—reducing the need for coercion. The PRI brought members of the public into a beneficial relationship with the state and the government, which was the case for members of the Confederation of Mexican Workers (CTM). The PRI supported unionization and helped establish the CTM. The President of Mexico at the time, Lázaro Cárdenas enacted reforms that were of great importance to the workers. However, Charles L Davis and Kenneth M. Coleman state, "The origin of corporatist control over organized labor in Mexico can be traced to the inclusion of the then newly created Confederation of Mexican Workers (CTM) into the official party during the presidency of Lázaro Cárdenas, 1934-1940" (89). Since the then President Cárdenas, the CTM has been thoroughly integrated and controlled. As a matter of fact, unions as a whole are highly centralized in Mexico. Local unions register with the state under one of the five confederations, the CTM being the largest with a little more than 19 million members as of 2017 (CTM). The other four confederations are more independent, but less influential mainly due to a smaller membership translating into fewer resources and connections.

Methods

The research started with the goal of creating surveys and distributing them to members of the Confederation of Mexican Workers (CTM). A survey and consent form were created in English, translated into Spanish, and approved by the University of Wisconsin-Eau Claire Institutional Review Board (IRB). The survey consisted of ten multiple choice questions that were designed to measure CTM members' degree of independence in self-governance and to what extent CTM, if any, has been instrumental in Mexico's drive toward political democracy since 2000. Unfortunately, two challenges inhibited the distribution of the surveys: CTM leaderships' reluctance to cooperate with the distribution of prepared questionnaires and lack of time due to

the researchers' limited stay in Mexico. Thus, this research fundamentally relies on scholarly work, socioeconomic indicators and personal observations.

The socioeconomic indicators included: Gross Domestic Product per capita (PPP), GINI Index, and the Freedom House Ratings. The Gross Domestic Product per capita (PPP) summarizes the economic state of Mexico. The GINI Index coefficient measures the income or wealth distribution within a country; in other words, the GINI coefficients represents the degree of income inequality in a country. The Freedom House is an "independent watchdog organization dedicated to the expansion of freedom and Democracy around the world" by analyzing and rating the level of freedom in a country as "not free," "partly free," or "free" (Freedom House).

Discussion

Overall, Mexico is an emerging market with an increasing gross domestic product per capita. However, the GINI coefficient for Mexico is 0.459, well above the global average of 0.315. In the most recent report from the Organization for Economic Co-operation and Development (OECD), Mexico ranked the highest out of 37 countries; in other words, Mexico faced the most uneven income or wealth distribution. This disparity in income and/or wealth is correlated with the developmental performance of the country that is marred by an uneven geographical and regional development. The northern parts of Mexico and Mexico City are economic hotspots, while the central part and especially the southern part of Mexico face poor infrastructure, higher unemployment rates, and high levels of poverty.

In spite of uneven distribution of income and wealth, Mexico has, since 2000, moved toward a more political opening. The question remains, to what extent has Mexico's move toward political opening and democracy been the result of the organized labor's push for not only higher wages—and thus alleviating some of the poverty income disparities—but also political representation at local and national levels? Organized labor in the West has been instrumental in countering the power of the state and promoting political democracy through their political linkages with personalities and political parties. Labor organizations, through their support of social democratic parties and/or formation of independent labor parties in England, Italy, the Scandinavia, Turkey, Israel, and elsewhere, for example, have been instrumental, to varying degrees, in the promotion of democratic politics.

What does the future hold? After the 2000 election, when the PRI opposition party: National Action Party or *Partido Accion Nacional* (PAN) won the first presidential election, the Freedom House rated Mexico as "free." This was largely due to the competitive political system during the 2000 elections. However, in 2011 the Freedom House ranked Mexico as "partly free." What changed? Around the same time, Enrique Pena Nieto, representative of the PRI, won the 2012 presidential elections. Pena Nieto ran on an anti-corruption campaign, but since his election the administration has been plagued with corruption scandals. Most importantly, as a PRI representative, we must question whether an old authoritarian political machine can transform itself into a democratic political power?

Conclusion

Because Mexico is such a young democracy, we really are unsure of where the PRI will head; meaning that if the CTM decides to maintain its relationship with the PRI then we will have to wait and see what the PRI decides to do. I say "if" because more recent CTM *Informes* or reports call for a possible separation between the CTM and PRI. This could lead to more autonomy and an increased ability to contest government policy and promote democratization within Mexico (O'Niel et al., 2015, 594).

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Individualizing Early Math Intervention: Employing a Self-Monitoring Component

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Abstract

In academic settings, self-regulation skills refer to a student's ability to monitor the quality of their work (Uberti, Mastropieri, & Scruggs, 2004). Strong self-regulation skills are related to self-monitoring of progress. In addition, self-regulation is associated with student self-perception of academic efficacy for learning (Lichtinger & Kaplan, 2015). A high sense of efficacy for academic performance has been related to student commitment to complete challenges, or in other words, academic motivation (Zimmerman, Bandura, & Martinez-Pons, 1992). Ultimately, well developed self-regulation skills and positive self-efficacy lead to higher academic achievement (Lichtinger & Kaplan, 2015). Despite ample research on self-regulation interventions on academic performance, very little research has studied the specific changes in student self-efficacy for math following the implementation of a self-monitoring component to an academic intervention. The purpose of this investigation is to evaluate the impacts of adding a self-monitoring component to an existing math intervention. The analysis focuses on the academic growth of two second graders following a summer math intervention targeting single and double-digit addition and subtraction with and without regrouping. Changes in academic performance, measured by digits correct, and student ratings of self-concept, self-efficacy, and anxiety for math were evaluated. Overall, both students showed an increase in academic performance following the math intervention. However, changes specific to self-monitoring were not evident. The results of the rating scales for self-efficacy, self-concept, and anxiety for math were inconclusive. Limitations, Implications, and ideas for future research are discussed.

Literature Review

Self-regulation has been defined in academic settings as the active process where learners set goals for their learning and then attempt to monitor and control their behavior guided by those goals (Lichtinger & Kaplan, 2015). According to Zimmerman, Bandura, and Martinez-Pones (1992), self-regulated learners are distinguished by their proactive orientation, strong academic performance, and self-motivative abilities. Strong self-regulation skills are associated with goal setting, time management strategies, and self-monitoring of progress. Self-regulation is also associated with student self-perception of academic efficacy for learning (Lichtinger & Kaplan, 2015). A high sense of efficacy for academic performance has been related to student commitment to complete challenges, or in other words, academic motivation (Zimmerman et al., 1992). Self-efficacy, self-concept, and anxiety for math, all have an effect on learning and performance and determine how well students motivate themselves in the face of difficulties (OECD, 2013).

Lichtinger and Kaplan (2015) investigated the motivational orientation and self-regulation strategies elementary school students' use during academic tasks. The analysis focused on the integration of the student's purpose and goals for engagement, self-perceptions and affect, and action possibilities and strategies employed. The findings suggest that self-regulation strategies are framed by the purpose and goals a student adopts for engagement in the task. Furthermore, students' use of strategies is likely shaped by their sense of efficacy for the particular task.

In academic settings, self-regulation procedures can be employed to help students accurately complete tasks by providing instructional cues to monitor their own work. For example, procedures for self-monitoring and self-instruction aid students by breaking down tasks into steps they can independently follow (Uberti, Mastropieri, & Scruggs, 2004). Uberti and colleagues (2004) examined the use of instruction strategies with students with behavioral difficulties and learning disabilities. Individualized self-monitoring checklists were developed based on an error analysis of each student's difficulties in math. The checklists were created to accompany a teacher-devised worksheet containing math problems with regrouping. Students were taught to follow their checklists step-by-step, checking off each task as they completed them. Student academic performance significantly improved in this intervention and participants closed the gap between their peers on the final posttest.

Dunlap and Dunlap (1989) evaluated the effectiveness of a self-monitoring intervention on accurate responding to subtraction problems for three students with learning disabilities. An error analysis was used to create individualized self-monitoring checklists that the students used while responding to subtraction assignments. The self-monitoring procedures produced immediate and dramatic gains in correct responding, with more stable levels of accurate responding across sessions. Checklists were removed during the skill maintenance phase; levels of successful responding continued.

Method

Setting

Two clients participated in a summer math program offered through the Human Development Center Academic Intervention Clinic at the University of Wisconsin- Eau Claire. Participants were recruited via parental response to a flyer advertising the program. Participants of the program received 16 sessions of 1:1 direct instruction. Participants began their session by completing a daily assessment of their addition and subtraction skills. Next, interventionists led the student through the lesson for the day. The intervention specifically targeted single-digit and double-digit addition and subtraction. Individualized self-monitoring checklists were introduced following initial instruction for addition and once again for subtraction. Each session took place in the morning and lasted one hour. Interventionists were graduate students of the School Psychology program at the University of Wisconsin- Eau Claire.

Procedure

A single-case ABAC design methodology was used to evaluate gains in academic skills following self-monitoring. Self-efficacy, self-concept, and anxiety for math were measured via pretests and posttests. Specific outcomes evaluated included: 1) changes in accuracy of performance for intervention specific math skills; and 2) changes in self-efficacy, self-concept, and anxiety for math. Students were taught how to use the checklists when they were first introduced. The students then used the checklists during independent work. Points were awarded for on-task behavior and for correctly using their checklists. If students filled their point sheet by the end of the session, they could exchange them for a small prize

Measures

To measure changes in academic performance, participants completed math calculation worksheets with 26 double-digit problems each day. The number of digits correct was recorded (i.e. 20+13=33 would equal two digits correct). Problems included addition and subtraction with regrouping. The assessments were not timed. To measure changes in self-beliefs for math, participants completed an adapted scale for self-efficacy, self-concept, and anxiety. The scale used in this study was adapted from the self-concept, self-efficacy, and anxiety for math scale used by Lee (2009).

Results

Data from the daily assessments are shown for each participant in Figures 1 and 2. Math beliefs data for each participant is displayed in Figures 3 and 4.

Emma

Emma's addition and subtraction scores are represented separately by digits correct in Figure 1. In baseline, Emma's subtraction scores were consistently low while addition scores increased. No change

in addition accuracy occurred after either self-monitoring phase or during the second baseline phase. A change in subtraction accuracy was noted for the second self-monitoring phase, however subtraction accuracy showed an upward trend in the prior baseline phase. There was variability among Emma's scores for math beliefs (Figure 3). While there was an increase for self-concept, self-efficacy and anxiety remained the same.

Jack

Jack's addition and subtraction scores are represented separately by digits correct in Figure 2. In baseline, there was variability for both addition and subtraction accuracy. Addition was consistently over 80% for baseline. On day 9, Jack attempted only one problem and was incorrect. No change in accuracy was noted after the first self-monitoring condition. Contrary to hypothesized effects, addition accuracy decreased to levels below baseline after the second self-monitoring phase. Subtraction accuracy did not change. Jack's math beliefs scores showed variability (Figure 4). Self-concept decreased and anxiety appeared to increase.

In addition, one participant had behavioral challenges that made it difficult to include their data in this study. The participant was unwilling to complete worksheets or talk during the intervention. There would have been three participants in the study if we were able to collect this data.

Discussion

All students demonstrated academic growth over the course of the intervention. Accuracy for addition and subtraction problems increased for each participant following the teaching of each skill. Despite growth, it cannot be stated that there was an effect from implementing the self-monitoring strategy due to limitations of the study.

Initially, students were excited and willing to use the self-monitoring checklists. However, as time went on students stated that the checklists were slowing them down. Clinicians recognized that monitoring the steps for problem completion was not needed. Student participation decreased and overall checklists were not utilized as intended. In response, the checklists were edited to target different academic behaviors. Compliance for using the checklists in the final phase increased, however changes specific to self-monitoring were not evident.

The results for Math Beliefs (self-concept, self-efficacy, and anxiety for math) were inconclusive. Students did not interact with the scales as intended. Often, participants recorded their answer prior to having the question read to them. In addition, participants quickly chose the same response for multiple scale items in a row.

Limitations

There are two limitations to be noted in regards to the dependent measure used to evaluate changes in accuracy for math computation problems. As stated previously, after receiving instruction during the intervention, accuracy with computation skills increased significantly. For addition with regrouping, students often showed near perfect performance prior to self-monitoring phase. Because of the ceiling on the dependent measures score, it was difficult to see any additional growth in accuracy with addition after the self-monitoring component addressing mathematical procedure was introduced. In addition to ceiling effects for the dependent measure of math computation accuracy, there was a change in directions for how the measure was completed with students. As the intervention went on, students attempted fewer problems than they had been at the beginning of the intervention. To ensure that the dependent measure was evaluating changes in math computation accuracy, a prompt for the participants to try all problems was added. Once they started attempting more problems, their scores began to increase again, which indicated that they in fact did understand how to solve those problems.

Limits in the implementation of single case design influence our interpretations of results as well. Absences impacted our schedule for self-monitoring phases. Because of student absences, the self-monitoring schedule had to be altered. This shortened the amount of days allotted for each phase of the design. Lastly, there was also an implementation fidelity issue in regards to using the materials of the study. Students did not use the self-monitoring checklists as intended.

Future Research

On some days it was difficult to get through lesson materials due to off task behaviors, having additional intervention sessions would have been useful. Future researchers may consider planning a longer intervention schedule. There were also times where we needed to increase the reinforcement the participants were receiving for positive behaviors. Future research may consider using a preference assessment to determine motivating variables for each participant prior to implementing the intervention.

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Appendix

Figure 1

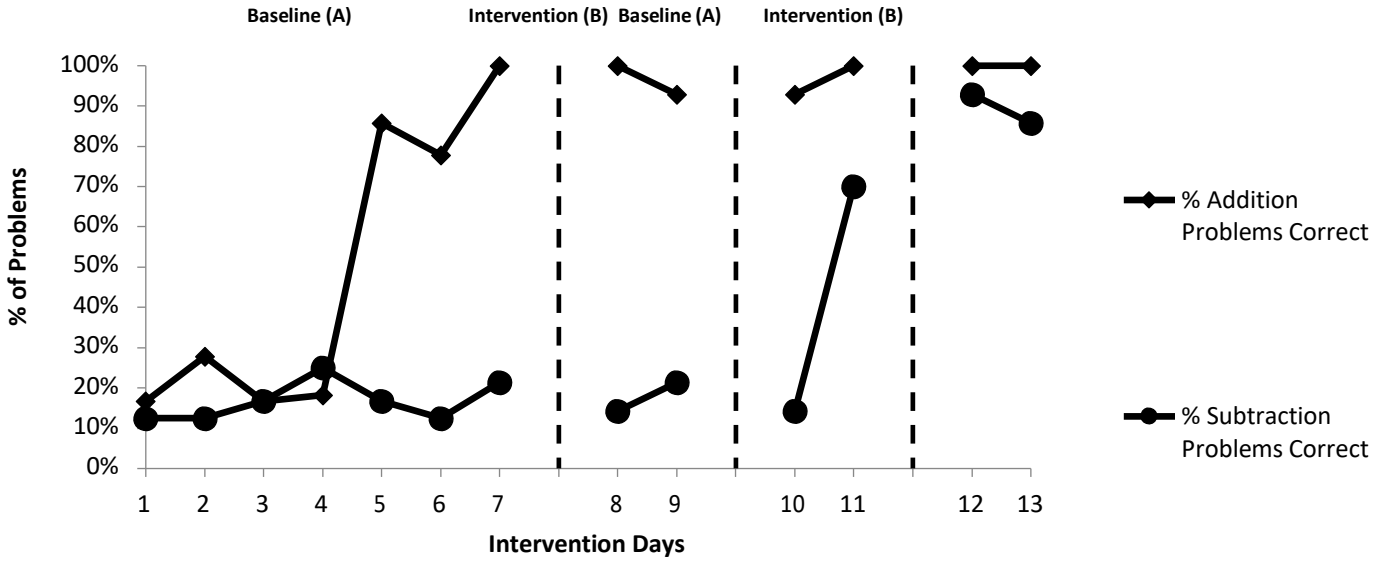

Figure 2

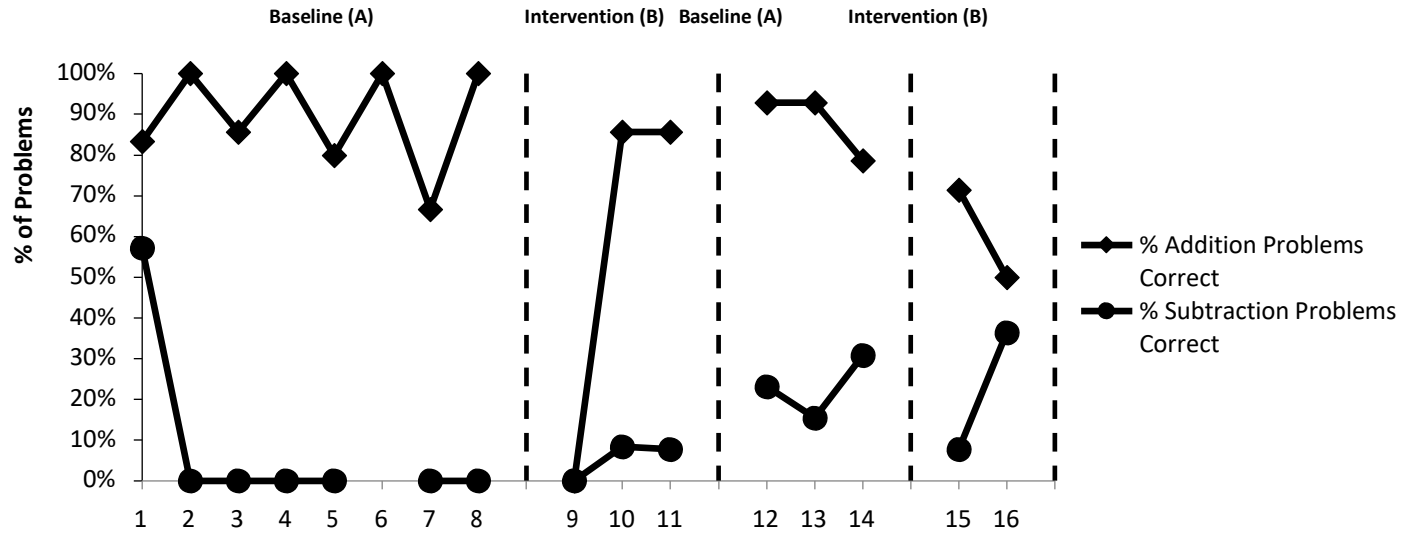

Table 1

Math Beliefs Emma

Probe	1	2	3	4
Self-Concept	16	19	20	20
Self- Efficacy	24	24	24	24
Anxiety	5	5	5	5

Table 2

Math Beliefs Jack

Probe	1	2	3	4
Self-Concept	16	11	12	14
Self- Efficacy	20	15	18	13
Anxiety	8	15	15	15

Are the Discriminative Stimulus Effects of Haloperidol Altered by Chronic but Limited Access to Sucrose Solution?

Kimberly James
Mentor: Dr. David Jewett

Abstract

This study assesses the ability of Sprague Dawley rats to recognize haloperidol when dopamine levels are increased. Avena (2007) suggests the ingestion of sucrose activates the release of dopamine and endorphins within the brain. Recently, our laboratory established that when rats are given limited access to sucrose they could distinguish effects of naltrexone that are normally unrecognizable at standard endorphin levels. Our question was whether or not sucrose consumption affects the ability of the rats to distinguish and report effects of haloperidol, a drug that blocks dopamine's effects. However, our laboratory was unable to replicate past haloperidol discrimination studies. In addition, the low responding data resulted in the inability to determine if sucrose had any effects on the discrimination.

Introduction

Rates of obesity are rapidly increasing within the United States. Currently, approximately one-third of adults in the United States are considered obese. Therefore, researchers are increasingly interested in the concept of sugar addiction. Avena, Hoebel, and their colleagues investigated the similarities of the effects of sugar and drugs of abuse, examining neurochemical withdrawal from sugar, and cross-sensitization of sugar and amphetamine (Avena & Hoebel, 2003; Avena, 2007). Avena and colleagues have demonstrated that rats' opioid and dopamine levels increased with limited exposure to a sucrose solution (Avena, 2007). These two pathways are involved in sugar addiction. The dopamine reward pathway activates with addictive substances. Additionally, Burton, Noble, and Fletcher (2011) suggest the opioid system influences the motivations for use of these substances. Dopamine, also, reinforces various eating behaviors (Rada, Avena, Barson, Hoebel, & Leibowitz, 2012). Jewett, Grace, & Levine (2005) reported altered opioid system response due to exposure to chronic sucrose consumption. Thus, our laboratory used an animal model exposing subjects to either water or sucrose solution in a discrimination paradigm. "Discrimination" is defined as the process of an organism responding differently in the presence of two or more different stimuli (McElroy, Stimmel, & O'Donnell, 1989).

Our laboratory established small doses of naltrexone, an opioid antagonist, as a discriminative stimulus in rats exposed to sucrose solution, but not rats exposed to water. The discrimination methods were similar to that previously used in Jewett et al. (2005). Subjects recognized and reported whether they had received an injection of saline or naltrexone. When endorphin levels were relatively normal, like in subjects with only water access, naltrexone produced no noticeable effects. However, when endorphin levels are increased with the sucrose solution consumption, naltrexone was discriminable. This indicated sucrose's role in the ability of an animal to learn this discrimination.

Our experiment replicated the paradigm using haloperidol, a dopamine antagonist, in place of naltrexone (Ashby, Hitzemann, Rubinstein, & Wang, 1989). Haloperidol is a classic antipsychotic and could be prescribed to treat schizophrenia. Classic antipsychotics have common side effects including anhedonia and extrapyramidal effects, such as tardive dyskinesia (Ashby et al., 1989; Ettenberg & Camp, 1986). Simply put, haloperidol can affect movement.

We selected haloperidol for a few reasons, including the effect the drug has on the dopamine reward system in combination with food. Properties of food reinforcement are mediated by dopamine and its substrates (Ettenberg & Camp, 1986). However, haloperidol, as a dopamine antagonist, can produce suppression in animals trained in a food-reinforced lever pressing paradigm (Jones-Cage, Stratford, & Wirtshafter, 2011). Haloperidol was established as a discriminative stimulus in McElroy, Stimmel, and O'Donnell (1989) as well as Colpaert, Niemegeers, and Janssen (1976). Our study will use a control group to replicate the findings by both McElroy et al (1989) and Colpaert et al. (1976). McElroy et al. (1989) established haloperidol as a discrimative stimulus in nine of the ten subjects with a training dose of 0.05 mg/kg in a mean of 45 training sessions. As predicted, there were rate suppressing effects at this dose. McElroy et al. (1989) also found no tolerance to the rate suppressing effect. Colpaert et al. (1976) established haloperidol as a discriminative stimulus with a training dose of 0.02 mg/kg, however the training took over 80 sessions to acquire.

Our hypotheses for this study is related to the ability to acquire the discrimination with the sucrose access. We predict that subjects with sucrose solution consumption would learn the discrimination more quickly compared to subjects with only water access. This is based on the research suggesting an increase in dopamine levels after sucrose consumption. Additionally, we predict the discrimination could be established with a smaller training dose in subjects exposed to sucrose solution. This is based on past literature that suggest when dopamine levels are increased, subjects are more sensitive to the antagonist effects of haloperidol.

Methods

Subjects. The subjects were male Sprague Dawley rats (n=15), individually housed in a room with a 12:12 hour dark/light cycle. The experimental group (n=9) had 25% sucrose solution access during the dark cycle with water substituted during the light cycle. While the control group (n=6) was exposed to twenty-four-hour water access. All subjects were food restricted to 80-85% of their free-feeding weight and fed Harlan Teklab rodent chow every day after the last session. This model was based on the addictive-like animal model proposed by Avena (2007). Weight was monitored daily.

Drug. The pharmacological agent was haloperidol, a dopamine antagonist. Haloperidol was dissolved in a saline vehicle for a dose of 0.056mg/kg or 0.018mg/kg. Since the saline vehicle has no effects, this was the control for the injections, all of which were administered subcutaneously.

Apparatus. Subjects were trained in a standard two-lever operant chamber (Med-Associates) with 45mg sucrose pellet reinforcers (Bioserve F#0021). Fixed-ratio reinforcement schedule reinforces condition appropriate lever presses. Our laboratory's discrimination criteria: subjects must respond with more than 80% condition appropriate lever presses both prior to delivery of the first reinforcer and for the complete training session. Subjects must reach these criteria in 8 out of 10 consecutive sessions under both conditions.

Procedure. For the first two weeks, subjects only had access to sucrose solution and no training in the operant chamber. Once training began, subjects received sucrose solution one hour prior to the training session. Thirty minutes prior to the session, they received an injection of either haloperidol or the saline vehicle and were placed into the operant chamber until the beginning of the session. The start of the session was indicated by the house light within the operant chamber turning on. The subjects were reinforced for left lever presses under the haloperidol condition. Conversely, the subject was reinforced for right lever presses under the

saline vehicle condition. If condition appropriate lever responses were emitted, a sucrose pellet was delivered to the food tray. However, if lever presses were not condition appropriate, the subject received an eight second time out indicated by the house light turning off. The training session lasted until the subject earned all the reinforcers on the fixed ratio schedule or after the fifteen minute session timer. Subjects were then returned to their home cage and sucrose access was reinstated for the remainder of the dark cycle.

Results

Acquisition. Subjects were unable to reliably acquire the haloperidol discrimination. As seen in figure 1, it appears that subjects acquired the discrimination, however, compared to past research, the number of trials to reach discrimination criteria was increased. The training dose used by McElroy et al. (1989), 0.05 mg/kg, allowed subjects to acquire the discrimination in a mean of 45 session, while the training dose of 0.02 mg/kg, had acquisition occur in a mean of 80 sessions (Colpeart et al, 1977). Yet, in this study the majority of control subjects were unable to acquire the discrimination after 75 sessions. For the subjects drinking sucrose solution with the 0.056 mg/kg dose, acquired in approximately 52 sessions and subjects with sucrose on the 1.18 mg/kg dose, acquired in approximately 96 sessions.

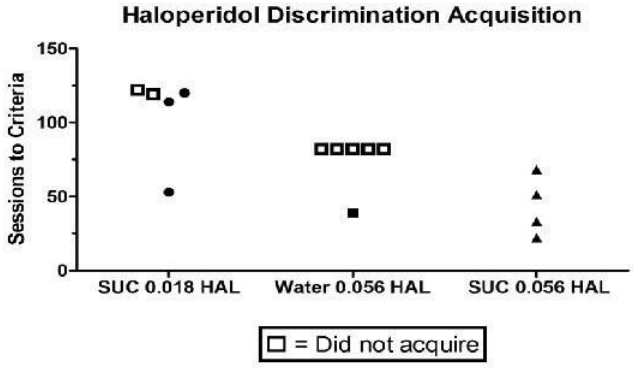

Figure 1.

Rate. One complication was severe rate suppression due to the haloperidol. As seen in figure 2, subjects on the 0.056 mg/kg training dose, regardless of sucrose access, had rate suppression during the discrimination task. The effect was not as severe in the subjects with the 0.018 mg/kg training dose. As seen in the figure 3, top panel, the subject was exposed to sucrose solution and a training dose of 0.056 mg/kg. This subject acquired the discrimination, however, there were less appropriate responses on the haloperidol-paired lever compared to the saline-paired lever. Some responses were as low as 0% appropriate response, usually due to a lack of

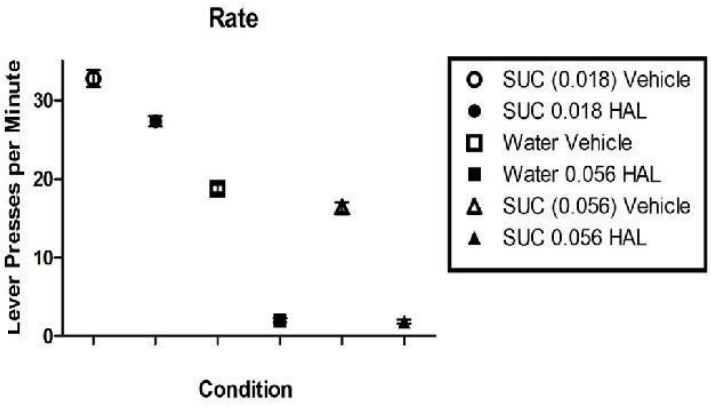

Figure 2.

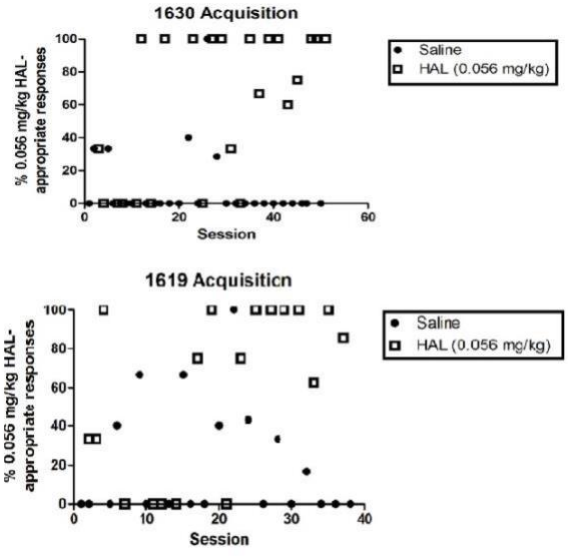

Figure 3.

responding in the operant chamber. Similarly, the bottom panel displays a control subject that was unable to acquire the discrimination.

Sucrose Consumption. The amount of sucrose consumed by the subjects was not different based on the condition. The amount of sucrose consumed was calculated daily for the two weeks prior to and two weeks after the haloperidol exposure. As seen in the figure 4, subjects did not consume any more sucrose two weeks prior to training compared to after, regardless of the training dose of haloperidol.

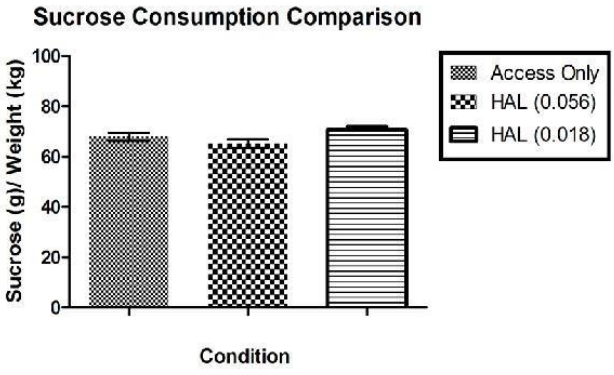

Figure 4.

Discussion

Some of the subjects completed the discrimination but the number of trials to reach discrimination was much higher than past research. Subjects consuming the sucrose solution with a training dose of 0.056 mg/kg were able to reach discrimination criteria in an average of 45 sessions. However, due to severe rate suppression, subjects did not reach a fixed-ratio schedule higher than five. Normal discrimination paradigms reach a fixed-ratio schedule of ten or higher. Similarly, subjects with sucrose access on the 0.018 mg/kg training dose, which completed the discrimination reached a normal fixed-ratio level. Still, this took over one hundred sessions to acquire compared to the eighty sessions for Colpaert et al. (1976). Another discrepancy with past research included subjects with twenty-four-hour water access unable to learn the discrimination at the 0.056 mg/kg training dose. Resulting in a discontinuation of training after eighty-two sessions, almost double the number of sessions to acquire by McElroy et al. (1989). We were unable to replicate the findings by McElroy et al. (1989) or Colpaert et al. (1976).

As previously mentioned, rate suppression was an issue. Rate suppression was more severe in subjects exposed to the 0.056 mg/kg does compared to the 0.018 mg/kg dose. The suppression impaired both the raising of fixed-ratio levels but also prevented completion of a number of the training sessions. Rate suppression effects were predicted as is common with haloperidol. Food reinforced lever pressing paradigms also show suppression in animals treated with haloperidol (Jones-Cage et al., 2011). Ashby et al. (1989) state the most common side effect is extrapyramidal effects, which includes difficulty in moving and controlling movements, which may be a possible explanation for the low rates. Additionally, there are anhedonia effects produced by haloperidol (Ettenberg & Camp, 1986). This questioned whether the sucrose pellets had any real reinforcing value, providing another possible reason for poor response rates.

Since the ending of this study, our laboratory continued this study by adjusting other variables to assist with the acquisition of the discrimination. This includes an adjustment of the training doses. Subjects receiving the 0.056 mg/kg training dose moved to a lower training dose of 0.032 mg/kg. Similarly, the time between the injection and the operant chamber testing has been extended. Other aspects can be manipulated to test haloperidol as an established discriminative stimulus. The main focus from this point is to establish haloperidol as a discriminative stimulus in subjects with only water access and replicate those past studies.

Food reinforcement and eating behaviors are mediated by dopamine (Ettenberg & Camp, 1986). Dopamine is also activated in the reward pathway by addictive substances. Therefore, if this research could establish a connection between sucrose and the dopamine reward pathway, there would be more evidence supporting the concept of sugar addiction, as proposed by Avena (2007). A connection could help researchers understand and combat the obesity epidemic in the United States.

Acknowledgments

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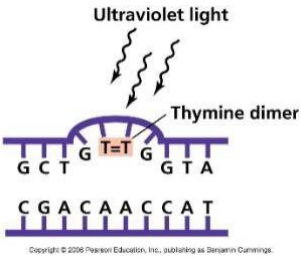
ELECTRICALLY NEUTRAL FLOURECENT INDICATORS FOR DNA ELECTROPHORESIS.

Fatou Bintou Kebbeh

Mentor: Dr. David E. Lewis

ABSTRACT



Fluorescence detection and imaging are vital technologies in the life sciences and clinical diagnostics. The key to obtaining high-resolution images and sensitive detection is to use fluorescent molecules which absorb and emit visible light. The primary aims of our project is to synthesize a stain that will not dissociate from DNA in an electric field but will not intercalate into the double helix. This will allow us to keep track of DNA movement on the gel plate without the need for post-staining. Today most of the dyes used for DNA labelling are intercalating dyes and the problem with that is intercalating agents induce mutations such as frame shifting in DNA. This can have dramatic effects on the DNA because it changes all the amino acids in the rest of the gene unlike non-sense mutation which only changes one amino acid. Dyes like ethidium bromide especially have been found to prevent the synthesis of mitochondria when intercalated into the DNA. This is very problematic because mitochondria are the primary energy production sites. For these reasons, we decided to synthesize a non-intercalating dye. We have prepared precursors to the dye by literature methods from 4-chloro-1,8-napthalic anhydride. We will explore two possible approaches:

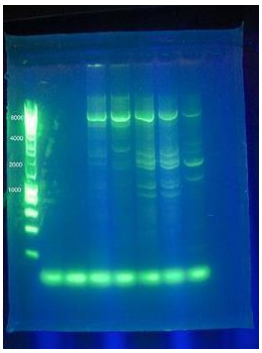
- The synthesis of a multiply charged, neutral zwitterionic dye
- And a dye carrying polyamide side chains.

Thus, when it interacts with DNA there is no net change in charge, thereby preventing the stain from being stripped from the DNA upon exposure to an electric field. The main purpose of the project is to develop a new compound that will be:

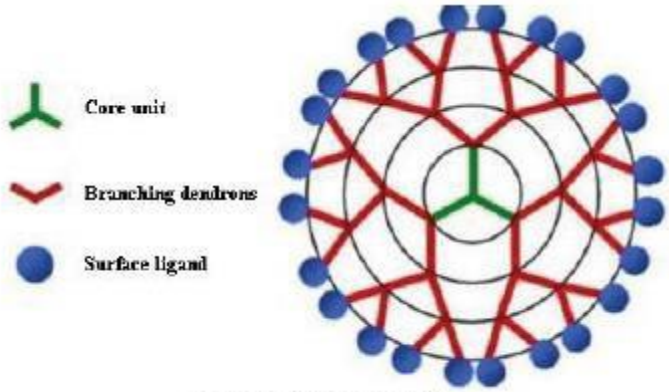
- Non-toxic,
- Will not distort the double helix,
- Will allow the user to keep track of DNA movement using visible light,
- Will not require post staining,
- Will bind to the DNA,
- And will be easily removed to permit later reuse of the nucleic acid.

We hypothesize that making an electrically neutral dye will permit pre-staining of the DNA without dissociation from the DNA during electrophoresis.

INTRODUCTION



DNA is usually visualized using ethidium bromide, which intercalates within the DNA, as a fluorescent label following gel-electrophoresis. However, the intercalation between ethidium and DNA is problematic in terms of replication and transcription purposes. This is because ethidium bromide slips between adjacent base pairs and causes a stretch of the DNA double helix which greatly enhances its fluorescence intensity and life time. However, this also inhibits a wide range of biological processes such as DNA synthesis, transcription and translation. According to Shohreh Nafisi and colleagues, it has been reported that ethidium bromide shows significant antitumor and anti-viral properties. They reported that these activities are a consequence of high affinity of ethidium for DNA double helix. The pigment base stacking tendency and intercalation site specificity depend on electrostatic interactions. This electrostatic interaction is mediated by the positive charge on the exocyclic amines of ethidium bromide and it is also important for hydrogen bonding interaction with the phosphate groups and may strengthen their bonding. When DNA is stained using ethidium bromide it can only be seen by using ultraviolet light. This is problematic in terms of obtaining the original DNA because ultraviolet light destroys the DNA and leads to reading errors due to thymine dimer formation between adjacent base pairs. Ethidium bromide on its own is highly toxic and mutagenic. Our project aims to synthesize a florescent stain that will not dissociate from DNA in an electric field but will also be fluorescent without use of ultra violet light. This will allow us to keep track of DNA movement on the gel plate without the need for post-staining. Non-denaturing arose gels can be used for the study of DNA structure and its dynamic properties. The electrically florescent dye we are trying to make will have a high molecular weight and according to Bartolome electron microscopy results indicate that associated fragments and the fragments of higher molecular weight show similar electrophoretic properties as the histones because they become very compact in the presence of Mg21 and form cylindrical structures with a diameter of ;33 nm. These results suggest that the interactions involved in the self-assembly of small fragments are the same that direct the folding of larger fragments; in both cases, the resulting compact chromatin structure is formed from a basic element containing 5–7 nucleosomes. We also looked at the possibility of making dendrimers which are tree like synthetic polymers whose structure and interaction pattern with the florescent core prevents the florescent molecule form intercalating with the DNA. Building a dendrimer using phthalic anhydride and 1,3-diaminopropane and using that as the anchor for florescent core because the outer portion of the dendrimer is bulky enough to allow binding in the major groove which will amplify bonding strength between the minor groove and the florescence label without causing any distortion. It is also going to prevent the dye from intercalating into the DNA. The problem with this synthetic pathway is that it requires a lot of polymer chemistry and since there is not a lot of experience with polymer chemistry within the group this turned out to be challenging. In



Basic dendrimer components

addition, dendrimers are very expensive as well. Dendrimers can be considered one of the more attractive recent discoveries in the field of organic and polymer synthesis. They are exciting because they have an exceptional three-dimensional structure comprising three distinct components: core (or focal point), branching point and periphery. According to Alaa Dendrimers are also considered one of the best potential drug delivery carriers due to their high biocompatibility. They are: hydrophilic, nanostructured, mimics of globular proteins, are transported across the epithelial barrier of the gut inhibit protein-protein binding, and have intrinsically fluorescent behavior under acidic conditions ii addition to their ability to load fluorescent compounds in their core and/or peripheries. The synthesis of PAMAM dendrimers is mainly dependent on iterative steps. In addition to dendrimers we also explored the class of florescence molecules call cyclodextrins. Like dendrimers, their cyclic structure binds to the florescence core in a manner that prevents its intercalation into the DNA base pairs. The fluorescent cyclodextrin (CD) in aqueous solution alone usually adopts a self-inclusion conformation in which the chromophore is located in the interior of the CD cavity. Binding of a guest molecule may lead to exclusion of the chromophore from the hydrophobic cavity into the polar aqueous solution. This drastic environmental change around the chromophore group often results in fluorescence intensity decrease and red shift. However, researchers reported that there have been a few reports about fluorescent cyclodextrins which showed a fluorescence enhancement response to guest molecules. This kind of phenomena was often explained in terms of a fluorophore-modified CD that exhibits shallow self-inclusion or no inclusion of the hanging fluorophore; the guest binding with such molecules could a provide less polar environment around the fluorophore by fluorophore–guest interaction. This is useful in terms of increasing fluorescent intensity.

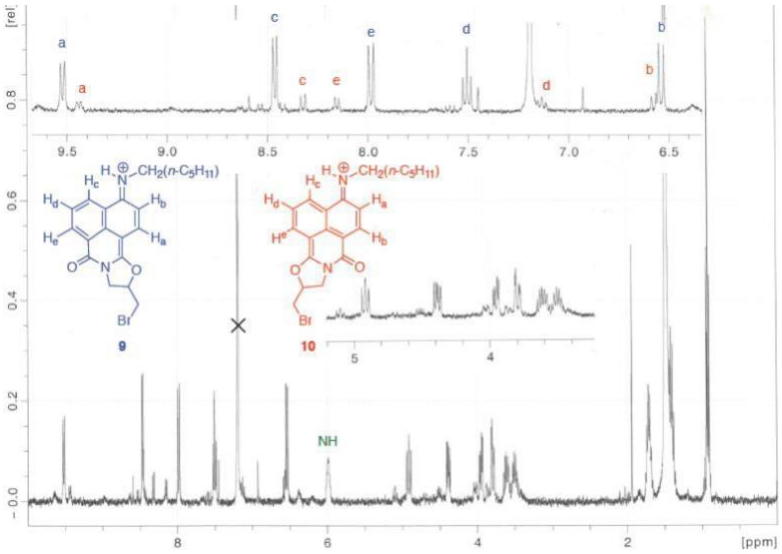
METHODS:

The required N-allyl-4-amino-1,8-naphthalimide was prepared by our previous methods based on the modified Gabriel approach, using the conjugate base of the parent 4-amino-1,8-naphthalimide with allyl bromide. The yields of pure product were not particularly high but were in line with the results of other chemists. The product was analyzed using inferred resonance spectroscopy and nuclear magnetic resonance.

RESULTS, DATA, AND DISCUSSION:

What is surprising about the product obtained is that bromination of the aromatic ring occurs in preference to the addition of halogen to the double bond of the allyl group. To put this into perspective, the addition of one equivalent of bromine to N-allyl-4-chloro-1,8-naphthalimide under the same conditions was complete within minutes, and the expected dibromide was obtained as the only product. This shows that the substituent at the 4- position of the dye exerts a substantial influence over the course of the reaction.

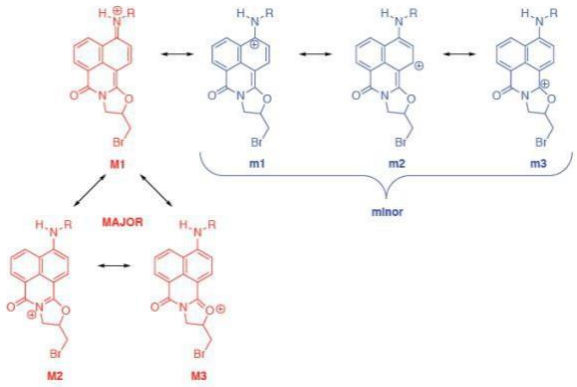
On the addition of one equivalent of bromine to N-allyl-4-butylamino-1,8-naphthalimide in dichloromethane, the red color of the halogen persisted for several hours. Reductive work-up of the reaction mixture with sodium sulfite gave two products: a minor product identified as the expected dibromide, and the major product identified as ring-brominated compound. Similar results were obtained using one equivalent of bromine in acetic acid. When two equivalents of bromine in dichloromethane were used, the tribromide was obtained as the product of the reaction.

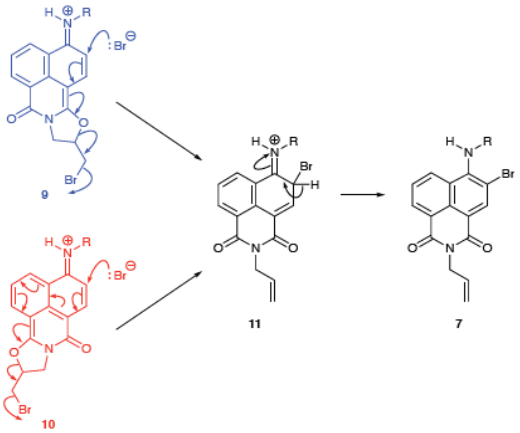


HNMR monitoring shows that within minutes of mixing, all the starting naphthalimide has been converted to a 4:1 mixture of two products. The 1 H NMR spectrum reveals that neither compound retains the olefinic double bond of the allyl group in the starting material, so the alkene must have reacted with the halogen. In addition, there are now two resonances close to d=9.5 ppm, at least 1 ppm downfield from any resonance in the starting naphthalimide. On the other hand, both ions retain the resonance near d=6.5 characteristic of the 4-amino-1,8-naphthalimide skeleton. Based on these observations, we propose that the most reasonable structures for these products are the cations 9 and 10, respectively. The simplest rationalization consistent with these observations is that the naphthalimide ring system participates in the reaction as a neighboring group. Taking cation 9 (the major regioisomer) as the model, we see that the cation is strongly delocalized. There are three major "onium ion" contributors to the structure of the cation (M1, M2 and M3), and three minor "carbocation" contributors (m1, m2 and m3). In M2 and M3, the naphthalene ring of the original 4-amino-1,8-naphthalimide is intact, so this can be used to rationalize the retention of the resonance at 6.5 ppm. In contributor m2, on the other hand, there is a positive charge at C2, which should shift the resonance of proton a well downfield from its position in the starting material.

Approximately 60% of the starting material is converted to the observed products 5 (major) and 6 (minor) within the first few minutes. The formation of 5 as the major product this early in the reaction means that the reaction products cannot be formed directly from the bromonium ion, so another intermediate must be involved in the reaction. For the reasons above, we believe that this intermediate is the mixture of cations 9 and 10. The slower conversion of these ions to the final product may be a result of solubility: the cation mixture frequently precipitates from the solution, so the rate of the final conversion may be determined by the rate at which the cation returns to solution.

A reasonable mechanism for the formation of the product with the intact allyl group is shown at left. In this case, the species that attacks the cation is the bromide anion, which leads to the iminium ion 11. Since it is generated in the same step as the addition, overall, bromide anion is a catalyst for the formation of 11. The tautomerization of the





iminium ion then completes the formation of 7.

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Corn Maze

Sierra Lomo

Faculty Mentor: Ned Gannon

Introduction:

The Midwest region of the United States is known for its large-scale corn production. One is bound to encounter acres of corn growing in orderly planted rows driving down any country road in the summer. The presence of corn might seem innocuous; however, the commodification of this crop has become increasingly problematic throughout US history. Analyzing the political and agricultural history of corn production in the US Midwest reveals the complicated nature of crop commodification.

Corn Maze is an attempt to encapsulate the impact of US corn production through a textless comic. Instead of illustrating the history of corn production or visualizing statistical data, *Corn Maze* uses information from environmental, philosophical, historical, and political sources to inform the narrative. The narrative follows a rat through various midwestern agricultural settings. As the rat navigates through cornfields, pond ecosystems, and even concentrated animal feeding operations (CAFO's), the viewer is exposed to the several ways these settings are interconnected. *Corn Maze* presents these topics to the viewer with no accompanying information in hopes to instill a sense of curiosity within them.

Previous artists who've created textless narratives include Shaun Tan and David Wiesner, both of whom inspired the format of *Corn Maze.* Shaun Tan's *The Arrival* and David Wiesner's *Flotsam* are both examples of textless comics intended for younger audiences. Each of these works showcases thoughtful illustrations to convey the themes of the narrative. *Corn Maze* is more in-line with the tone of *The Arrival* in that it tackles more serious themes such as social and environmental issues.

Incentivization of corn dates to the 1970's with the Farm Bill and the World Food Crisis. Under the Nixon administration, the Farm Bill was altered to increase the financial support in federal subsidies for farmers growing specific crops, corn being one of them (Kammer). Considering the surplus of corn, the US produces today, it's concerning to think about the overall implications of its mass production. The US Midwest produces about one third of the entire world's corn and (Basche). Corn production is an intensive process that requires significant resources such as land, water, pesticides, fertilizer, and overall energy to produce a successful harvest. Widespread use of synthetic pesticides and fertilizers risks water contamination which impacts nearby water-systems (Frump).

Methods:

General research was conducted before any sketching was done. Once a basic understanding of corn and crop commodification was established through relevant literature, visual research was gathered. Visual research includes compiling imagery related to the subject matter such as agricultural settings, animals, and crops. These images were often printed out to easily access visual references during the sketching phase. While thorough research is necessary

to root the narrative in facts, most of this information cannot be conveyed through a textless comic.

Immediately following the research, sketching, and playing with imagery and materials was fundamental to developing the narrative and visual aesthetic of the comic. The materials used in the sketching process, as well as the final artwork, includes ink, acrylic, colored pencil, and charcoal. All the materials were either black or white pigments; this focused any issues of color to be confined to a black and white value range. Using a large watercolor paper sketchbook, these materials were applied freely to learn more about the nature of the mediums and careful studies of the subject matter were conducted along with any media experiments.

The narrative was developed alongside the sketching and experimental stages of *Corn Maze.* Thumbnails, or small to-scale drawings of each page, were created to establish general panel flows and compositions throughout the comic. These drawings are used as guides and not as final page compositions since they're loose and general sketches. A total of eight pages were selected out of various thumbnails developed for the narrative.

The artwork itself was created on Arches Watercolor Hot Press paper for its durability and receptivity to water media. Following the thumbnail drawings, the general compositions were formatted and drawn on the final working surfaces. When formatting, margins, and spacing between each panel were carefully measured to maintain consistency between pages. During this stage, the sketches were continuously developed and finalized before applying permanent mediums. Ink washes were applied after the sketching phase and the values progressed from light to dark values, this is an additive process of establishing values. Subtractive processes were introduced after establishing initial values with ink washes such as using white acrylic paint to return lighter values to the image. Additive and subtractive processes were used interchangeably throughout the creation process. After the physical artwork was created, the pages were scanned in and edited digitally to clean the margins and spaces as well as any digital painting to correct drawing issues.

The Narrative:

The narrative begins by placing the viewer on the ground floor of a cornfield, looking down between two rows of corn. There's an impression of a creature placed at the bottom left of the first panel, cloaked in shadow. Upon moving closer, the creature turns out to be a rat looking up the towering corn stalks. We follow the rat's movement as it travels up the stalks and we are presented with a full page revealing the setting—a rolling cornfield and a horizon filled with the silhouettes of trees and buildings.

The idyllic Midwestern scene is interrupted by a looming shadow of a plane moving over the cornfield. The rat peers around an ear of corn and aerial drift from the plane rains down over the area. As the cloud worms its way through the corn stalks, the rat flees the scene. The rat watches from a distance and the aerial drift can be seen pouring out from a rift in the cornfield.

The setting transitions from the overview of the cornfield to ground level looking at a grassy environment with the impression of cattails in the distance. The still grass is disturbed by the rat poking its head out of the grass. The rat stumbles upon a pond ecosystem during its travels, however, something seems to be off about this scene. As we look out at the pond ecosystem from behind the rat, suggestions of fish are seen floating in the water and lying by the shore. Upon closer inspection, we see that the fish are dead. The rat leaves the area because it is inhabitable.

The following setting presents us with a single level building with a wide and open entrance. We zoom into the entrance and we see the rat again, peering into the dark environment. Switching points of view, we are positioned within the building looking out into the blinding brightness. The shadow of the rat pours into the building and we see rails piles of granular material inside. The rat goes to explore the pile and discovers that it is edible. A sudden exhalation of air captures the attention of the rat and it looks up the snout. We see a cow and the rat staring at each other from a profile view.

An overhead view of the scene is provided as the rat travels along the railing system. The viewer is shown the row of cows milling around and eating the feed below. Outside, the rat is seen traveling away from what appears to be a CAFO and it climbs on top of a hill where we're given an overview of the entire establishment. Looking out from behind the rat, we see the CAFO building and manure pits to the left of it. The final panel of page seven looks back towards the rat as it stares out over the scene.

While the viewer is positioned on top of the hill with the rat, we see that the clouds have rolled in and begin to rain over the entire setting before us. The following scenes return to the previous settings, the CAFO, cattails from the pond, and corn stalks from the cornfield. Evidence of raindrops and puddles can be seen within these scenes as the water cycle ties these settings together.

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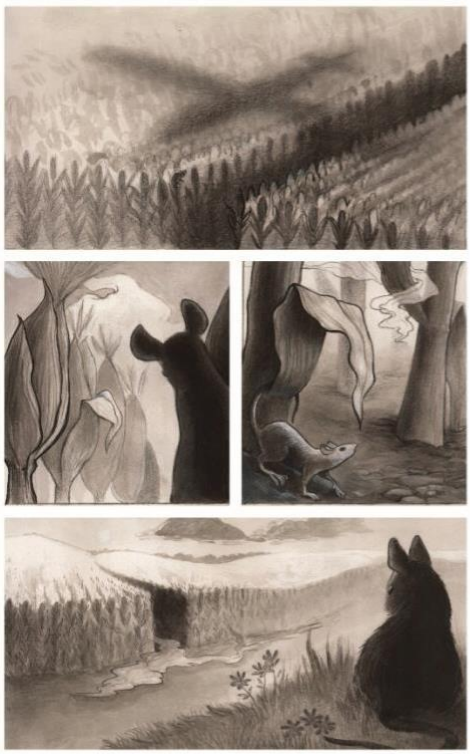

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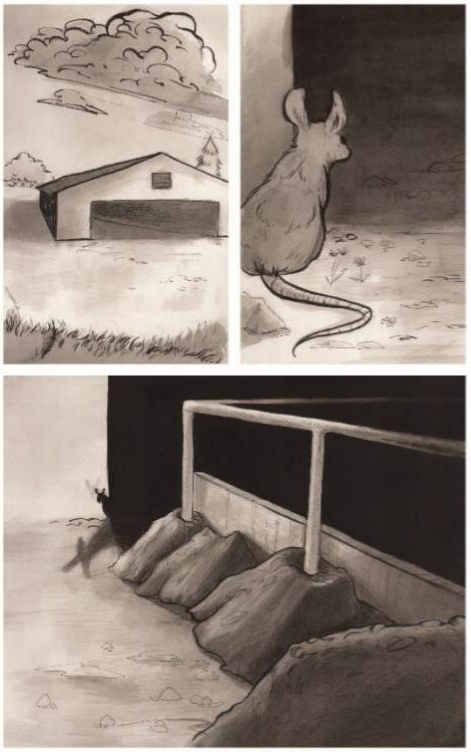

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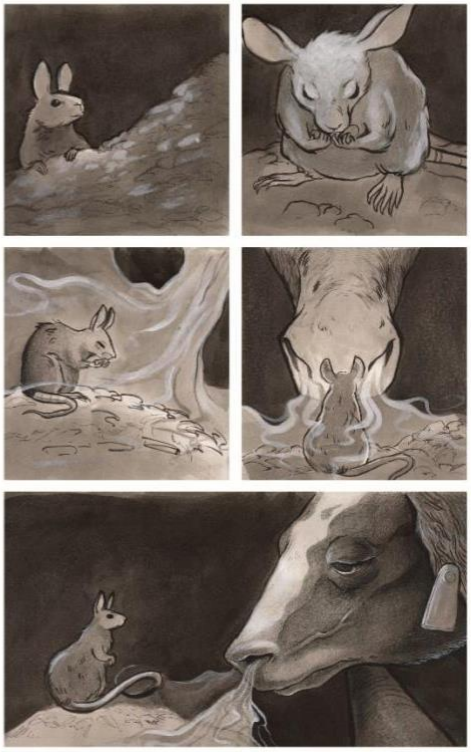

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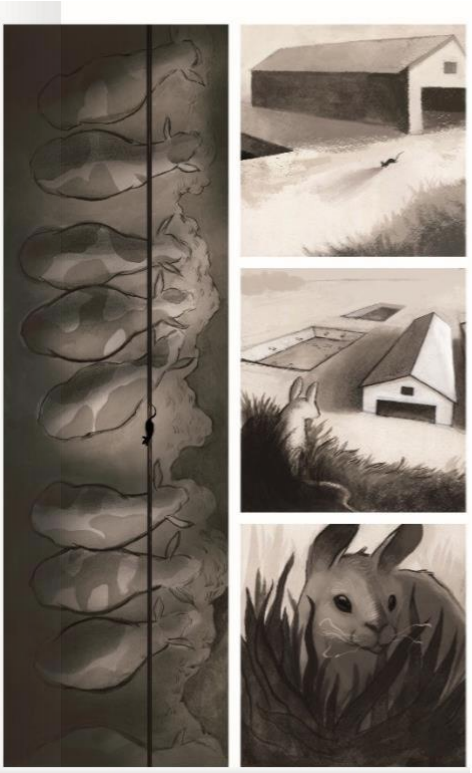

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Page 8

Discussion:

Rather than compile a history and statistics on the history and impact of corn, *Corn Maze* uses a textless visual narrative to convey the issues surrounding industrialized agriculture in the Midwest. The comic focuses on corn because it is such an iconic product of the Midwest and the environmental implications of its mass production are relevant to nearby communities. Visual interpretations of data and history allow for a broader audience and more accessibility to major themes and concepts regarding the topic of corn overproduction. In the narrative, the viewer follows the journey of a rat as it navigates through cornfields, pond ecosystems as well as concentrated animal feeding operations. The last page briefly revisits each of these settings as a rainstorm comes through the region, allowing the viewer to contemplate the cycle of in which industrialized corn production impacts Midwestern environments. The narrative simply presents these topics with lush illustrations to create a memorable experience for the viewer.

The main goal of this project was to take scientific data and interpret that information into a visual narrative. In doing so, the scientific information becomes much more accessible to a wider audience, such as children, however, many of the finer details from academic articles may be lost within translation. Other than accessibility, interpreting scientific information into a visual narrative allows people to experience the information in a much more personal way. As the viewer follows the rat through the narrative, they see how industrialized agriculture impacts the rat's immediate surroundings. At the end of the narrative, we are left contemplating the water cycle's involvement runoff of harmful materials such as synthetic pesticides and fertilizers.

The absence of text forces makes the imagery the focus of the presentation. The visual information is simplified to grayscale images. There is text at the end of the narrative to accompany the visuals, however, this text is supplemental and not necessary to read unless the viewer is curious to learn more about the topic.

Conclusion:

Industrialized agriculture plays a significant role in Midwestern society. Corn Maze is intended to promote awareness of the ways that industrialized agriculture impact its surrounding environment. Using a comic format changes how people perceive the information. Comics are a primarily visual format, and in the case of *Corn Maze*, it is purely visual. The absence of text keeps the imagery as the focus and removes issues of literacy. At first, it appears as a journey of a lone rat who is navigating through these Midwestern sites. However, the narrative prompts the viewer to wonder why the comic portrays these specific locations and begin to make associations between the various locations. The end of the narrative revisits previous locations within the story, contemplating the connection between these sites. There are multiple ways to interpret the narrative as viewers are encouraged to explore and draw connections while they accompany the rat on its journey.

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Laser Induced Fluorescence Spectroscopy of 4H-pyran-4-one in an Electronic Excited State

Michael McDonnell

Faculty Mentor: Dr. Stephen Drucker

Abstract:

The importance of computational chemistry in chemical synthesis, material design, and to chemistry in general has resulted in a demand for experimental benchmark data. Advances in computational chemistry are presently limited by a lack of excited state benchmark data. In order to meet his demand, the singlet excited state of 4H-pyran-4-one has been recorded and excited state vibrational assignments have been made. Several spectroscopic methods are employed in this paper including resonant two-photon ionization spectroscopy and jet-cooled laser induced fluorescence in an attempt to overcome 4PN's low vapor pressure. The experimental data acquired from this experiment is used to determine the accuracy of several *ab initio* and DFT computational methods.

Introduction:

Computational chemistry has become an increasingly important tool for predicting chemical reactivity. Computational techniques model the molecular collisions intrinsic to chemical reactions. During these collisions, a molecule's spring-like chemical bond may become stretched, compressed, or, as in the case of a chemical reaction, broken. A bond's flexibility influences whether or not the bond will be broken during a collision. Thus, understanding the resilience of a bond is important to being able to predict the outcome of a chemical reaction.

Under certain conditions, the flexibility of a chemical bond may be altered before a molecular collision even occurs. One way to achieve this is electronic excitation. Here, an outside source provides energy to move a negatively charged electron away from the positively charged nucleus. In the common case of photoexcitation, light supplies the energy. Analogous to a spring that has been stretched too far and has lost its resilience, electronic excitation causes the chemical bonds of a molecule to become deformed and changes the bond's flexibility. As a result, a photoexcited molecule is more susceptible to undergoing chemical reactions when it collides with another molecule.

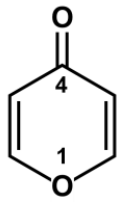

FIG. 1. 4H-pyran-4-one (4PN)

My current research is focused on the molecule 4H-pyran-4-one (4PN; see FIG. 1). My goal is to test how the flexibility of the bonds in 4PN change after electronic excitation occurs. 4PN has several notable features: (1) it is relatively small; (2) it is cyclic (i.e. it has a ring); (3) it is conjugated (i.e. it has alternating double and single bonds); and (4) its conjugation is partially outside of the ring. These structural features are common to photochemically active molecules and make 4PN an attractive computational target. By obtaining

experimental data on 4PN, I will be able to help computational chemists test the validity of their theoretical models.

Methods:

To accomplish this goal, I have worked with Professor Stephen Drucker in the UW-Eau Claire Chemistry Department since January 2014. In the lab we use an experimental technique known as laser spectroscopy. In the experiment, laser light is directed through a cell filled with a sample of gaseous molecules. The light energy from the laser will cause the molecules to become electronically excited. The laser can also excite molecular vibration associated with the spring model discussed above. We measure a spectrum by incrementing the wavelength of the laser light and recording absorption events as a function of wavelength.

One consequence of quantum mechanics is that molecules will only absorb laser light of specific wavelengths that correspond to allowed levels of electronic and vibrational excitation. The resulting spectrum will have peaks that correspond precisely to the energy needed for simultaneous electronic and vibrational excitation; this simultaneous excitation event is known as a vibronic transition. By knowing the energy (i.e. laser wavelength) needed to induce these vibronic transitions, one can determine the vibrational frequency of the molecule in the electronic excited state. Vibrational frequencies can then be used to quantify the flexibility of the chemical bonds in the excited state.

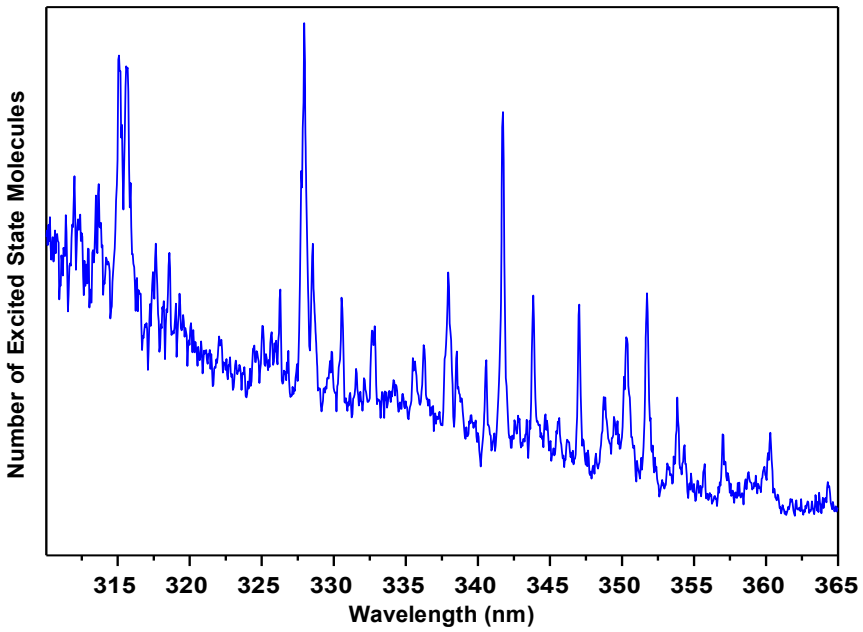

FIG. 2. R2PI Spectrum of 4PN

Current computational chemistry techniques can quickly predict accurate vibrational frequencies of molecules in the ground state-when electronic excitation has not occurred. However, analogous predictions for excited states remain challenging.[1] This situation has created

a demand for experimental benchmark data on excited states, such as I am obtaining for the 4PN molecule.[2]

Past Research:

Propelled by my experiences in Prof. Drucker's lab, in August 2016 and 2017 I collaborated with Professor Timothy Zwier's research group at Purdue University. There I worked with several graduate students in the Zwier group to record a resonant two-photon ionization (R2PI) spectrum of 4PN (see FIG. 2). R2PI is a specialized spectroscopic technique that operates in an ultracold environment to suppress interfering or unwanted peaks in a spectrum.[3] R2PI detects laser-induced vibronic transitions extremely sensitively. The collaboration at Purdue was initially a "test-of-principle" to determine if it would be feasible to study 4PN with R2PI. However, the experience exceeded expectations as we collected a complete spectrum of 4PN in its excited state. The subsequent analysis of the R2PI spectrum yielded numerous peak assignments. However, the analysis is not complete because the R2PI spectrum is limited in its resolution; this means certain peaks are actually composed of several peaks blended together. In my current project, I am implementing a complementary and higher-resolution technique known as jet-cooled laser induced fluorescence (LIF) to record the 4PN spectrum in Prof. Drucker's lab at UW-Eau Claire.

Current Research:

The LIF spectrometer I am developing in Prof. Drucker's lab detects the fluorescence, or emission of light, subsequent to a vibronic transition. The LIF instrumentation measures fluorescence intensity against a "dark" background. This allows one to detect tiny amounts of light emitted by the molecules. We are also incorporating a jet-cooling component into the spectrometer. Jet-cooling is a method for reducing the number of sample molecules having ground state vibrational excitation.[4] Transitions arising from these molecules lead to extraneous peaks in the LIF spectrum. The jet-cooling apparatus works by passing a high-pressure inert gas such as helium through a reservoir containing the sample of 4PN. The vapor of 4PN is entrained in the helium flow, and the gases then expand through a small nozzle orifice into an evacuated chamber. During the expansion, the sample molecules transfer energy to the helium carrier atoms. This dramatically reduces the number of sample molecules with ground state vibrational excitations and permits high-resolution spectroscopy free of various interfering states.

The LIF spectrum to be recorded will complement the existing R2PI spectrum, allowing me to characterize the 4PN excited state more fully. My combined results will clarify room-temperature data published by Gordon and Park in 1993.[5] Their work contained numerous vibronic assignments, some speculative. Preliminary computational predictions for 4PN indicate that several of these vibronic assignments are incorrect. This is likely due to spectral congestion appearing in the room-temperature spectrum of Gordon and Park. By recording the LIF spectrum under jet-cooled conditions, I will be able to clarify the assignments of Gordon and Park, particularly regarding higher-energy vibrational modes. Knowledge of the frequencies of higher-

energy modes is especially important chemically, as photochemical processes involve the excitation of these modes.

Conclusions:

My results will be of interest to chemists on two fronts: (1) to test the validity of computational predictions; and (2) as a means of gaining insight about the photochemistry of 4PN and conjugated, excited state molecules. In testing computational predictions, I will compare my spectroscopic results to values obtained through a variety of published computational methods.[1] By assessing the accuracy/cost ratio across computational methods one can better gauge why certain methods are more accurate than others. This will allow computational chemists to refine their code for treating photochemically relevant molecules. In turn, this will provide bench chemists with theoretical grounding for planned experiments, overcoming the need for "brute-force" or "trial-and-error" chemical design. The added efficiency could have far-reaching consequences in areas such as chemical synthesis, drug design, and materials design.

Further, my experiment will provide quantitative data on the vibrational frequencies of 4PN in particular. This is useful for understanding the photochemistry of conjugated, excited-state molecules. Understanding how the conjugation of 4PN (both inside and outside of a ring) affects its vibrational frequencies is useful for estimating the potential for bond breakage and photoreactivity in similar molecules.

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Cahokia: Reshaping the Future by Relearning the Past

Hayden L. Nelson

Advised by Dr. Wendy Makoons Geniusz, Dept. of Languages

"For most Whites throughout the past five centuries, the Indian of imagination and ideology has been as real, perhaps more real than the Native American of actual existence and contact… the Indian of imagination and ideology continued to be derived as much from the polemical and creative needs of Whites as from what they heard and read of actual Native Americans or even at times experienced… As a consequence, one finds less of a cumulative development in the genealogy of the imagery, for the basic images of the good and bad Indian persist from the era of Columbus up to the present without substantial modification or variation."[1]

[1] Robert F. Berkhofer, Jr., *The White Man's Indian: Images of the American Indian from Columbus to the Present*, (New York: Alfred A. Knopf, 1978), 71.

Unpacking the Pre-Contact Stereotypes

What does it mean to be "civilized"? This ever-allusive word creates a line of bias in our minds and societies, with perspective largely shaping how we come to define it. It is a word that historically never seems to be all-inclusive. Thus, there must always be the dichotomous relationship of the "civilized" (though, generally, the civilized person is the one using the word) and the "uncivilized." Throughout history different societies with differing ways of life have not been able to coalesce into one group, rather, ulterior motives, usually of domination, are at play. This word is one that has glorified the feats of Europeans and Americans while stifling the accomplishments of minority peoples. Furthermore, "civilized" is even less-frequently used for the peoples of the "New World": that is, Native Americans.

The perceived savagery of the Native Americans during the early colonial period espoused by the colonists pervaded the image of the Native American, demonizing them and justifying the Anglo-Saxon conquest as fulfilling "God's work." These perceptions have persisted and adapted in accordance with the changing social structures of America, evolving into what we now know as modern racism. The repeated fallacies and stereotypes presenting the overall "uncivilized" Indian in textbooks and teaching curriculums led the members of the 1927 Grand Council Fire of American Indians to ask, "What is civilization? Its marks are a noble religion and philosophy, original arts, stirring music, rich story and legend. We had these. Then we were not savages, but a civilized race."[2] The misuse of "civilized" and "uncivilized" as classifiers continues to be an issue in history textbooks today, perpetuating the white American theories of phrenology and innate racial differences, espoused by leading academics in the early 1800s. One textbook that uses such language, *A History of the United States*, authored by Daniel J. Boorstin and Brooks Matthew Kelley, devotes only a single page to the Aztec, Mayan, and Incan empires. This book succeeds in ridiculing the pre-Contact Natives for not having the bravado to cross the oceans, claiming that their progress towards civilization had, therefore, plateaued in their isolation. Boorstin and Kelley even appear to justify the practices of colonization, using language that claims that, because of their plateau in advancement, the Indigenous peoples "were ripe for conquest."[3] Loewen heavily criticizes this textbook for looking only through the rose-colored glass of Eurocentrism: "Of course, if Boorstin and Kelley had looked around the world in 1492, they would have seen no such decisive differences between American and European cultures. This is a secular form of predestination: historians observe that people were conquered and come up with reasons why that was right. In sociology we call this 'blaming the victim.'"[4]

However, on occasion, some Native societies are given the status of being "civilized," usually the Aztecs and Mayans since their cultures resembled closest the European cultures and ideas of advanced societies. According to Loewen, these textbooks only confer civilization onto groups of Natives in using the same premises used by the Spanish conquistadors themselves, that being, material wealth as directly equivalent to civilization or advancement.[5] The issue with modern textbooks is that they continue to perpetuate the racist sentiment of the long-dead conquistadors who first discovered the New World.

Modern history textbooks approach Native history in one of two ways: through a fantastic "Pocahontas-esque" manner, which describes Native Americans as the monolithic "Noble Savage," fighting a lost cause as the last defense against the evils of Anglo-Saxonism. Conversely, Native history is also taught in the past-tense, fitting into the "Vanishing Indian" stereotype in that the Indian, as is interpreted by whites to have existed (all tribes monolithically donning Plains Indian

[2] James W. Loewen, *Lies My Teacher Told Me: Everything Your American History Textbook Got Wrong*, 2nd ed. (New York: Simon & Schuster, 2015), 100.
[3] Ibid., 98.
[4] Ibid., 99.
[5] Ibid., 98.

attire, war whoops and raids, etc. – in other words, the "Savage Indian"), is an artifact of the past and, thus, the actual Indian descendants of today are not "real Indians." Ojibwe writer Edward Benton-Banai explains this phenomenon of the "Vanishing Indian" and the issue with modern history textbooks:

> Today, America has replaced the bayonettes with more sophisticated, less visible weapons like school systems that ignore Indian history and culture; textbooks that falsely represent the settlement of this country; and movies and media that misunderstand Indian culture and portray Indian life in a shallow, token way. Still the purpose is the same: to absorb Indian people into the melting pot of American society and to forget the real history of this country and the injustices done to its Native people. The old ways, these teachings, are seen as unnecessary to the modern world. It is becoming more and more evident today that many Americans feel the philosophy advocated by traditional Native people, the respect for all living things, is a roadblock to American progress.[6]

These textbooks, such as the ones that Benton-Banai and Loewen describe, teach history as though it is static and unchanging, therefore continuing to use derogatory and insensitive remarks towards multicultural peoples. Rather, revision and re-evaluation are required, as is central to the dynamic and ever-changing field of history. This paper argues that we need to re-evaluate the images of pre-Contact North America and reconsider how Indigenous people are portrayed in textbooks and teaching curriculums, as well as in other media. To achieve a more inclusive history, emphasis must be placed on the requirement that historians must work to "decolonize" the historical narrative to dispel stereotypes and misinformation towards multicultural people, which is the basis of racist ideologies.

First Impressions

Interest in the mounds and earthworks scattered throughout the United States, largely the Great Lakes region, American Bottom, and Southeast, is first credited to Thomas Jefferson. The first impressions of those who discovered these massive earthen works of art was one of awe. In fact, the common belief of the time was that the people who erected these structures – referred to as "Moundbuilders" – were entirely unrelated to the Native Americans of the nineteenth century. As George R. Milner describes, the common belief was that the people who built such inspiring structures were some superior people, perhaps even equivalent to the Anglo-Europeans, who were tragically overthrown by the barbaric Native Americans that populated the territory. This provided a convenient justification to expansion-hungry Americans that if the land had been taken by force by an "inferior people," then it only made sense for a "superior, more sophisticated people" to reclaim it.[7] Theories for whom these mysterious "Moundbuilders" could have been were innumerable and far-fetched. In *Indian Mounds of Wisconsin*, Robert A. Birmingham and Leslie E. Eisenberg state that there was a significant group of scholars of the eighteenth and nineteenth centuries who believed the mounds to have been built by the Phoenicians, Hebrews, Greeks, Romans, Persians, Hindus, Vikings, Welsh, Danes, and Atlantians, with only a minority of scholars believing them to have actually been Native-made.[8] Milner notes that the common sentiment of the time directly correlated enormous structures with enormous and sophisticated populations, resulting in many people drawing direct comparisons to the great empires of Egypt, Mesopotamia, or of the Mayans, Aztecs, or Inca. These seemingly-ridiculous theories strengthened the position

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[6] Edward Benton-Banai, *The Mishomis Book: The Voice of the Ojibway*, (St. Paul: Indian Country Press, 1979), 111.
[7] George R. Milner, *The Moundbuilders: Ancient Peoples of Eastern North America* (London: Thames & Hudson, 2004), 15.
[8] Robert A. Birmingham and Leslie E. Eisenberg, *Indian Mounds of Wisconsin* (Madison: The University of Wisconsin Press, 2000), 16-17.

that in no way could such magnificent peoples, capable of such fantastic achievements, have been related to the people who were increasingly being forced to relocate to and survive on the worst possible lands.[9]

It is probably impossible to find the exact date when the moundbuilder theory gave way to the reality of these fantastic structures indeed being constructed from Native American ancestry; however, it was probably around the time of the end of the Indian Wars when most tribes across the United States were either extinct or confined to reservations. As Milner pointed out, this provided the white settlers with a form of "convenient justification" with which they could Manifest their own Destiny, at the peril of the destinies of the Indigenous peoples across the land. Only once all the territory from the Atlantic to the Pacific had been claimed, America's Destiny fulfilled, its Native inhabitants subjugated and, therefore, the convenient justification no longer needed, would scholars begin to seriously consider the probability that the structures could have been Native-made.

Cahokia in Relation to London

The popular comparison for historians studying Cahokia is to Medieval London, mostly due to the belief that the two cities had comparable populations. However, this is merely a superficial and convenient comparison for historians studying Cahokia because, around the eleventh and twelfth centuries, London and Cahokia *could* have been similar in population. Historians know to some degree of accuracy London's population at the time because of government documents written down and preserved throughout its history; however, Cahokia is not so fortunate in terms of record keeping. The population estimates of Cahokia are based off of archaeological remains found in and around the site, since there are no existing forms of record keeping found that could have been contributed to the Cahokians. These estimates are not very accurate, however, with numbers ranging anywhere from 5,000 all the way up to 40,000 inhabitants. Therefore, although population may be the most attractive comparison to the reader, it is perhaps the least helpful and hardest to prove. Moreover, size of a city does not make the larger city any more civilized than a smaller one - if that were the case Los Angeles or New York would be seen as a Mecca of civilization and Madison, Wisconsin would be seen as some uncultured backwater. It would be absurd to think such a thing, and it is for this reason that population, though a flashy statistic, is really a moot point when comparing the "civilization" between two cities.

The history of Cahokia is riddled with speculation due to the sheer lack of documentation. Rather than making speculations of the city and comparing it to another city we must instead take Cahokia for what we know that it was: a magnificent pre-Contact Native American city that was the largest and, perhaps, most significant Indigenous settlement north of the Rio Grande. This approach takes out the messy speculation without really removing any of the significance from Cahokia. In fact, being that Cahokia was a large pre-contact North American city, regardless of what the actual population was, it is widely believed that it was the religious center for a rather extensive area outside of the city's immediate vicinity. Given Cahokia's religious importance, it is plausible to believe that the population of the city could have increased substantially during certain times of the year. Sally A. Kitt Chappell believes that Cahokia may have had 10,000 to 14,000 people at its height, but when crowds came in from the surrounding region for festivals the population may have doubled or even tripled.[10] Even if we take the lowest population estimate of 5,000, that means the population of Cahokia could have certainly increased to 10,000 or even 15,000 during important festivals, such as the solstices and equinoxes.

It is believed that Cahokia's peak population occurred during the twelfth century A.D. London's peak occurred roughly one hundred years later in the thirteenth and early fourteenth

[9] Milner, 15.
[10] Sally A. Kitt Chappell, *Cahokia: Mirror of the Cosmos* (Chicago: University of Chicago Press, 2002), 46.

centuries, which is another issue with the population statistic. When Cahokia was at its peak in the twelfth century, London had not experienced its boom yet; conversely, in the thirteenth and fourteenth centuries when London was at its peak, Cahokia's population was rapidly decreasing and, around 1350 A.D., was completely abandoned. In his book, *Medieval London: From Commune to Capital*, Gwyn A. Williams regards the population of London as having doubled in size from the beginning of the thirteenth century to the early fourteenth.[11] Given the approximate population of London during the late thirteenth and early fourteenth centuries and Cahokia experiencing its peak in the twelfth century, Cahokia would have needed to have a population in the upper estimates (30-40,000) to have been larger than London. However, Claudia Gellman Mink, author of *Cahokia: City of the* Sun, brings up an interesting view, taking a somewhat moderate stance in terms of population estimate. Mink, estimating Cahokia's population at 20,000 at its peak around A.D. 1150, argues that the city of Cahokia, covering an area of 5.1 square miles, had about 4,000 people per square mile. By modern American standards a community is regarded as a city when there are more than 250 people within a square mile.[12]

The population statistic is unreliable and does not reveal anything too substantial in terms of "civilization," rather, I argue that more socio-cultural-political aspects should be examined and compared, truly comparing the "civilization" of the cities, as opposed to an arbitrary population estimate. Indeed, there are some useful comparisons to be made between the two cities. For example, architectural marvels are present in both places, for instance, London began construction of the "first stone bridge in 1176."[13] This bridge, after many periods of renovations and rebuilding, is the same London Bridge that stands today. Another architectural masterpiece during this period was "Old" St. Paul's Cathedral. This cathedral, the fourth church upon the site, was the first to be built of stone and began construction in 1087 following a devastating fire to the third church, which was constructed of wood. "Old" St. Paul's stood until being irreparably damaged by the Great Fire of 1666, upon which the modern St. Paul's was built.[14]

Similarly, the architectural achievements of Cahokia were many. Perhaps the most famous accomplishment of the Cahokians was the construction of a colossal mound, named "Monks Mound." The size of this mound is not to be understated, as William Iseminger states, "The basal measurements of the mound give it an area of about 14 acres, which is greater than the base area of the Great Pyramid of Cheops in Egypt and the Pyramid of the Sun at Teotihuacan, Mexico, both of which are about 13 acres."[15] This colossal earthen mound played a role in both the political and spiritual life of the Cahokians. Atop this great mound would have resided the primary chief, his family and other nobles of the city, as well as religious leaders. The physical separation of these key figures to the rest of Cahokian society served to demonstrate the separation of tangible power in the city, but also a separation from the rest of the populace in terms of religious influence as well, due to the simple fact that their elevation made them closer to the heavens.[16] In Cahokian society, as seen in many Native American cultures throughout North America, political influence and religious influence were intertwined: whoever had political power was likely closer to the spirits, and whoever was closer to the spirits would garner more respect and, therefore, political influence.[17]

The Cahokian people were very sophisticated technologically. Gellman Mink points out that it was the increasingly more sedentary lifestyle of the Mississippians that made possible the hallmarks of modern cities, such as magnificent structures, widespread commerce, and stratified

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[11] Gwyn A. Williams, *Medieval London: From Commune to Capital* (London: The Athlone Press, 1970), 20.
[12] Claudia Gellman Mink, *Cahokia: City of the Sun* (Collinsville: Cahokia Mounds Museum Society, 1992), 24, 26.
[13] Gordon Home, *Mediaeval London* (London: Ernest Benn Limited, Bouverie House, 1927), 94.
[14] William Benham, *Old St. Paul's Cathedral* (Project Gutenberg Ebook, 2005), 3.
[15] William Iseminger, *Cahokia Mounds: America's First City* (Charleston: The History Press, 2010), 42-43.
[16] Milner, 125.
[17] Whiting Young and Fowler, 264-265, 272.

social, political, and religious organization.[18] Native inhabitants at Cahokia were able to shift from primarily small bands of hunter-gatherers to a densely-populated city due to their adeptness in agriculture, particularly with the introduction of one species: maize. The introduction of maize and other agricultural crops also led to large-scale surplus and storage of food. These surpluses enabled the inhabitants more "free-time" because they no longer had to rely on hunting and gathering on a daily basis for mere survival. They utilized this free-time to specialize and advance in other areas, particularly in astronomy, mathematics, and the arts. One such example of the advanced geometric and astronomical knowledge present at Cahokia is, as Eric E. Bowne points out, "The circles (woodhenges) could be used to determine the solstices, equinoxes, and other important dates on the agricultural calendar. The engineers of Cahokia were sophisticated enough to understand that an accurate calendar at their latitude required the center post to be placed five and a half feet east of the exact center in order to align it properly with the solstice sunrises."[19] This achievement is not to be understated. The astronomical and mathematical advancement required in a society to determine such minute details as that is astounding, especially since there is no evidence that these people possessed instruments akin to the telescope.

Both Cahokia and London were regional centers for both trade and religious purposes. It is widely believed that Cahokia's trade influence extended north as far as the Great Lakes, east as far as the Atlantic, south as far as Florida, and westward into the Plains, maybe even extending to the Rocky Mountains. Regarding the trade system operating in the American Bottom, Patricia J. O'Brien concludes that the ethnohistoric record suggests a class of traders --- that trade was extensive, a system of trails and canoe routes were employed to move goods between core and periphery, and that a potentially common standard of value was present. This proposed standard of value is believed to have been marine shells and cumullae, which held value as "primarily wealth items of extreme tradeability and secondarily as a status item."[20] Gellman Mink also alludes to the vast Cahokian trade system, noting that their central location (approximately ten miles east of modern-day St. Louis) in the land and their location at the confluence of three major river systems enabled them to engage in long-distance trade. Archaeological findings prove that the Cahokians procured copper from the Upper Great Lakes, mica from the southern Appalachians, and seashells from the Gulf of Mexico.[21] Similarly in London, all the currents of European trade were flowing into London harbor by 1300.[22]

Religion, however, was an inversion of trade operations in both cities; instead of everything going out, everyone flocked to the city center for ceremonies. The scale of importance of religion in Cahokia is evident in the fact of the estimation of more than 120 mounds at the site during it's time, the five woodhenges that had been constructed, and the pottery discovered at the site. Chadwick Allen describes the multi-functionality of Native earthworks:

> The raised forms of Indigenous earthworks marked territorial boundaries and significant roadways; they created focal points within urban settlements and within centers for economic trade; technological and artistic exchange, intellectual and spiritual practice. Platform, conical, and pyramid, ridge-top, geometric, and effigy mounds thus represent achievements in science and aesthetics on a monumental scale. They integrate the precise observation of natural phenomenon with geometry and other abstract forms of knowledge, as well as with practical skills in mathematics, architectural design, engineering, and construction. Many earthworks were sculpted to mirror perceived patterns in the sky, both in the bodies of individual works and in the arrangements of multiple works into complex

[18] Gellman Mink, 4.
[19] Eric E. Bowne, *Mound Sites of the Ancient South: A Guide to the Mississippian Chiefdom* (Athens: University of Georgia Press, 2013), 74.
[20] Patricia J. O'Brien, "The 'World-System' of Cahokia Within the Middle Mississippian Tradition" *Review (Fernand Braudel Center)*, Vol. 15, No. 3, (Summer 1992), 398-399.
[21] Gellman Mink, 13.
[22] Williams, 106-107.

> sites and cities; moreover, particular works were often aligned with specific celestial events, such as an equinox or solstice sunrise, or sunset point on the horizon.[23]

Milner also notes the multi-functionality of the woodhenges, "While the woodhenges could be used to mark the passing of the seasons, they would no doubt have had more ritual than practical significance since people knew perfectly well when to plant and harvest their crops."[24] Biloine Whiting Young and Melvin L. Fowler confirm this belief in the importance of religion to the early Native Americans inhabiting Cahokia:

> An understanding of the ideological basis of Cahokia begins with Monks Mound and the few plazas that surround it, one at each of the cardinal directions. Monks Mound and its plazas form a cross, making it the central icon around which the landscape was organized and oriented. The mound with its four plazas embodies the concept of quadrilateralness, of the four-cornered world, and reflects the profound significance of directional symbolism to early Native Americans.[25]

For the inhabitants of Cahokia, the symbolism that they chose to physically construct in their cities directly correlated to the constructs of their worldviews. Similarly, the strength of religion in the fabric of London society is evident in its many churches. According to Home, around the year 1200, there were approximately 126 parish churches throughout the city of London.[26]

The ability to adapt to change is also present in both cities. In Cahokia, farmers had to contend with the often-unpredictable weather patterns of the American Bottom. Fred A. Finney details the coping mechanisms that the Cahokians employed to combat the weather patterns of the area, utilizing exchange, diversification, storage, and mobility to maximize year-to-year crop yields and defend against weather extremities.[27] Intrasite and intersite exchange built relationships and alliances between groups, as well as providing each party with exotic goods and services. One such site that Cahokia is believed to have been in both a trading and a military alliance with is Aztalan, located in Jefferson County, Wisconsin. Regarding the relationship between Aztalan and Cahokia, Whiting Young and Fowler believe that:

> The Woodland people of Aztalan and their Mississippian neighbors to the south had a symbiotic relationship. Since farming and seminomadic hunting occupy different niches in the ecological system, the two groups were not in competition with each other and could afford to be cooperative… The newcomers from Cahokia probably came to Aztalan as permanent colonists. Whatever their guise, it is evident that a group came to Aztalan from Cahokia with the express purpose of taking Aztalan's side against their enemies at Lake Koshkonong. Their efforts quickly transformed the Woodland community into a fortified Cahokian temple town.[28]

In this example, the Cahokians were not just sending an envoy to Aztalan to help them in their war against their enemies. Rather, by helping them in their conflicts, the Cahokians were solidifying their relationship with the inhabitants at Aztalan, thereby ensuring that their trading relationship would continue by intermixing with each other.

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[23] Chadwick Allen, "Serpentine Figures, Sinuous Relations: Thematic Geometry in Allison Hedge's *Blood Run*," *American Literature,* Vol. 82, No. 4 (December 2010), 809.
[24] Milner, 134.
[25] Biloine Whiting Young and Melvin L. Fowler, *Cahokia: The Great Native American Metropolis* (Urbana: University of Illinois Press, 2000), 264.
[26] Home, 96.
[27] Fred A. Finney, "Exchange and Risk Management in the Upper Mississippi River Valley, A.D. 1000-1200," *Midcontinental Journal of Archaeology*, Vol. 25, No. 2 (Fall 2000), 358-361.
[28] Whiting Young and Fowler, 291, 293.

Finney also identifies two divided risk management strategies utilized by the Cahokians, these being complementary agricultural systems and alternating field locations. With the evidence of floral remains, Finney argues that the Cahokians utilized other crops that were better suited for extreme conditions, that is, "The retention of these nonlocal plants after the widespread presence of maize emphasizes a perceived need for alternative or second-choice, supplemental food supplements. It is likely that the weedy plants would produce greater yields than maize in drought years."[29] Finney points out another advantage of this complementary system being that the growing seasons were offset, with the weedy plants growing from late spring to early fall, white corn growing in the mid-summer, and flour corn growing in the fall. Alternating field locations, both in area and elevation would have been another divided-risk strategy to defend against both flood and drought. In a drought season the upland fields would not yield much, while the lower-lying fields would yield most of the crops, and vice versa for a flood season.[30] In this strategy, it is believed that the Cahokians defended against both environmental extremes and would therefore minimize the chance of total loss.

London was also innovative in its way of coping with potential disaster. After numerous fires that ravaged the city in the twelfth and thirteenth centuries, something had to be done to defend the city from total engulfment. Therefore, early in the fourteenth century, the order was given to replace all thatched roofing in the city to defend against the indefensible speed with which the fires traveled. At the time, London's houses were roofed predominantly with thatching, which is how the fires were able to travel quickly and greatly decimate the city. In fact, it is estimated that approximately three thousand people perished in a fire in 1212.[31] The dangers of fires in London during this period, largely in part due to their mostly wooden and thatch architecture, greatly influenced the city to transform from a wooden city into one of predominantly stone.

One markedly profound difference between the two cities was their treatment of waste and debris. Of course, Medieval London is notorious for its putrid foulness. Regarding London's conditions, the streets were paved with the town's rubbish and refuse with sewage being haphazardly washed away in the rivers.[32] Furthermore, there are also accounts of livestock roaming the streets and living in houses, an issue apparently so troublesome and widespread that London was forced to make a law banning free-roaming livestock throughout the city.[33] Not only can one imagine the terrible stench arising from the city and the surrounding area, but the close contact with livestock, pests, and refuse no doubt laid the groundwork for such crippling diseases as the Black Death to occur in London. Conversely, Cahokia, although obviously still producing waste and pollution, seems to have experienced much more pleasant conditions compared to those of London. Although it is not exactly known if the Cahokians exhibited any form of waste removal *en masse,* there is evidence that each household had several refuse pits surrounding them. The inhabitants of Cahokia would dispose of trash, excrement, and any other disposables in these pits and, when full, the pit would be covered over with earth, something akin to a small-scale form of the modern landfill.

Furthermore, there is very little evidence of contagious diseases being present in any significant number in pre-contact North America, whereas Medieval London was rife with such diseases, culminating in the Black Death of the mid-fourteenth century. However, that is not to say that Cahokia did not lack ailments of their own. The conditions of Cahokia, although preferable to the stench and free-roaming swine of London, were not perfect. For instance, excessive amounts of human and food waste would have built up over time. Although there is no evidence to prove it, it is believed that the Cahokians established some form of large-scale waste removal to deal with the

[29] Finney, 361-362.
[30] Ibid.
[31] Home, 103, 122.
[32] Ibid., 96.
[33] Williams, 16.

over-abundance of waste that the city would have produced. Furthermore, the miasma of the surrounding swamps, the stagnant waters of the old borrow pits used in mound building, and the countless wood fires and the smog that they produced would have led had deleterious effects on the health of the Cahokians.[34] Other health issues that have been found in examining Cahokia and other Mississippian sites include the presence of soil-borne fungi and nutritional deficiencies. Of course, with all the earth-moving and farming that occurred at Cahokia, the presence of soil-borne fungi is not coincidental. Neither are the nutritional deficiencies, as it appears the wealthy experienced more variety in their diets, particularly ingesting more meats and proteins, while those of lower social status would have been more reliant on food that was in abundance, specifically corn. Analyses of skeletal remains at these sites suggest bone issues resulting from the high-carbohydrate diet in the forms of cavities, gum diseases, and iron-deficiency anemia.[35]

Another similarity is the style of leadership in the two cities. London was ruled by a monarchy, which had a very close relationship to the Church. It was a mutually beneficial, but not equal relationship. The monarchy clearly had authority over the church. In England, like many other European royal families, incest was not only condoned but desired in effort to keep the bloodlines and lineage pure. The preservation of the purity of the royal lineage was to preserve the image of the "undefiled" and "unsullied" leader, acting in accordance to God's will, as well as keeping the monarchy within the family, which would have reasserted their divine claims to power over the populace. Similarly, under the theocratic chieftainship that was supposedly practiced at Cahokia - meaning that the leader claimed divine power and authority - the leader could manipulate facets of the religion to increase his authority and power over the populace. Whiting Young and Fowler elaborate on this practice:

> In Mississippian society the leaders legitimated their power over the commoners through the careful manipulation of culturally meaningful symbols. Just as the illiterate peasants of the Middle Ages in Europe could read their own creation story in the stone carving and stained glass windows of the cathedrals to which they had contributed their labor, the residents of the American Bottom drew their life's meaning from the physical arrangement of their community and the rituals they observed… Cahokia was North America's Rome, the center to which awe-struck pilgrims traveled miles to worship at the sacred eternal fires burning on the hilltops of the gods.[36]

In both cities the leaders succeeded in influencing society by manipulating the religions to which they adhered to further their own agendas. The leaders utilized powerful symbols in their respected religions, oftentimes injecting themselves or their lineages into the religious narratives, thereby justifying their divine right to rule. The practice of appropriating culturally meaningful symbols into their leadership would have been physical reminders to all inhabitants of the absolute preeminence of the ruler.

Mounds in Indigenous Society

The Indigenous mounds that scatter the American Midwest have their roots in astronomy. In Indigenous societies, astronomy, prophecy, spirits, and humans are all very closely intertwined, as the mounds would either serve as burial grounds for the deceased, as spiritual or territorial markers, or symbolize an intimate relationship with the spirits. The four main types of mounds are conical, ridgetop, platform, and effigy. Archaeological findings suggest that when European explorers first arrived in what is now Wisconsin there were between 15,000 and 20,000 mounds scattered throughout the state. However, due to the carelessness of many early archaeologists and

[34] Iseminger, 155.
[35] Ibid., 155-156.
[36] Whiting Young and Fowler, 264, 273.

treasure-seekers in the late nineteenth and early twentieth centuries compounded with the abrasive callousness of American progress, many of these mounds have been destroyed so that only about 4,000 remain.[37] Despite notions of white supremacy there were still a few people, even in the nineteenth and early twentieth centuries, like Thomas H. English, an English professor at the University of Wisconsin in 1921, who begged the public to take more notice of the value of these earthworks and help in their preservation.[38] However, both the colonizers and the years have not been kind to the mounds, as either amateur or professional digs would take place and the earth would not be replaced, leaving uncovered soil that would be severely washed out with rainfall. There are also many examples of wanton plowing and building that have usurped the mound's land.[39] Early archaeologist Charles E. Brown noticed the overall American indifference toward Native sacred sites and mounds in that the first settlers did not hesitate to dig up the skeletons of Indians interred in the mounds to make room for the deceased "of a more civilized race." Because of perceived racial hierarchies and other racist ideas, many mounds were recycled into either white cemeteries or housing platforms to protect against the high waters of the flood season.[40]

Each of the different types of mounds served different purposes in the society. The most mysterious of the mounds being effigy, as not much is known exactly for what purpose they were constructed to serve. The functions of the other mounds, however, are known, with conical usually being associated with burials and mortuary functions, ridgetop acting as boundaries or territory markers, and platform mounds acting as elevating substructures for the houses of the elite or priesthood.[41] Sometimes effigy mounds were involved in burials, but on a smaller scale than those accredited to the conical mounds, occasionally containing one or, at most, two burials. Charles Brown, in his work with among the Winnebago (now Ho-Chunk), found that many of the effigy mounds represented the various clan symbols in the Ho-Chunk society. According to Brown, these effigy mounds were constructed in the likenesses of the clan symbols, as these symbols were the ancient ancestor shared with everyone in that distinct clan, and the effigy served as a sort of protective symbol for the people of that clan. Thus, the effigy and the spirit associated with it would protect the people of that clan in times of need.[42]

A similar viewpoint, provided from an interview with Ojibwe elders who wish to remain anonymous, is that the mounds could have been constructed as some form of prophecy or to mark, honor, or designate an area to the spirit that the mound's shape portrays. But perhaps what is even more puzzling than the different meanings behind the symbols of the effigy mounds is how they, and the other mound types were constructed. These were massive undertakings. According to Kitt Chappell:

> Some useful numbers also help us grasp the enormous effort that goes into making a structure the size of Monks Mound with human labor. This pharaonic enterprise required carrying 14,666,666 baskets, each filled with 1.5 cubic feet of dirt, weighing about fifty-five pounds each, for a total of 22 million cubic feet. For comparison, an average pickup truck holds 96 cubic feet, so it would take 229,166 pickup loads to bring the dirt to the site. If thirty people each carried eight baskets of earth a day, the job would take 167 years.[43]

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[37] Birmingham and Eisenberg, 3.
[38] Thomas H. English, WIS MSS DB, Box 16, Folder 12, Increase A. Lapham Papers, Wisconsin State Historical Society Archives, Madison, Wisconsin.
[39] Ibid.
[40] Charles E. Brown Papers, 1889-1945, Typescript of Some Curious Uses of Indian Mounds, WIS MSS HB Box 39, Wisconsin State Historical Society, Madison, Wisconsin.
[41] Bowne, 67.
[42] Charles E. Brown Papers, Typescript of Significance of the Indian Mounds, WIS MSS HB, Box 3, Folder 4 (Winnebago Indians), Wisconsin State Historical Society Archives, Madison, Wisconsin.
[43] Kitt Chappell, 63.

Although not an effigy mound, the labor required for Monks Mound shows how laborious an enterprise mound construction of any size was. According to the Ojibwe elders, Native peoples long ago would have been able to accomplish this feat with ease, due to gifts provided from the Creator. When asked how these gigantic earthworks got here, they said that, in the times before Euro-American arrival, the Native peoples possessed inherent and individual gifts bestowed unto them by the Creator. Such gifts would have made enormous tasks easy and almost effortless; however, with the introduction of Euro-American vices coupled with the loss of land and culture, the Indigenous population began taking these gifts for granted and began polluting the earth. To the Ojibwe, the spirit of Mother Earth is a living being and the pollution of her is simultaneously polluting their culture. The message is simple: respect and take care of Mother Earth and Mother Earth will take care of you.[44]

Many of the mounds are so large that they are only visible from above, with numerous mounds being over six hundred feet in length. To a person on the ground, the mound would not look like a mound at all and, to fully appreciate the structure, one must be looking from above. Allen points out the significance and travails involved in the construction of such structures:

> Earthworks have been sketched, mapped, surveyed, sometimes excavated, and too often looted by non-Indigenous settlers and their descendants since at least the eighteenth century. However, it is a twentieth-century technology – aerial photography – that has enabled contemporary viewers to see individual earthworks and earthwork complexes from a great height, the only perspective from which these works can be viewed as complete wholes. (Some archaeologists and art historians suggest that the geometric shapes and aesthetic forms of earthworks may not have been intended primarily for human viewing at all). With all of the technology available today, such as satellite and laser imaging, it has been confirmed that the earthworks of Ohio all appear to be based on a consistent unit of measurement, that unit's multiples, and that unit's key geometric complements.[45]

Agreeing with this, one of the Ojibwe elders suggested that the flat-topped platform pyramids could have potentially even been used as landing platforms for "UFOs"; however, they are not considered unidentified flying objects in their worldview, rather, these are the spirits central to their ideologies and worldview.[46] The scale and precision of such massive indigenous earthworks is detailed by Allen, who describes the Octagon Earthwork complex in Newark, Ohio as "a mathematically perfect Octagon the size of a football field and a type of lunar calendar that marks the 18.6-year cycle of the moon's northernmost and southernmost rise and set points along the horizon. Remarkably, the accurate observation of these sky phenomena is possible in North America only within a restricted range of latitude."[47] The spiritual importance of these earthworks is very significant and undeniably the reason behind their construction. However, due to culture loss and the predominant disdain among historians for the accreditation of oral histories as reliable sources in the past century has left a void in Native history. Aside from this gaping void of cultural views from the cultures that constructed these mounds, another issue lies in the persisting issue of closed-mindedness in considering multicultural histories. As is too often the case, white Americans tend to believe that their whitewashed educations - espousing Anglo-Saxon triumphs in textbooks and teaching curriculums and also believing Hollywood films to be factual documentaries - provide a more complete understanding of multicultural histories than the multicultural peoples themselves possess.

Decolonizing the Historical Narrative

[44] Ojibwe Elders, interview by Hayden Nelson, 7/6/17.
[45] Allen, 810-811.
[46] Ojibwe Elders, interview by Hayden Nelson, 7/6/17.
[47] Allen, 810.

Why has history become a fictitious rendering crafted to tell the tales of the "victors"? A major issue with American history is the difference in values between white cultures and multicultural peoples. In multicultural communities, ancestral heritage plays a crucial role to their cultures and identities. Conversely, many white Americans simply identify as American. But what exactly is "American"? According to Philip Deloria, American-ness is a hodgepodge of different, minority cultures tacked on to the original European identity of the settlers. To this end, Americans sought (and still seek) to "savor both civilized order and savage freedom at the same time."[48] Perhaps the most famous recollection of such a paradox in American history is the notorious Boston Tea Party, where colonists dressed up as Mohawk Indians in war paint, imitating war whoops, in the ultimate act of defiance against the British. Summarily, "The performance of American Indianness afforded a powerful foundation for subsequent pursuits of national identity."[49] Appropriating aspects of minority cultures in America, although paradoxical, separated the colonists from the Europeans at perhaps one of the most crucial instances in the founding of the United States. Thus, modern (generally white) Americans who identify solely as American are unconsciously identifying to this hodgepodge of both European and minority cultures. This rejection of European ancestry, which dates to the first colonial uprisings, distances white Americans from the wrongdoings of their ancestors and, in doing so, allows them the comforts of not having to take responsibility for their actions and not having to confront the issue of modern racism. To this end, white Americans succeed in distancing themselves from the historical issues, thereby deferring to confront and resolve the issues that remain. The issue of modern racist thought persists for what can be identified in two parts: firstly, the refusal to acknowledge modern racism as a thriving phenomenon, and secondly, textbooks and curriculums teaching history of multicultural people through a Eurocentric lens, which alters it, bending and shaping it to the will of the American agenda.

Modern white Americans are afraid to confront the past and apply it to present situations, or they feel the need not to, as these were injustices committed by their long-dead ancestors. Regardless of the reason, there is one truth to be gleaned: history makes modern white Americans uncomfortable. American history textbook authors try to cater to and make their content comfortable for their intended audience: presumably, the young, white male. For instance, Loewen suggests: "Replacing settlers with whites makes for a far more accurate but 'unsettling' sentence. Invaders is more accurate still, and still more unsettling… Textbook authors still write history to comfort descendants of the 'settlers''… Our journey into a more accurate history of American Indian peoples and their relations with European and African invaders cannot be a happy excursion."[50] What can we as historians do about this issue? A more understanding and open-minded approach is a good base, if not an altogether cure, for this endemic that continues to plague American society. This is the essence of what has been termed "decolonizing" the historical narrative, which has been the goal of the burgeoning field of ethnohistorians since the 1980s. Ethnohistorians seek to decentralize the historical narrative from the Euro-American, instead looking at other histories that were simultaneously occurring and are equally valuable. However, explaining cultures and religions foreign to oneself is often difficult if that person has not familiarized themselves with the belief system and values central to those peoples. Without that understanding – and this must truly be an understanding – inaccurate and insensitive remarks will surely be made, and these, typically, work towards devaluing the religion or various traditions of the people being studied.

Regarding this phenomenon of devaluing Native religions, anthropologist Frederick Turner suggests that the callousness of whites towards Indigenous spirituality is due to their own loss of a

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[48] Philip J. Deloria, *Playing Indian* (New Haven: Yale University Press, 1998), 3-5.
[49] Ibid., 7.
[50] Loewen, 95.

"deep spiritual relationship with the earth." Turner continues, pointing out that, in the Indigenous worldview, spiritual health is attained only in the whole-hearted attempt in living in accordance with the earth and the endless legion of spirits that abound on it.[51] In a similar vein, anthropologist Robert Hall argues that the callousness of whites towards Indigenous religions may never result in a true understanding of those cultures as, "Archaeology seeks to explain the inner workings of cultures in which even baked clay pots were animated with particular spirits. But, until as archaeologists we develop more than a little empathy for the prehistoric Indians we presume to understand, prehistory may never be more than what it has become, the soulless artifact of a dehumanized science."[52] To truly understand Native cultures from their own perspectives, archaeology and history must transform themselves into humanized sciences, sciences that are not obsequious to the static and close-minded thoughts of white settlers encountering a people altogether "Other."

The only thing holding historians back from achieving a greater understanding of not only pre-Contact Native cultures, but also the cultures and traditions of today, is their own ineptitude to open their minds to different perceptions and knowledges and ways of being. Understanding these things on a greater level would benefit Americans today, as these issues are still pertinent. For instance, as recently as 2016, there was tension mounting with the Dakota Access Pipeline issue, in which sacred sites were believed to have been encroached upon by an oil pipeline and in the direct vicinity of a possible leak zone. These instances of ignorance and desecration of Native religious and culturally important sites are still happening in the present-day - they are not instances of the past which white Americans can accredit to their forefathers and dismiss, these issues are still occurring - and that is why it is so important to gain an understanding of Native American perspectives and histories. Decolonizing the historical narrative is, therefore, an essential goal that must be paramount in today's constantly deteriorating race relations. These issues will not subside if society continues to elect to ignore them or be "color-blind," white Americans tend to suffer cultural amnesia, only remembering the moments of import in white American history. However, modern issues must first be analyzed through their historical origins to better understand how they operate in their present incarnations. Historians need to understand that American history, for the most part, has been whitewashed, and need to recognize that issue as, indeed, being an issue so that they can then change how history is taught in the modern sense.

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[51] Frederick Turner, ed. Calvin Martin, *The American Indian and the Problem of History* (New York: Oxford University Press, 1987), 21.

[52] Robert Hall, "Ghosts, Water Barriers, Corn, and Sacred Enclosures in the Eastern Woodlands," *American Antiquity* Vol. 41, No. 3 (1976), 363. DOI: 10.2307/279525

Determining the Effects of Commercial Fishing on Fish Reaching Reproductive Maturity in the Galapagos Islands Marine Reserve*

In collaboration with the Charles Darwin Research Station

Alexandra Sueldo

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Introduction:

In most recent years, fishermen and locals alike have noticed a significant difference in fish populations around the Galápagos National Park. Three species specifically, Brujo, Bacalao, and Camotillo have proven the most endangered of all. This is because these fish are commonly used in traditional Ecuadorian food and are often sought after by tourists and other locals for a nostalgic meal. Since large corporation fishing is not allowed in the national park it is the local fishermen who are noticing these declines. In Galápagos, fishing is a career of interest because it helps locals to support their families and provides an income when they sell their catch to touristic restaurants and hotels. These fishermen rely on the presence of these fish to have a stable income. Due to the demand of these fish species, more and more fishermen have come to terms with this decline and have decided to take home any of them that they can catch, due to their popularity. The issue with this is that since smaller fish are being caught, these fish never get a chance to reach reproductive maturity, and are, therefore, unable to repopulate.

This fact is especially true in the case for Bacalao, which is a hermaphroditic fish. For Bacalao, the female stage is earlier in life while the male stage is later. Therefore, since fishermen aim to catch the largest Bacalao possible, they fish out all the males in the surrounding area.

To add to this decline, it was not discovered until recently that these three fish have an average lifespan of thirteen to twenty years. Therefore, even if restrictions are put on these species, it will take a while before there is a significant growth in their populations.

In order to confirm that the fish being caught had not reached sexual maturity, our research focused on the analysis of fish otoliths – which provides the most effective way to measure age. Fish otoliths are calcium carbonate structure that lie behind the eyes of the fish and range in size from 0.4 millimeters to roughly 31.3 millimeters. These structures function in the fish's hearing as well as their perception of gravity (Paxton, 1299.) Along with their physiological functions, the otoliths also function as a predictor of age. Otoliths, like trees, have age rings. Otoliths begin by adding daily age rings, and then eventually annual rings. Daily rings tend to disappear as the fish gets older. This was the primary method of determining a fish's age and whether or not it had reached the age of sexual maturity. The age of sexual maturity is widely different across all species with a range of five to twelve years old; Camotillo starting at age five, Bacalao at age seven, and Brujo at twelve years. These were the minimum amount of annual age rings that we tried to find among the otoliths we analyzed. 'Figure 1: Microscopic Image of Bacalao Otolith,' is an example of a figure we used to determine age based off of rings. The thick and denser rings are annual rings, while the thinner rings could either be daily rings or false rings.

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Figure 1: Microscopic Image of Bacalao Otolith

Methods and Materials:

Study Site

The fishermen utilized fish aggregate devices (FADs) off the coast of Puerto Ayora, Santa Cruz, Galápagos Islands, to catch the largest fish possible. FADs are giant buoys that attract fish with their bright colors. The idea of these devices is to rapidly increase populations by providing easier access to feed larger fish. FADs are seen as a cascade effect. The small fish are attracted to the large buoy, which then attracts the medium fish trying to eat them, ultimately leading to the large fish wanting to eat all the smaller fish. FADs are a great way to increase yield in fishermen's catch and prevent completely modifying the surrounding ecosystem. They are known as the most economical style of increasing fish yield. The only downside is that they require a large investment and government approval (Bell, 102-104.) These FADs are our main way to get to the largest fish and has been an up and coming program since 2011 in the Galápagos Islands. Currently, there are only four FADs in the Galápagos Islands with hopes of expanding to more islands for fishing. As shown in 'Figure 2: Fish Aggregate Device (FAD) designs' there is a variety of styles of FADs but the ones in Galápagos most resemble the FAD in 'B' (Bush, 104.)

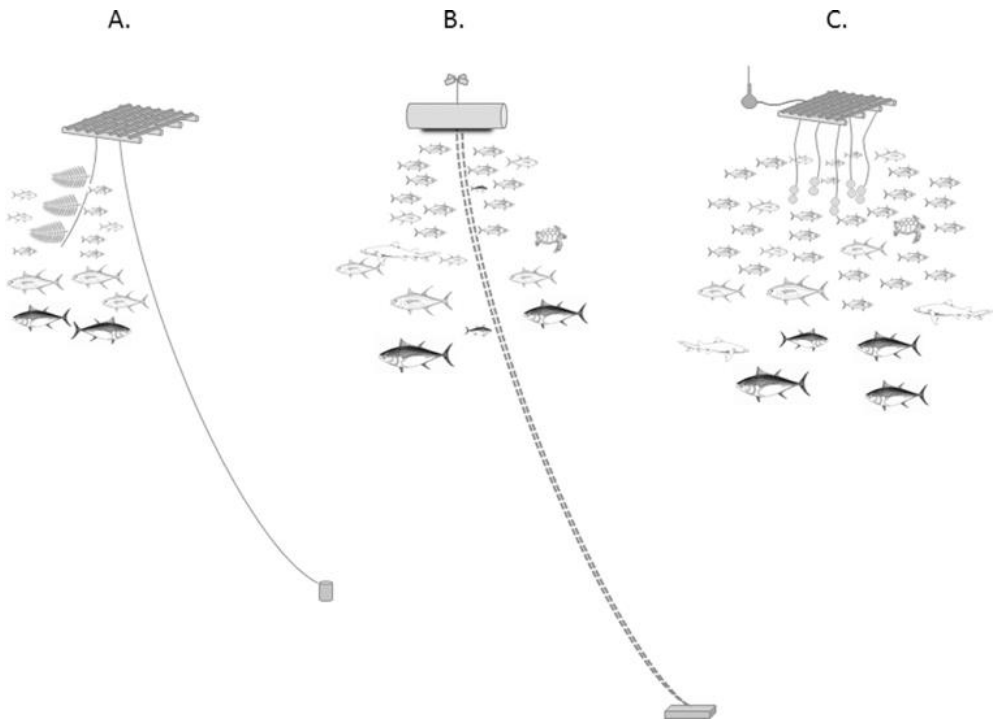

Figure 2: Fish Aggregate Device (FAD) designs

In order to get data from these FADs, few of us were employed to go on 'fishing trips' with the fishermen. These fishing trips entailed going on a fourteen hour fishing expedition out to the various FADs around the islands. The fishermen would stay at the FAD locations for roughly seven hours at a time, and every fish that they caught would be documented by one of the researchers. Once we were handed the fish, we would document various aspects of the catch. These details included: the species, bait used, the length in centimeters of the fish. Once this data was collected it was filed and the otoliths from several of the fish caught that day were extracted.

Fishing trips proved very important because it was an easy way to quantify how many of the fish had reached sexual maturity. Aside from otoliths, we also used the fish's length in order to determine that sexual maturity. An example of this is in 'Figure 3: Outreach Graphic on Buying Sustainable Fish" which shows how age of sexual maturity is reached when a fish grows to a certain length. This image was printed on stickers by our research group to pass out to locals and tourists to inform them on how they can make sustainable choices when buying fish. In Galápagos, tourists often have the time to choose which fish they would like for their meal, and this sticker can act as a guide when making these purchases.

Figure 3: Outreach Graphic on Buying Sustainable Fish

Although measuring a fish's length can produce fairly accurate results, the most precise results come from the analysis of otolith rings. After the extraction of the otoliths, we split them laterally and use five different textures of sand paper to make the rings visible. This process was what took the longest because of the fragile nature of these bones. The polishing consisted of continuous cycles of rubbing the otolith with five different types of textured paper. A long with the use of textured paper was the continuous monitoring that rings, were indeed, appearing. One otolith could take anywhere from two to four hours for an experienced polisher to finish polishing. Once the otolith was polished it would be put under another a microscope, with greater magnification, and photographed. This photographing process is shown in 'Figure 4: Taking Photos of Otolith Under Microscope.'

Figure 4: Taking Photos of Otolith **Under Microscope**

These images were taken using a Nikon D3400 and then transferred to a desktop computer to have the otoliths analyzed. On the desktop computer, we then counted the amount of true rings that could be found in the image. I use the term 'true ring,' because there are such thing as false rings (Grammer, 489.) It is unknown as to why these false rings are formed, but they are easy to spot with a trained eye. True rings will overlap and mimic each other's shapes perfectly while a false ring might be unparalleled to the previous one. This process was then repeated for as many otoliths as possible. As one can assume, this was a long process. Lack of volunteers and time is what got in the way of finishing all the otoliths before I had to return to the United States. Although we did not process as many otoliths as we wanted, the ones we did finish followed the general trend that we had assumed we would find. The majority of the otoliths analyzed were well under the age of sexual maturity.

Discussion:

The fisheries program of the Galápagos Park Marine Reserve has come to the conclusion that three specific fish (Brujo, Camotillo, Bacalao) are being caught before reaching the age of reproductive maturity. This was found through the analysis of otoliths which had the majority of fish younger than the age of reproductive majority. What does this mean for the islands? This lack of sexual maturity could mean that fishermen are not using a sustainable method for catching these species. There is constantly regulation on larger marine animals, but we must also look at the basis of our oceans which include the fish and other animals in larval stages. Their decline is ultimately harming fishermen as well as the offspring of all these fish. The goal of this research is to shed some light on the issue of overfishing. At the moment, this is a topic of great controversy because regulations on these species would mean less fish to bring home to their families and less income overall.

The research station and I believe that it is worth taking a 'break' from these species in order to let them repopulate and focus on fish that are much more abundant. By putting this regulation in place, we can assure that they have produced offspring in order to keep populations stable. Since creating laws and regulations is a long process we are unsure when they will take place, but we are hopeful going forward in our fight for a sustainable Galápagos and its ocean.

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Asian American Masculinity in Hegemonic White Masculine Society: Hmong Men Perspectives

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Abstract:

This research examines Hmong American men perspectives on Asian American masculinity in White hegemonic masculine society. Prior research on Asian American masculinity has generally been focused on Korean Americans, Japanese Americans, and Chinese Americans (Lu and Wong, 2013; Chua and Fujino 1999; Espiritu 2008). While the Hmong people have been in the U.S. for more than 40 years, their story is yet to be told. To help elaborate on this, Critical Race Theory (CRT) is used as the conceptual framework to guide this research. CRT is based off of storytelling, skepticism of legal doctrines, intersectionality, critique of liberalism, primary beneficiaries of civil rights legislation, moving beyond black and white binary, and property as power. CRT is also used to analyze literature, collect and code data, and discuss results. Data collection consisted of semi-structured focus groups and personal interviews with five Hmong American college age men. My research question asks how does White hegemonic masculinity affect Asian American masculinity from Hmong men perspectives? This research sheds light to masculinity, stereotypes of Asian Americans, and amplifies the experiences of Hmong American college age men, simultaneously shedding light on oppressive structures and practices that perpetuates masculinity.

Asian American Masculinity in Hegemonic White Masculine Society: Hmong Men Perspectives

Introduction:

Along with the thousands of refugees from the Secret and Vietnam Wars, my father Teng Nkias Teeb Yang is an orphan of the Secret War as the U.S. calls it. He is a machinist working in factory jobs often doing manual labor such as picking peppers, cutting steel, and lifting 50+ pounds of wood and materials for 8-12 hours a day. Teng's experience in his jobs were physically exhaustive and emotionally challenging. But the reality of his experiences extends beyond his jobs and into the Hmong community. As Kao Kalia Yang describes her father in *The Song Poet* (2017), "My father is a poet...his poetry complicates what he says to us, my brothers and sisters and me. We are not the walking and talking, quick-acting and hard-feeling products of his creativity; it is instead the songs that he composes, songs born deep inside, rising fourth to find improvised life in the very breath that he breathes, that his art and his contribution to our world" (p.17). Similarly, Teng is a person in the Hmong community who is able to speak lyrics of Txiv Xaiv (funeral songs), Kab Tshoob Kev Kos (wedding songs), and hu plig (soul callings). His love for Hmong culture, language, and poems run deep in his soul as he is a Txiv Neeb (Shaman) and a healer himself. Even with his knowledge and voice in the Hmong community, stepping into workplace and White spaces, his voice is often silenced, emasculated, and marginalized. His experiences of oppression comes from White male co-workers, bosses, and management. But if not silenced, emasculated, or marginalized, he has to fight for his voice to be heard, similarly like that of many non-English speakers.

Recognizing Teng's experiences, as an Asian American man working in predominantly White male spaces, posed the research question "how does White hegemonic masculinity (WHM) affect and/or influences Asian American masculinity from Hmong men perspectives?" As described by Connell and Messerschmidt (2005), "White hegemonic masculinity presumes the subordination of nonhegemoinc masculinities" (p. 846). In other words, all other forms of masculinity are lower than White masculinity. The location where data was collected is called Midwest University (MU) and Midwest Technical College (MTC). Data was coded into four themes: family messages, community messages, U.S. dominant messages, and reflections of masculinity. Discussion of data, future research, and acknowledgement of support follows the findings/data section.

Literature Review:

Asian American History & Experiences. A snippet of Asian American history begins with U.S. capitalist searching for cheap labor across seas. Many overseas nations such as China, Japan, Korea, the Philippines, and India emerged as cheap and manipulable labor for U.S. capitalists for the benefit of U.S. economy which brought Asian men into the U.S. Through the idea of "cheap" labor, Asian men were separated from their families through policies which prohibited Asian men to sponsor their families to come to the U.S., marry white women, and prohibit Chinese, Asian Indian, Korean, and Japanese men from entering the U.S. Some of these laws include the Page Law of 1875, anti-miscegenation laws, 1882 Chinese Exclusion Act, 1907 Gentlemen's Agreement Act, and the Immigration Act of 1924 which limited or barred Asians from immigrating to the U.S. and created an unbalanced sex ratio of Asian men to Asian women. With laws limiting Asian women to enter the U.S., Asian men were stripped of their manhood in part because they were denied family and children. In a cultural context, having children is a value in cultural community (Espiritu, 2008, p. 19). This meant that family life was not available until the third decade of the 20th century. The government passed the Immigration Act of 1924 denying the entry of "aliens ineligible to citizenship" in response to the influx of Japanese women arriving in the U.S. as picture brides to Japanese American men (Espiritu, 2008, p.21).

Congress passed the Immigration and Naturalization Act of 1965, which abolished the racial quotas of the 1924 Immigration Act. According to Erika Lee (2015), the Immigration Act of 1965 resulted in three major changes which included 1) abolishing the old national origin quotas law 2) creating a family reunification and professional skills preference categories, and 3) establishing a global cap on immigration from the Western Hemisphere (p. 286). Thomas M. Philip (2012) explains this reform opened doors for professionals specifically in the field of engineering, mathematics, science, and medicine to fight technological battles of the Cold War. With these changes and strategic interest convergences, the act ushered a new era of immigration. This would allow over 14 million and rising immigrants' post-1965 to enter the U.S. with Asian and Latin American immigrants making a majority of the population who migrated to the U.S.

The 1965 Immigration Act allowed immigrants and refugees from war torn nations like Vietnam, Cambodia, and Laos to enter the U.S. Erika Lee (2015) writes that the 1954 Geneva Accords was signed dividing Vietnam into two parallel states---North and South---as a result of the Korean War to make peace in Indochina. The North was led by communist Ho Chi Minh while the South was led by anti-communist Ngo Dinh Diem. During this time, the U.S. supported the South against the communist regime. In 1964, the North Vietnamese ships fired on the U.S. naval ships which allowed President Johnson to declare this act as aggressive and led to the signing of the Gulf of Tonkin Resolution. This allowed the Johnson administration to deploy U.S. troops in South Vietnam which led to the Second Indochina War otherwise known as the Vietnam War.

The Hmong people's involvements began when the U.S. needed troops to disrupt the Ho Chi Minh supply trail from North to South Vietnam, which was where thousands of Hmong people were geographically located. E. Lee (2015) explains, "The goal was to limit the North Vietnamese government's ability to arm and supply its supporters in the south" (p. 317). General Vang Pao agreed to CIA agent James William Lair's recruitment of Hmong soldiers which in turn the U.S. would give military and humanitarian aid to the Hmong people.

After the fall of Saigon in 1975, U.S. troops pulled out and leaving thousands of refugees to fight for themselves. The first wave of refugees consisted of high and elite classes. Next, would be Cambodian people who were made up of mostly diplomats and high level officials. After the U.S. military left Laos and Vietnam in 1975, the Pathet Lao targeted Hmong people for siding with the U.S. Over 2,500 Hmong people were lifted out of Long Cheng air base to seek refuge in the U.S. as promised by agent Lair and the U.S. By the end of 1975, the total admitted Southeast Asian refugees to the U.S. equaled 130,000 (E. Lee, 2015, p. 325).

Each successful wave of refugees brought poorer and less educated refugees (B. Ngo, 2006, p. 52). According to the 2000 U.S. census, figures indicate that 59.3% of Hmong Americans, 52.05% of Cambodian Americans, 49.3% of Lao Americans, and 38.1% of Vietnamese Americans, aged 25 and over, have less than a high school education. Of these Southeast Asian groups, Hmong Americans averaged the lowest per-person income of any ethnic group with an average of $6,613 compared to Cambodian Americans at an average of $10,215 and Lao Americans at an average of $11,454. When compared to White Americans from the lowest per-person income ethnic group (Hmong Americans), there is an average income disparity of $17,022. In the realm of poverty, 37.6% of Hmong Americans, 29.3% of Cambodian Americans, 19.1% of Lao Americans, and 16% of Vietnamese Americans lived under the poverty line (B. Ngo, 2006, p. 54). S. Lee (2006) explains the intersection of race and class:

> Wealthy Chinese immigrants have been ideologically whitened in the dominant discourse because whiteness and middle-class are related while lower income Southeast Asian refugees have been ideologically blackened in the dominant discourse because of the high rates of poverty among Hmong, Lao, Cambodian, and other Southeast Asian refugees. (p. 20)

At the intersection of race and class as described by S. Lee (2006), there are dominant Asian American stereotypes, which include the model minority and perpetual foreigner that lumps Southeast Asian Americans into categories of academic and financial success or as gangsters, high school dropouts, and government welfare-dependents peoples (B. Ngo, 2006, p. 60).

Stereotypes of Asian Americans. The Model Minority Myth emerged in the 1960's as the 1965 Immigration Act opened up family reunification and encouraged Asian professionals into the U.S. As more Asian professionals entered the U.S., this created a generalization of Asian Americans and ignores the diversity among Asian Americans. Even if the model minority attributes to success and hard work, White supremacy uses the myth to pit communities of color against each other "to leave the institutional barriers of racism unquestioned and unchallenged" (Shek, 2006, p. 382). An example of this is with opponents of Affirmative Action. They argue that affirmative action only helps Latinos and African Americans but hurts Asian Americans because dominant society holds up Asian Americans as the model minorities which in turn promotes antagonism between Asian Americans and other people of Color (S. Lee, Wong, Alvarez, 2008).

Continuing to fight and navigate racism, Asian Americans face foreigner statuses due to racist media portrayals of Asian Americans. Japanese Americans were specifically targeted after the bombing of Pearl Harbor in 1941. The result was evastating as the government signed Executive

Order 9066 to evacuate and intern 120,000 Japanese Americans. The perpetual foreigner was created to make Asian Americans seem untrustworthy and unable to assimilate completely (S. Lee et. al. 2008).

Whereas the yellow peril stereotype existed to portray Asian American men as hyper masculine, menacing, villains, liars, traitors, and spies in times of economic hardships (Shek, 2006; Lu & Wong, 2013; Espiritu, 2008). Currently in the U.S, the yellow peril stereotype takes the form of business threat. The idea is that Asian Americans are taking over U.S. businesses with their greediness and cleverness, for example the U.S. real estate. The threat is not physical but economic and cultural to White supremacy (Espiritu, 2008, p. 101).

Asian American Masculinity. For Asian American men trying to live up to White hegemonic masculine ideals create "stress from failing to embody these characteristics because they lacked whiteness" (Lu & Wong, 2013, p. 355). While Asian American men hold male privilege, at the same time they are still racially oppressed. Chua and Fujino (2007) explains:

> ...because of their subordinate position, some Asian American men try to counter the effeminate image of Asian-American men by emulating hegemonic masculinities, which include dominance over women. Though they can engage in patriarchy and obtain male privileges, they find that racism eventually prevents them from fully copying white hegemonic masculinity. (p. 408)

S. Lee (2004) also discuss the differences in how White hegemonic masculinity affects Hmong American young men. As much as Hmong young men would like to be accepted by the dominant group and play by White hegemonic masculine rules, they will never achieve White hegemonic masculinity because of their ethnicity and race (p. 29). Whiteness is central to hegemonic masculinity which causes Hmong young men to negotiate their masculinity between the standards of whm and Asian American masculinity. S. Lee (2004) explains, "White males who are academically successful and involved in one or more high status extracurricular activities" are able to live to hegemonic masculine standards (p. 18). On the other hand, new ideal Hmong American masculinity accommodates to the education system understanding it is a path for "social mobility for their family", supporting their parents in old age, all while maintaining a distinct Hmong identity in order to not assimilate into mainstream America (S. Lee, 2004, p. 20). This is what Gibson calls a strategy of "accommodation without assimilation" quoted from S. Lee (p. 25).

On the contrary of "accommodation without assimilation", William Liu (2002) says in *Exploring the Lives of Asian American Men: Racial Identity, Male Role Norms, Gender Role Conflict and Prejudicial Attitudes,* "For many Asian American men it is either copy the dominant White male or 'accept the fact we are not men'" (p. 108). There will always be a constant negotiation with Asian American men on what it means to be a man of Color in White dominant society (Liu, 2002, p.116).

Methodology:

Semi-structured focus groups and one-one interviews were utilized to collect data (Creswell, 2007). To obtain interested research participants, we asked the Multicultural Center (MC) at the Midwest University (MU) for a list of all individuals who identified as Hmong and Hmong American. Next, a blanket email, which was approved by the Institutional Review Board (IRB), was sent to all Hmong and Hmong American students at MU. In this email, we asked for individuals who identified as a Hmong man. We also connected with the Midwest Technical College (MTC) to get a list of individuals of Hmong and Hmong Americans. This attempt was unsuccessful which

eliminated the pool of participants to Hmong and Hmong Americans MU students. Five participants from MU and one from MTC expressed interest in the study from the email response. Unfortunately, the participant from MTC and I could not meet on our scheduled time, which resulted in no interview and data collection. Of the five participants, we had two focus groups and one one-one interview. The two focus group consisted of two people per focus group and the one-one interview was between me and the participant. During focus groups and one-one meetings, standard IRB procedures and protocols were conducted and explained. Participants voluntarily agreed and signed consent form. All focus groups and interviews were recorded on an audio device and transferred to a password protected computer. Recordings of the focus groups and interviews were transcribed and coded into themes (Falk & Blumenreich, 2005). Themes, messages, and experiences of participants will be discussed in depth in the next section for findings and data.

Findings/Data:

Interviews were coded into four themes: family messages, community messages, U.S dominant messages, and reflection of masculinity. There were a total of five Hmong American college age men who participated. Age of participants ranged from 20-22. Participants ranged from lower middle class to upper middle class. Participants included first- and second-generation college students. All participants were raised by refugee parents and caretakers of the Secret War. All participants are from the Midwest region of the U.S. Some differences include the size of the city participants grew up in. Three participants grew up in a large urban Midwest City and two participants grew up in a mid-sized city.

Family Messages. Family messages were overall consistent with one another. Sub-themes which participants identified were respecting elders, success in higher education, and autonomous teaching from parents. When respecting Hmong elders, Student 1 shares that in his experiences, respecting Hmong elders' means:

> Being a Hmong man, my dad has always told me and my brothers, whenever we are with the elders, depending on how old we are, you always have to shake their hands and always greet them with the most utmost respect because they are wiser. It's all about Hmoob kev cai (practices and manners). You got to respect who live there and know that you are the guest. Just have that hospitality.

As noted by Student 1, respect and hospitality are factors of Hmong masculinity. Other factors which contribute to Hmong masculinity includes pursuing and finishing higher education. As Student 2 explains, in his family, expectations of a Hmong man includes finishing college and pursuing graduate school. But as stated by Lu and Wong (2013), failure of expectations or hegemonic masculinity creates stressful lives. And as Student 2 continues to say, "It very hard because they are always bothering me. They won't let me do me". As Student 1 and Student 2 express struggles with living up to the gender expectations of being a Hmong man in their family, Student 3 expresses the struggle of navigating two worlds, or as W.E.B Du Bois (1903) says a double consciousness. Student 3 quotes, "Growing up in Westernized culture and then going home to our Hmong culture. It was definitely hard to balance just because you know when you're losing language and you're expected to be like the best." In response to Student 3's concerns of double consciousness, his mother responds to him when expressing his difficulties and expectations to her by saying "you're a man and you could figure it out or if you're a man you could figure it out." Figuring "it" out for Student 3 means because he is a man, he is attached with the gendered expectations of solving all problems. Student's 1-3 experiences of being a Hmong man in their family by living up to their parents expectations,

finishing higher education, and bearing the responsibilities as problem solvers run parallel to the community messages of what a Hmong man means in the Hmong community.

Community Messages. Like many cultures, patriarchy is deeply embedded in the Hmong community through power, respect, and the number of kinship a Hmong man is connected to. Lu and Wong (2013) explain Asian American masculinity encompasses the form of respect and recognition. As stated previously, recognition is through the quantity of kinship. From family and community messages, Student 2 received messages like, "(Hmong men) want as many kids, as many wives as you can that, which shows economic power. And also shows that, hey, you know, it's kind of like a masculinity I got like all this, all this right here". These messages reinforce the ideas of patriarchy and masculinity in Hmong communities. While Hmong masculinity is shown through the number of kinship, another factor which Hmong masculinity is shown includes the act of accepting alcohol. Like that of consuming alcohol in hegemonic society, the environment of alcohol consumption is a site of power relations. One example of the act of accepting is through the form of alcohol. During the interviews, participants mentioned that the act of accepting alcohol during wedding ceremonies, funeral services, or soul calling ceremonies is an unsaid message of respect and recognition towards the person giving the beverage. In most scenarios, it is older Hmong men who are the givers of alcohol to younger Hmong men. But in counter narrative to dominant Hmong masculinity community messages of accepting alcohol during ceremonies and services, Student 5's experience included that the alcohol was limited in value but what was accounted to be more valuable was the gesture of accepting the alcoholic beverage from the Hmong elders. In his words, "it's more about the act than the substance....carrying on the tradition and the practices is more important to them (elders) than the substance". In other words, the act of accepting alcoholic beverage is more valuable than the substance itself. Student 2 frames this act in the sense of his experiences accepting alcohol beverages is similar to accepting food. He says that even if he is full or has eaten already, whenever someone offers food he would sit and eat with them. This was a sign that he has accepted the food out of care, recognition, and respect of the person's time to prepare the meal. A Hmong proverb exemplifies this act as "tsis luag los lam ntxi hniav, tsis noj los lam tuav diav."

As many of the participants expressed, they are often faced with a fork in the road in terms of masculinity in the Hmong community. While they recognize that by consuming alcohol and participating in Hmong community events like Hmong funerals, weddings, and hu plig's is perpetuating masculinity, many still value traditional Hmong customs and values such as acceptance and respect of elders. As described by Student 3 in his experiences of trying to navigate two worlds feels like he "is literally looking left and right at the same time".

U.S. Dominant Society Messages. To complex issues even more, not only do the five participants face messages of masculinity from Hmong communities, but from U.S. dominant messages of Asian American men as well which influence their perception of masculinity. Dominant forms of U.S. messages of Asian American which participants felt contributed to their socialization of masculinity are from media representation, such as U.S. sports, movies, and T.V. shows. From participant's experiences, White hegemonic masculinity has greatly influenced how they see themselves as men. Similarly related to what Connell and Messerschmidt (2005) defined as White hegemonic masculinity, Student 2 and Student 5 in dialogue define WHM as "benefiting at the expense of others, because I've really learned that when you boil it down from the clothing to the music to the jokes or the way white masculinity holds itself, it's all about putting down others so you can become more superior". In response to Student 5's definition, Student 2 provides an example of WHM by comparing NFL quarterback of the Carolina Panthers and NFL cornerback of the San Francisco 49ers to NFL quarterback of the Green Bay Packers. He says, "Cam Newton and

Richard Sherman, American football, are highly outspoken. They dance, they, you know, do all this stuff seen as very, very ignorant. There's a lot of these terms really derogatory terms use against them, but then you got like Aaron Rodgers of the Packers in he'll showboat or he'll say something on the field and no one will ever question that, you know, because he's White." This example showcases that at the cross roads of race and gender play a powerful role in determining the status quo of what is "normal" in dominant U.S. society. To simply put it, Student 6 says, "it's not so much White masculinity or whatever the norm is, but the norm is whatever White masculinity decides it to be."

Stereotypes perpetuated by dominant U.S. media of Asian Americans include model minorities, yellow peril, and perpetual foreigners. The generalization of Asian Americans ignores the diversity among Asian Americans. The blindness to Asian American diversity leads to movies such as Gran Torino. As described by all of the participants, the movie *Gran Torino* (2008) perpetuates stereotypes of yellow peril and perpetual foreigner of Asian Americans. Asian American men in this film were either hyper masculinized or effeminized. The film was set in Detroit, Michigan with the "protagonist" being Clint Eastwood, a retired White veteran man of the Korean War who is portrayed as "saving" his Hmong neighbors, specifically Bee Vang, a Hmong American young man, from the Hmong gangsters of the area. In synopsis, Bee Vang is portrayed as quite, reserved, and feminine while the Hmong gangsters were portrayed as violent, aggressive, and menacing. Bee Vang is the epitome of the dominant stereotype of the nerd and effeminate Asian American man whilst the Hmong gangsters are the epitome of yellow peril. Not only does Gran Torino perpetuate Asian American stereotypes, news outlets portray Asian Americans as perpetual foreigners to make Asian Americans seem untrustworthy and unable to assimilate completely (S. Lee et. al. 2008). An example of this stereotype would be when Chai Soua Vang was found guilty of killing 6 white hunters in northern Wisconsin in 2005 after being subjected to racial slurs and intimidation. After this case, bumpers stickers were created saying "Save a Deer, Shoot a Mung". Hmong Americans in Minnesota and Wisconsin reported being victims of hate crimes due to the stereotype that Hmong people were unable to assimilate (E. Lee, 2015, pg.350). The message of Gran Torino and news outlet showing Chai Soua Vang communicates the idea that an Asian American man can only be one or the other. In other words, Asian American men are captured in a vicious binary cycle where identities are fixed and growth as a human are already predetermined by dominant messages. As Student 3 says, my "whole life is jeopardized by how manly you are or how masculine you can be or will be."

As described by the participants, other dominant messages of masculinity portrayed by U.S. media include the sports industry and television industry. Student 4 expresses that the National Football League (NFL) takes over Sunday's in the U.S. displaying the "gladiators" of current U.S. America. The beauty standards of men are often normalized as six packs (abs), White, and having a good physique. As the "gladiators" of the NFL take over Sunday's, television shows such as *How I Met Your Mother,* displays what being a man means through the form of money and sexualization of women. This analysis runs congruent to what Chua and Fujino (2007) state in their research that "white men associate masculinity with strong personality, sexually exciting, college graduate, independent, feminine (negative), high income potential, dominant, high occupational status potential, and values traditional sex roles" (p. 404).In the case of *How I Met Your Mother,* Neil Patrick Harris plays the rich, single, dominant, sexually exacting character of Barney Stinson who continuously reinforces the vicious cycle of hyper masculinity by employing pages from his "Playbook" to sexualize and dehumanize women while his book of "Bro Code" is used to uphold the status quo of patriarchy. Through media like Gran Torino, the NFL, news outlets, and television shows, messages of masculinity are constantly reinforcing hegemonic masculinity at the expense of portraying Asian American men negatively.

Reflections of masculinity. The experiences of the five participants portray the plague of patriarchy and masculinity that silently hurts all peoples. In this research case study, participants were asked what strategies they were doing to use to deconstruct patriarchy and reconstruct healthy versions of themselves, and what messages they would give to the younger generation of Hmong men. A common response among the participants was a recognition that dialogues and conversations on patriarchy and masculinity need to start at an earlier age. Student 2 explains,

> It has to be more than just a message. It has to be a conversation, like what we're talking about now, deconstructing it or figure out what we think of it right now deconstruct it from there of our ideas of it, how did it become who is benefiting from it and then break it down from there because there's a lot of things to be talking about.

In common with the participants, conversations need to have institutional spaces where these conversations can happen in a brave space (defined by NASPA - Student Affairs Administrators in Higher Education: brave space constitutes "controversy with civility," where varying opinions are accepted, "owning intentions and impacts," in which students acknowledge and discuss instances where a dialogue has affected the emotional well-being of another person, "challenge by choice," where students have an option to step in and out of challenging conversations "respect," where students show respect for one another's basic personhood, and "no attacks," where students agree not to intentionally inflict harm on one another). As noted by Student 3, there needs to be new leaders in position of power to actively advocate to deconstruct patriarchy. The topic of conversations and dialogue brings up the question of who is participating in these conversations. As noted by all the participants, there is a recognition that conversations to dismantle patriarchy cannot only be between men. As articulated by Student 6,

> It's a conversation that's going to require both groups….patriarchy occurred through the involvement of both groups of Hmong men and Hmong woman (including gender fluid persons). So that's going to take the same thing for it to move on or like to be dismantled. Like it's not going to be only Hmong men or Hmong women. I think it's definitely going to be a lot more effort and work on one side, which is those who hold the power, which is Hmong men. But I think it's definitely going to involve both open dialogue.

Other responses to this theme include Student 1 saying it is important to, "Teach them (Hmong young men) to include everyone so that hopefully someday there will be a time where everyone lives equally and everyone treats everyone with the same amount of respect and love." Adding to this Student 4 reflects that dismantling his own internalized patriarchy and masculine thoughts and actions begins with himself. A way to help him with self-reflection is listening to the people who are hurt most by patriarchy such as his aunts, sisters, mothers, and grandmothers. To conclude reflections of the participants' masculinity, Student 1 summarizes masculinity as instead of overpowering people, we need to empower people and the community instead. The importance of research about Hmong American men experiences is particularly important because it will help services and programs connect Hmong American and Asian American men to the education system. The more exposure and conversation about education they have will help their children educationally, be more active in school, and be more independent and self-sufficient (K. Yang, 1997, p. 13).

Discussion:

Masculinity changes throughout time like that of culture. Similarly, the five participants do not have a fixed single identity of masculinity. Instead, much of the time are in constant negotiation between their gender privilege and racial oppression (Liu, 2002). They recognize that in the Hmong community they have tremendous value as they benefit from the system of patriarchy through recognition and respect by consuming alcohol and easier access to Hmong elders knowledge by sitting at the table. For some of the participants, their lives are caught in a binary which is the results of dominant message of masculinity from influential institutions of power. In contrast, they recognize that in U.S. dominant society, they face limitations as stereotypes such as yellow peril, model minority myth, and perpetual foreigner inhibits their success as Asian American men. White hegemonic masculinity continuously affects the five college age Hmong men as they move navigate and fight multiple systems. Through dominant messages such as stereotypes of Asian Americans and White masculinity as "benefiting at the expense of others", leaves the five Hmong American college age men in reflections of how can Hmong men be inclusive of all genders and peoples while maintaining traditional Hmong values? There are limitations to this research including the lack of different perspectives on Hmong masculinity.

Masculinity has effects beyond male identifies and has repercussions of all peoples In contrast to my father's experience, narratives like my mother Paj Nyiag (Pa Nhia) Xiong, a Hmong American woman, are needed in order to provide a holistic understanding of Hmong masculinity. Pa Nhia lost her birth father in Thailand growing up in refugee camp in Thailand. After migrating to the U.S. in 1995 with her husband and two children, she also has been working in factory and manual positions, often lifting 50+ pounds of lumber and materials. Almost all of the time she is the only female worker in a male dominated workplace. Not only does she experience patriarchy at her workplace, Pa Nhia faces silencing and masculinity within the Hmong community as well. Further research needs to examine perspectives of Hmong women, LGBTQ, youth, and elders about Hmong masculinity. Potential research questions that could be explored include: What other factors might contribute to Hmong Masculinity? What is the relationship between Hmong masculinity and Hmong femininity? What is Hmong femininity? While asking these questions it is important to acknowledge that gender is fluid thus we need to acknowledge communities and peoples who are non-binary or gender independent.

Future Research:

Future research needs to include different perspectives about Hmong masculinity. This case study only follows five Hmong American college age men, which has many limitations as previously stated above. As Muhammed, Wallerstein, Sussman, Aliva, Belone, and Duran (2016) explains in *Reflections on Researcher Identity and Power: The Impact of Positionality on Community Based Participatory Research (CBPR) Processes and Outcomes*, the insider-outsider relationship in research helps position researchers in their respective disciplines or research. Insiders have access to different forms of information, especially with shared experiences, but is additionally held more accountable to friends or family who assume this relationship. Outsiders face similar accountability but may lack personal experience and access to information (Muhammed et. al, 2016). For example, in this research, I am an insider, given that I identify as a Hmong man and I have shared experiences with the participants in the research as well as access to information. This is also limiting because I view the world from my own masculine lens and as much as I like to think I am including other people's voices, I lack the ability to have shared experiences with groups of different identities. As Smith (2011) states, "Drawing attention to different purposes of critical reflection may help to achieve more collaborative and constructive approaches to thinking, learning and assessment (p.14)". With this practice, it is critical I collaborate with people from different disciplines, identities, and life experiences to do justice for the participants and the community.

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Lastly, to anyone who will pick this article up and read it; I want to thank you for taking your time and effort to do so. You are important and special. With this, I hope you carry what I say to your circle of people and continue the conversation of masculinity, patriarchy, and strategies to improving Hmong communities. I have said a lot in this article, but as Hmong elders say, "hais kaum los, txawm khaws tsis tau los yuav tsum khaws kom tau ib los."

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Modeling Wind Speed Distributions Using Skewed Probability Functions: A Monte Carlo Simulation with Applications to Real Wind Speed Data

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ABSTRACT

Finding suitable distributions for modeling wind speed is crucial since wind speed data generates valuable information about wind energy and power. The goal of this study is to demonstrate a framework for modeling wind speed data using different distributions. For illustration, three real data sets were obtained from the National Buoy Center (NBC) and the Minnesota Department of Natural Resources (Minnesota DNR). Since typical wind speed data exhibits skewness and shows bimodal characteristics, we fit and analyze the data using a set of skewed and flexible-skewed distributions. We also use several mixture models and compare all our results to the traditional models used in previous studies. Suitability of the models were investigated by fitting the three data sets to all distributions. Parameters were estimated using maximum likelihood estimation (MLE) method. Accuracy of each distribution was assessed using Kolmogorov-Smirnov (K-S) and R^2 goodness-of-fit tests. Our findings show that Weibull, Gamma, and skew-normal distributions can model wind speed data accurately. In addition, mixture models such as gamma-Weibull and GEV-lognormal show exceptional fit due to bimodal features of one of the NBC data. Finally, a Monte Carlo simulation study was conducted to explore the performance of different parameter estimation methods available for Weibull and skew-normal distributions. All estimators were compared based on their mean squared error (MSE) values obtained from the simulation. Among the methods considered, weighted least squares and MLE performed better for both distributions, followed by method of least squares.

Keywords: wind speed data; flexible-skew distributions; mixture distributions; K-S test; R^2 test; Weibull distribution; skew-normal distribution; Monte Carlo simulation; estimation methods

INTRODUCTION

With the depletion of fossil fuels and coal energies, the search for a renewable, cost-effective and fuel-efficient energy source is vital. Some of the most common bioenergies include solar, wind, ocean and geothermal energy[1]. Among them, wind energy is an inexhaustible source that ensures sustainability of pollution-free fuel while demonstrating potential to pacify climate change. Additionally, wind energy has shown potential in combatting human health problems and economic damages. Wind turbines may be built without concern of atmospheric emissions or exhaustion of power. Because of this, researchers and environmentalists are actively seeking ways to characterize wind speed data in order to harness maximum wind energy. Accurate modeling of wind speed data is important to better evaluate wind energy and its potential.

BACKGROUND

Concern over limited fossil fuels and the aspiration to mitigate climate change has motivated researchers to characterize wind speed to better assess wind power. Many probability density functions (pdfs) have been applied to wind speed to fit and analyze it for practical purposes. In previous studies, the most common distributions used to describe wind speed include Weibull and Rayleigh. However, extensive literature review show that several other distributions can demonstrate exceptional fit as well. In more recent studies, parametric, non-parametric and mixture distributions have been used to describe wind speed characteristics.

Yilmaz and Celik[2] used well-known and some less common unimodal distributions to fit wind speed series collected in the Gelibolu region of Northwest Turkey including Weibull, beta, gamma, lognormal, etc. Morgan et al.[3] assessed offshore wind speeds by comparing common and other closely related distributions including Rayleigh, generalized normal, Kappa, Wakeby, etc. Furthermore, Indhumathy[4] proposed the generalized skew logistic model because of its flexibility to accommodate the shape parameter associated with wind speed distributions. Indhumathy found that generalized skew logistics described wind speed distributions efficiently in Kanya Kumari, India when compared to some other well-known pdfs. Masseran et al.[5] used nine distributions including Burr, inverse gamma, inverse Gaussian and models already listed above to evaluate wind speed and power over East Malaysia. Pobocikova et al.[6] employed two-parameter Weibull, three-parameter Weibull, 2-parameter gamma and 2-parameter lognormal for wind speed forecasting at an aviation center. Mazzeo et al.[7] used some of the distributions mentioned above for wind speed modeling at locations along the coast of Italy and one location in Colorado. Safari[8] also used models listed above for wind speed modeling in Rwanda.

When describing bimodal wind regimes, mixture distributions were generally employed to model the data. Ouarda et al.[9] used mixture Weibull (WW) and mixture gamma (GG) to assess wind potentiality at several meteorological stations in the United Arab Emirates. Kollu et al.[10] proposed the use of Weibull-lognormal (WL), GEV-lognormal (GEVL) and Weibull-GEV (WGEV) distributions and summarized that WGEV and GEVL were especially competitive in fitting bimodal data. Rajapaksha and Perera[11] evaluated wind speed energy by modeling monsoonal seasons with WW, WL and gamma-Weibull (GW) distributions and concluded that mixture models were also better for fitting the observed data. Qin et al.[12] proposed two improved mixture Weibull models for the analysis of wind speed data. They presented mixture of two-parameter Weibull and three-parameter Weibull (W2-W3) and the two-component mixture of three-parameter Weibull (W3-W3) pdfs in describing wind speed at five geographical locations. Jaramillo and Borja[13] also used WW to fit bimodal wind speed distributions in La Ventosa, Mexico. Tian Pau[14] applied GW and the two-component truncated normal distribution (NN) for assessing wind strength and power. Tran et al.[15] also employed the distributions listed here for fitting unimodal and bimodal-skewed data sets.

The goal of this research is to present the most practical method concerning the question: which distributions are most effective and accurate in modeling wind speed data? We explore different families of distributions and their ability to fit unimodal and bimodal skewed data. We focus on some recently developed distributions which has demonstrated flexibility in modeling skewed data with one or more modes. We emphasize on the univariate skew-normal distribution studied by Azzalini in 1985[16]. The skew-normal distribution is an extension of the continuous normal distribution that is then modified to account for skew forms. It has been extensively used in diverse applications to study asymmetric, unimodal and bimodal behaviors. Simplicity and applicability of the model has motivated researchers to develop other skew-symmetric pdfs that are related with skew-normal. Among them, we explore the skew-t distribution which was first considered by Branco and Dey but later given by Azzalini and Arellano-Valle[17]. The skew-t distribution is commonly used to study robustness especially with data set that are skewed or have heavy tails[18]. We examine the alpha-skew-normal distribution proposed by Elal-Olivero[19] in 2010. The alpha-skew-normal distribution is

an extended form of the skew-normal distribution and is flexible enough to accommodate unimodal and bimodal patterns. Futhermore, the Alpha-Skew-Laplace distribution was introduced by Harandi et al.[20] and is a new family of skew distributions following Elal-Olivero's class. The Alpha-Skew-Laplace distribution includes flexible hazard rate behavior for unimodal and bimodal distributions. We also explore the alpha-skew-logistic distribution proposed by Hazarika et al.[21] in 2014. The alpha-skew-logistic distribution was introduced following the same ideas as [19-21] and is adaptable to unimodal and bimodal shapes of skewed data. In 2016, the bimodal skew-symmetric normal distribution was introduced by Hassan et al.[22], which is capable of describing models with two distinct peaks, asymmetry and excess kurtosis. Using skewed, flexible-skewed and mixture distributions, we test for accuracy of each model by fitting them to three applications of real wind speed data.

Significance

To harness maximum wind energy, wind turbines must be carefully placed in geographical sites that will yield strength and resource availability. Thus, proper statistical modeling of wind speed distribution is fundamental to understanding aspects of wind exploitation[23]. Proper models must be employed to ensure accurate estimation of wind power potential and turbine productivity. Inappropriate modeling may encourage erroneous estimates of machine power output and economic viability. Therefore, it is essential to find a distribution that will correctly model wind speed shape at specific locations.

Since typical wind speed exhibits skewness and bimodal features, our study emphasize on modeling real data with flexible skewed distributions while still adopting unimodal and mixture models at hand. We are hopeful that the distributions in this article will provide groundwork for fitting bimodal data in the public environmental health discipline.

METHODS

Wind distribution models

Model Fitting

In this study, we use 20 models from three families of distributions to fit wind speed data. The three families include unimodal-skew, flexible-skew and mixture distributions.

Unimodal Skew Distributions

Among the unimodal skew family, we examine seven pdfs including Weibull, normal, gamma, lognormal, generalized extreme value (GEV), skew-normal (SN) and skew-t (ST).

Bimodal Flexible Distributions

For the flexible family of distributions, we explore four models. They include the alpha-skew-normal (ASN), alpha-skew-Laplace (ASLP), alpha-skew-logistics (ASLG) and bimodal skew-symmetric normal (BSSN) distributions.

Mixture Distributions

Lastly, we analyze nine models from the mixture family of distributions. The nine models we consider were gamma-Weibull (GW), two-component truncated normal (NN), two-component truncated Weibull (WW), normal-Weibull (NW), Weibull-lognormal (WL), Weibull-GEV (WGEV), GEV-lognormal (GEVL), mixture of skew-normal (MSN) and mixture of skew-t (MST).

We do not provide mathematical descriptions of these models because their pdfs can be found in any standard book on distributions or in [15].

Estimation

All model parameters were derived using the maximum likelihood estimation method. First, the log-likelihood function must be written using the provided probability density function for all models considered. Then, the GenSA function from the R package 'GenSA' is used to maximize the log-likelihood function with respect to the desired parameters.

Assessment Criteria

After obtaining all parameter values, we evaluate the fit of the distributions using the following assessment criteria: the Kolmogorov-Smirnov and the R^2 goodness-of-fit tests.

- **Kolmogorov-Smirnov test (K-S test)**

  The K-S test is a goodness-of-fit measure used to assess the maximum degree of agreement between a theoretical distribution function, $F_0(x)$, and observed distribution function, $S(x)$, where

$$D = max\,|F_0(x) - S(x)| \tag{1}$$

  The null hypothesis, H_0 assumes that the sample is drawn from $S(x)$. The test statistic, D, is compared to a critical value to which the H_0 is rejected or kept for further inferences. A lesser K-S value indicates better fitness of the distribution.

- **Coefficient of Determination test (R^2 test)**

  The R^2 test is used to compare the goodness-of-fit and correlation between observed cumulative probabilities, F, and predicted cumulative probabilities, $\hat{F}$. R^2 is defined below as:

$$R^2 = \frac{\sum_{i=1}^{n} (\hat{F}_i - \bar{F})^2}{\sum_{i=1}^{n} (\hat{F}_i - \bar{F})^2 + \sum_{i=1}^{n} (F_i - \hat{F}_i)^2} \tag{2}$$

  where $\bar{F} = \frac{1}{n} \sum_{i=1}^{n} \hat{F}_i$ and $\hat{F}$ probabilties are obtained from cumulative distribution functions. A larger R^2 value indicates a greater fit.

Monte Carlo Simulation

To assess the performance and accuracy of parameters, we explore various estimation methods. We explore common estimation techniques including the method of moments, method of maximum likelihood, least squares method and weighted least squares method. All four estimation methods can be found with application to the Gumbel distribution in [24]. In this section, we do not include estimation models for the Weibull distribution because their statistical descriptions are common throughout textbooks and can also

be found in [25]. Since estimation models for the skew-normal distribution are not as common, we provide their details below.

Skew-normal distribution

A skew-normal distribution, denoted $SN(\alpha)$ has the following PDF

$$f(y;\alpha)=2\varphi(y)\Phi(\alpha y) \tag{3.a}$$

where φ and Φ represent the probability density and cumulative distribution functions of $N(0,1)$ and α is the shape parameter. The linear transformation $X = \mu + \alpha Y$ with $\mu \in R$ and $\sigma > 0$ has the distribution $X \sim SN(\mu, \sigma, \alpha)$ with density

$$f(x;\mu,\sigma,\alpha)=\frac{2}{\sigma}\varphi\left(\frac{x-\mu}{\sigma}\right)\Phi\left(\alpha\frac{x-\mu}{\sigma}\right), \quad x \in R \tag{3.b}$$

When α is set to 0, a standard normal distribution returns. The skew-normal CDF is given by

$$F(x;\mu,\sigma,\alpha)=\varphi\left(\frac{x-\mu}{\sigma}\right)-2T\left(\frac{x-\mu}{\sigma},\alpha\right), x \in R \tag{4}$$

where T represents Owen's function.

The three-parameter skew-normal distribution can be characterized as skewed, unimodal and leptokurtic/platykurtic. See **Figure 1** for the density plot of three-parameter skew-normal distribution at some selected values of α.

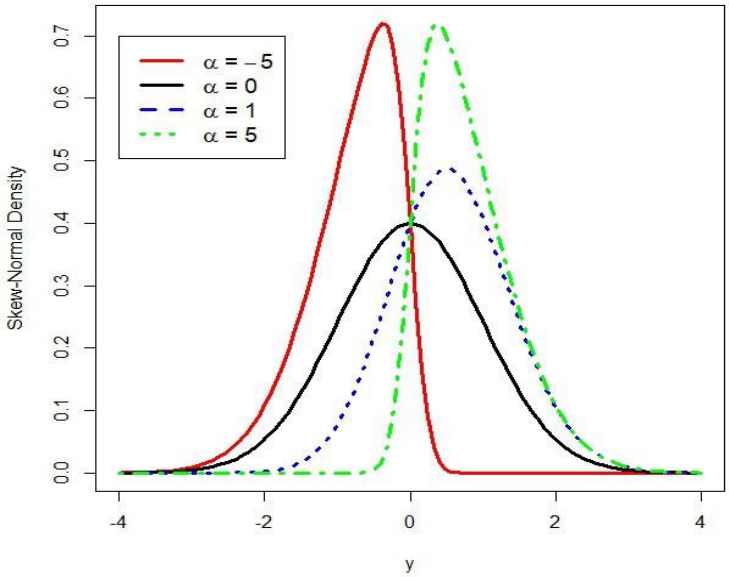

Figure 1. Density plot of skew-normal distribution at some selected values of α

1. **Method of moments (MOM)**

Moment estimators of the parameters μ, σ and α are derived by equating the sample moments to the corresponding population moments and solving the inequality for the parameters of interest. The first three sample moments are provided by

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \tag{5.a}$$

$$s^2 = \left(\frac{1}{n}\sum_{i=1}^{n} x_i - \bar{x}^2\right)^{1/2} \tag{5.b}$$

$$\hat{\alpha}_3 = \frac{\frac{1}{n}\sum_{i=1}^{n} x_i - \bar{x}^3}{\frac{1}{n}\sum_{i=1}^{n} x_i - \bar{x}^2 \frac{3}{2}} \tag{5.c}$$

The first three population moments are given as

$$E(x) = \mu + \sigma\delta \sqrt{\frac{2}{\pi}} \text{ where } \delta = \frac{\alpha}{\sqrt{1+\alpha^2}} \tag{6.a}$$

$$V(x) = \sigma^2\left(1 - \frac{2\delta^2}{\pi}\right) \tag{6.b}$$

$$\alpha_3 = \frac{4-\pi}{2}\frac{\left(\delta\sqrt{2/\pi}\right)^2}{\left(1-2\delta^2/\pi\right)^{3/2}} \tag{6.c}$$

The parameter estimates will be obtained using numerical approximation.

2. **Method of maximum likelihood (ML)**

Maximum likelihood estimators are found by optimizing the log-likelihood function with respect to the parameters of interest and can be found in [26]. The skew-normal log-likelihood function is provided below:

$$L(\mu,\sigma,\alpha) = n\ln\left(\frac{2}{\sigma}\right) - \frac{n}{2}\ln(2\pi) - \frac{1}{2}\sum_{i=1}^{n}\left(\frac{x-\mu}{\sigma}\right)^2 + \sum_{i=1}^{n}\Phi\left(\alpha\frac{x-\mu}{\sigma}\right) \tag{7}$$

The systems of equations we return from maximizing (7) with respect to μ, σ and α are

$$\frac{\partial L(\mu,\sigma,\alpha)}{\partial\mu} = \sum_{i=1}^{n}\frac{x-\mu}{\sigma^2} - \alpha\sum_{i=1}^{n}\frac{\varphi\left(\alpha\frac{x-\mu}{\sigma}\right)}{\Phi\left(\alpha\frac{x-\mu}{\sigma}\right)} = 0 \tag{8.a}$$

$$\frac{\partial L(\mu,\sigma,\alpha)}{\partial\sigma} = -\frac{n}{\sigma} + \sum_{i=1}^{n}\frac{(x-\mu)^2}{\sigma^3} - \alpha\sum_{i=1}^{n}\frac{\varphi\left(\alpha\frac{x-\mu}{\sigma}\right)}{\Phi\left(\alpha\frac{x-\mu}{\sigma}\right)}\frac{x-\mu}{\sigma} = 0$$

$$\left(\frac{x-\mu}{\sigma}\right)_{x-\mu\ \sigma} = 0 \qquad (8.b)$$

α —

$$\frac{\partial L(\mu, \sigma, \alpha)}{\partial \alpha} = \sum_{i=1}^{n} \frac{\varphi\left(\alpha \frac{x-\mu}{\sigma}\right)\left(\frac{x-\mu}{\sigma}\right)}{\Phi\left(\alpha \frac{x-\mu}{\sigma}\right)} = 0 \tag{8.c}$$

Since the ML estimators include non-linear functions, they cannot be solved for explicitly. Therefore, the systems of equations must be solved for iteratively.

3. **Method of least squares (LS)**

Let $X_1, X_2, \ldots, X_n$ be a random sample of size n from some distribution F(.). Then, the LS estimators can be solved by minimizing the following function with respect to the distribution

$$\sum_{i=1}^{n} \left[F\left(X_{(i)}\right) - \frac{i}{n+1} \right]^2 \tag{9}$$

where $F\left(X_{(i)}\right)$ represent the skew-normal cdf given in (4).

4. **Method of weighted least squares (WLS)**

WLS estimators are obtained by minimizing the following equation with respect to the parameters of interest.

$$\sum_{i=1}^{n} w_i \left[F\left(X_{(i)}\right) - \frac{i}{n+1} \right]^2 \tag{10}$$

where w_i represents the weighted component and is given by $w_i = \frac{(n+1)^2(n+2)}{i(n-i+1)}$.

Assessment Criteria

We evaluate the performance of different estimators proposed above by conducting a comparison between the simulated mean square error.

- **Mean square error (MSE)**

MSE is defined as the average squared difference between estimated values and real values. It is defined mathematically below.

Definition: Let θ represent the true value and $\hat{\theta}$ represent the estimated value, respectively. Then the MSE of the estimator $\hat{\theta}$ is defined as

$$MSE(\hat{\theta}) = E\left(\hat{\theta} - \theta\right)^2 = Var(\hat{\theta}) + Bias^2(\hat{\theta}) \text{ and } Bias(\hat{\theta}) = E(\hat{\theta}) - \theta \tag{11}$$

where a smaller MSE value represents a better estimation.

RESULTS AND DISCUSSIONS

Model Fitting

In this section, the several distributions described above were applied to three wind speed data sets. The first two data sets were obtained from the National Buoy Center (NBC). All values were recorded at 5m above sea level for an average of ten minutes. The third data set was retrieved from the Minnesota Department of Natural Resources and was collected by the National Weather Service and Federal Aviation Administration. To determine the fit of each model, we employed the AIC and BIC selection measures and the K-S and R^2 goodness of fit tests. All estimations were computed using the statistical software R.

Station 46014 Wind Speed Data

The first station, 46014 (PT Arena, 19NM North of Point Arena, CA), was measured over a period of three years (2008 to 2010). The original data set contained 157681 rows of observed wind speed data. After deleting all zeros and missing values, we used n=25130 for analysis. **Table 1** shows the summary statistics for wind station 46014, where g_1 and g_2 represent the skewness and kurtosis.

n	$\bar{x}$	s	g_1	g_2
25130	6.20	3.71	0.54	-0.52

Table 1. Summary Statistics for Station 46014 wind speed data.

Station 46014 data has a mean of 6.20 m/s and standard deviation of 3.71 m/s. The skewness and kurtosis are 0.54 m/s and -0.52 m/s respectively. The data exhibits a highly-skewed and unimodal pattern. Therefore, we considered skewed distributions as competitive models for fitting the data. We focused on some popular distributions and other recently developed models.

Estimated parameters for skewed distributions are presented in **Table 4** of the Appendix. K-S and R^2 values are given in **Table 6**. When considering skewed distributions, Weibull and skew-normal provide the best fit. This is evident from their small K-S errors and large R^2 values. Normal, lognormal and alpha-skew-normal distributions are inadequate in modeling the observed data. This is shown by their larger K-S errors and smaller R^2 values. The observed and estimated densities are plotted in **Figure 2** for further fitness evaluation. All density plots were produced using the estimated parameter values.

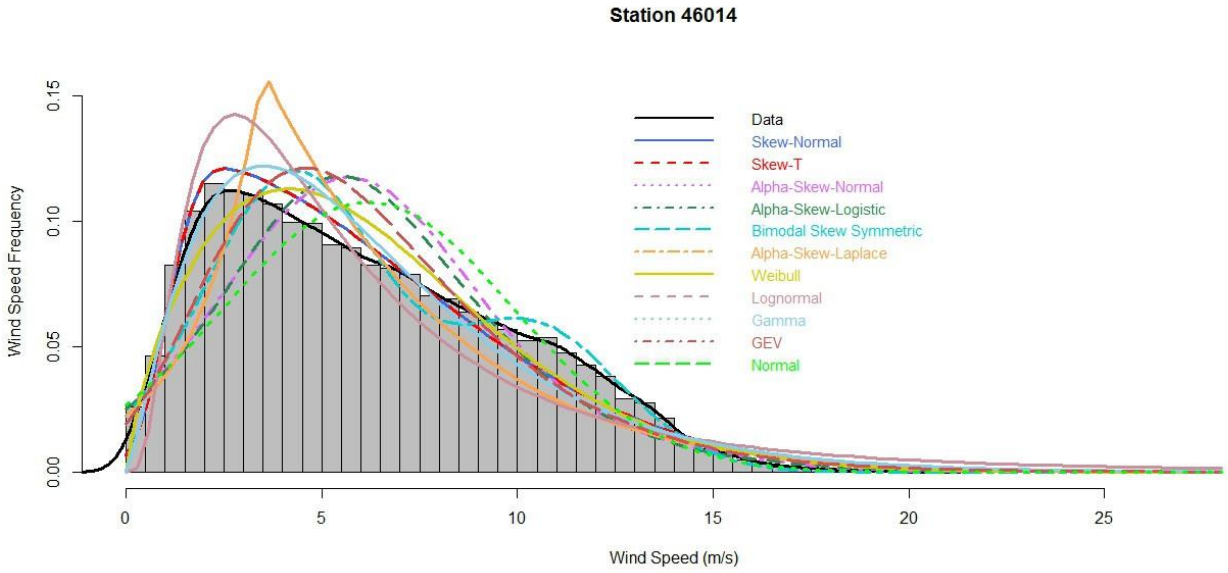

Figure 2. Observed and Expected Density plot of Station 46014 wind speed data

The density plot show that Weibull and skew-normal provide the best fit among the skewed models. When examining the tail closely, one can argue that there is some variation to it. Therefore, we considered mixture models to see if it can account for some of the noise at the end. Maximum likelihood estimates of mixture models are given in **Table 5** of the Appendix. The observed and expected density plots for mixture models are given below in **Figure 3**.

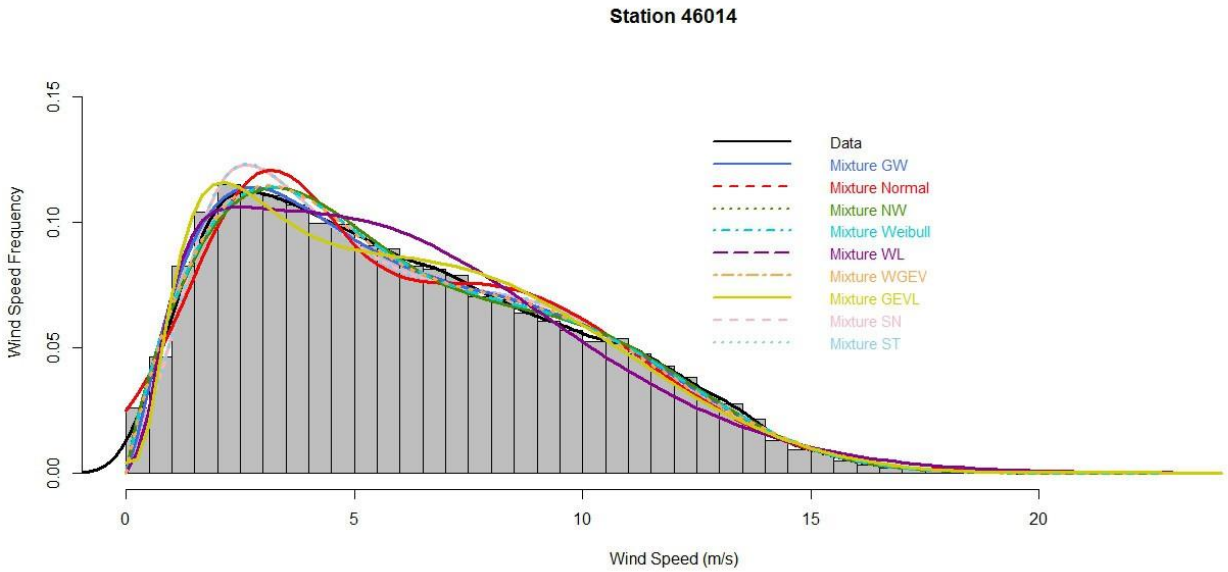

Figure 3. Observed and Expected Density plot of Station 46014 wind speed data

Skewed probability functions demonstrated suitability in modeling station 46014 data, but mixture models

showed exceptional fit compared to it. This is provided by their smaller K-S errors and larger R^2 results. Among the models given in **Table 5**, GW provide the closest fit. MW, NW and WGEV followed closely behind. All pdfs show exceptional fit except MN.

Station 46054 Wind Speed Data

The second station, 46054 (Santa Barbara W 38 NM West of Santa Barbara, CA) was taken over the period 1999-2000 and was used for wind modeling. The original data set had 105373 rows of data. After deleting missing and zero values, n=15812 was used for final analysis. **Table 2** provides the preliminary statistics for station 46054 data.

n	$\bar{x}$	s	g_1	g_2
15812	8.08	4.23	-0.01	1.93

Table 2. Summary Statistics for Station 46054 wind speed data.

Station 46054 has mean 8.08 m/s and standard deviation 4.23 m/s. The skewness and kurtosis are -0.01 m/s and 1.93 m/s. The observed data exhibits bimodal and skewed patterns. Therefore, we considered skewed probability functions in fitting this data set.

All parametric values are provided in **Table 4**. The test values are presented in **Table 6**. Using the estimated parameter values, we plotted their observed and expected skewed densities shown in **Figure 4**. Considering the bimodal features of the data set, we also used mixture distributions for modeling. Estimated values for the mixture models are found in **Table 5**. The assessment values are presented in **Table 7** of the Appendix. Observed and expected mixture densities are plotted below in **Figure 5**.

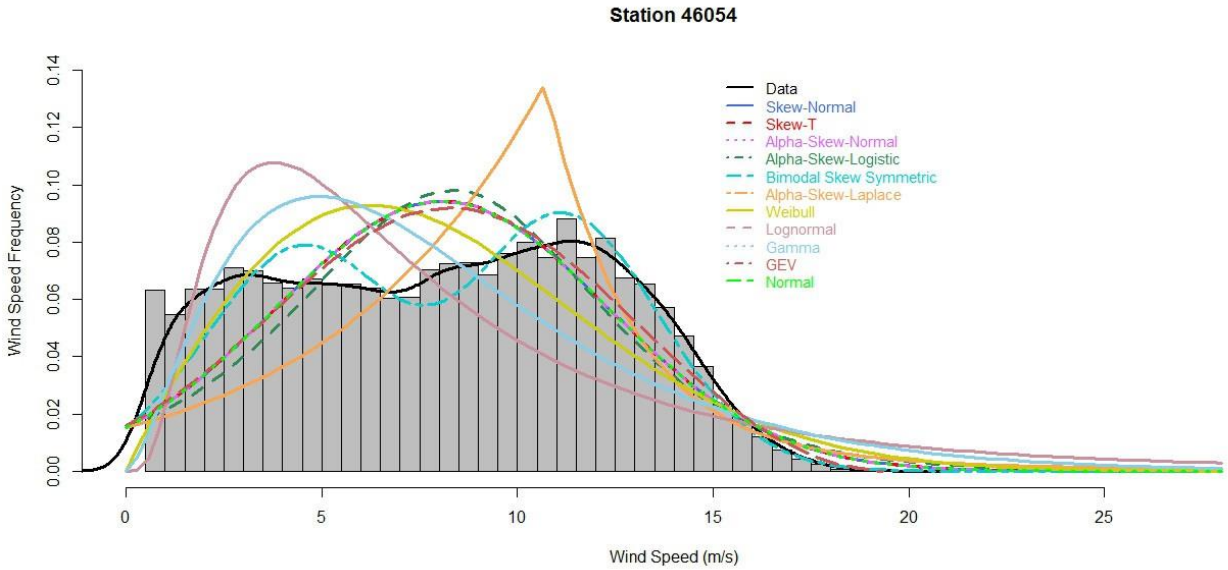

Figure 4. Observed and Expected Density plot of Station 46014 wind speed data

Among the skewed models, GEV resemble the data set closest. Although GEV is a strictly unimodal pdf, the single peak modeled the data set well and stayed grounded to the real values. The normal, skew-normal, skew-t and ASN distributions followed closely after with very similar values. BSSN is argued to

be a competitive fit because it accounts for both peaks. Considering the bimodal features of the data set, mixture models are believed to be better fit for application.

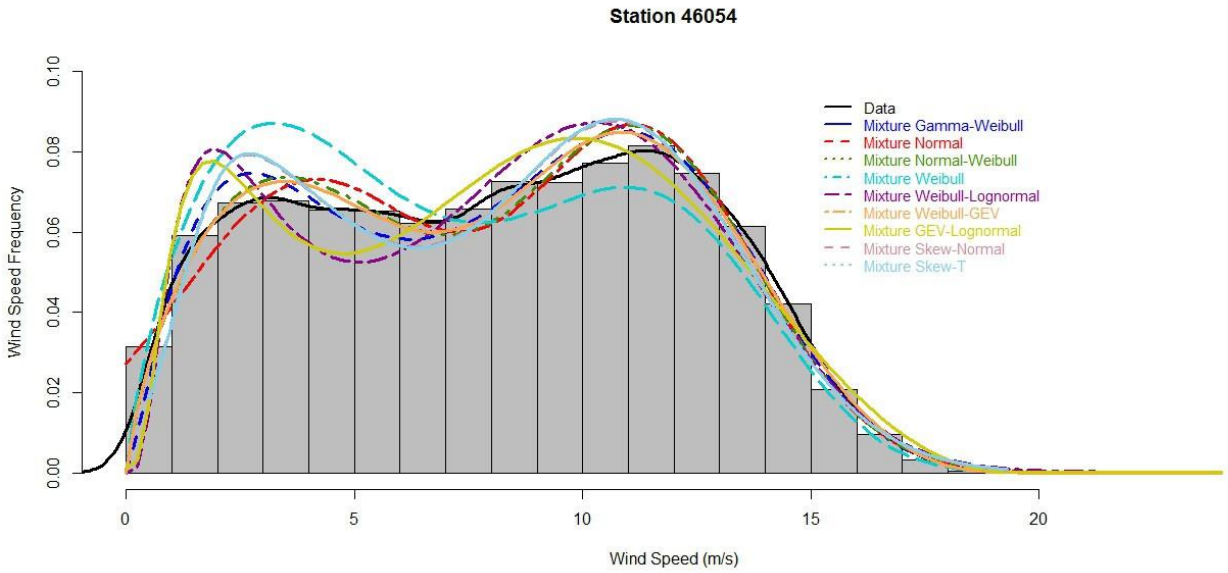

Figure 5. Observed and Expected Density plot of Station 46014 wind speed data

Among the mixture distributions, WGEV and GW are the best fits. Consistent with the K-S criteria, WGEV has the smallest value which indicates a better model. GW trails closely with the largest R^2 value. MW show inadequacy in modeling the data.

All pdfs show suitability in fitting the data as shown by the density plots and estimated values. Although skewed models are good fits, mixture distributions performed better. This is explainable as mixture models typically resemble bimodal data sets with more accuracy.

Minneapolis Wind Speed Data

The Minneapolis/St. Paul (MSP) International airport, USA was the location of data collection for the period of January 2012 to March 2016. The data, in miles per hour, was averaged each day for a total of 1827 records. **Table 3** provides the preliminary results.

n	$\bar{x}$	s	g_1	g_2
1827	9.04	3.56	0.56	0.08

Table 3. Summary Statistics for Minneapolis wind speed data.

MSP airport has mean 9.04 mi/hr and standard deviation 3.56 mi/hr. The kurtosis and skewness are 1.56 mi/hr and 0.08 mi/hr respectively. The data set revealed a slightly-skewed pattern. After performing log transformations, the data remained skewed. We proceeded to model the data set with only skewed distributions because of the minor skew.

The parameter values for MSP are arranged in **Table 4** of the Appendix. The assessment values are provided in **Table 6**. According to AIC and BIC measures, the distributions that provided the best fit were gamma,

SN and ST. Based on R^2 values, gamma was also reveal the best fit (0.9996). ASLP distribution was not able to describe the data well as shown by the relatively distant values. Provided below in **Figure 6** is the observed and expected density plot of MSP wind speed data.

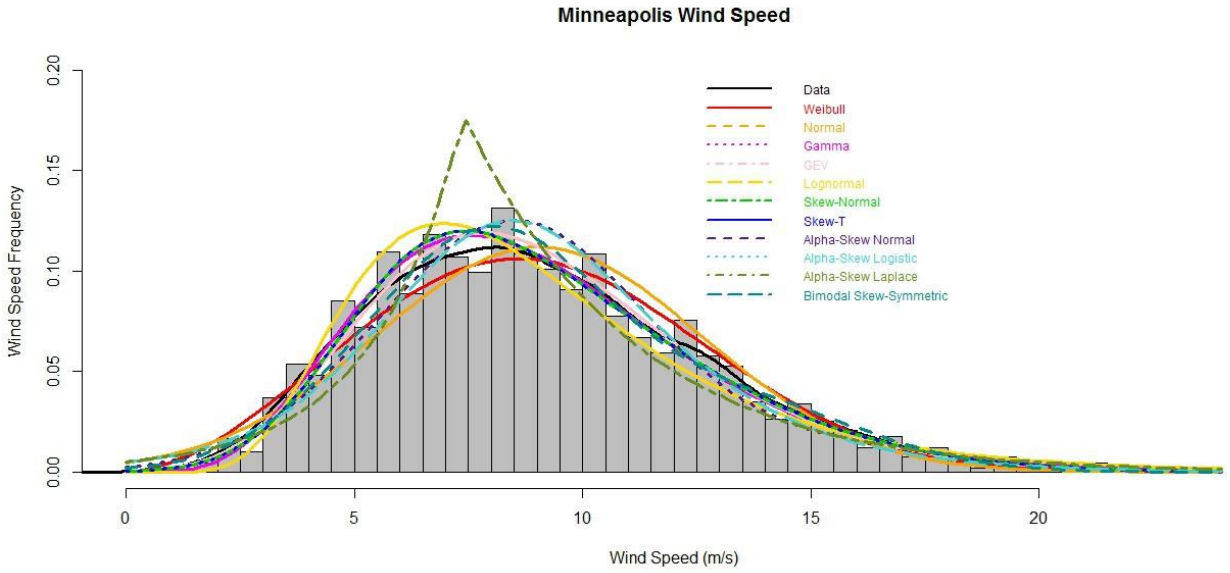

Figure 6. Observed and Expected Density plot of Station 46014 wind speed data

From the above figure, it is obvious that ASLP is incapable of modeling the data. All other pdfs seem to provide a similar fit except ASLP which displays a sharp peak.

Monte Carlo Simulation

Comparing the fit of all distributions above, it is clear as far as K-S and R^2 values are concerned that the skew-normal and Weibull distributions were most appropriate and accurate in modeling skewed wind speed data sets. Thus, we proceeded to conduct an extensive simulation study to compare the performance of different estimators for both distributions. Using the estimation techniques described in the Methods section, the performance of each estimators were compared base on their MSE values obtained from the simulation.

All simulated parameter and MSE values were computed based on 10,000 Monte Carlo runs for sample sizes n = 10, 20, 50, 100 and 500. The location parameter μ, scale parameter σ and shape parameter α were set to 0, 1 and 0.9 without loss of generality. All computations were done in R. Table **Table 8** and **9** provide simulation results for the skew-normal and Weibull distributions.

Skew-normal distribution

Simulation results show that for the location parameter μ, LS and WLS performed very similarly except when n = 20. Both methods return some of the smallest MSE values for the location estimator. For the scale parameter σ, MLE performed best followed by WLS. As far as the shape parameter α is concerned, WLS outperformed the other methods in all cases of n. From our simulation results, it is evident that WLS performed the best overall. Compared to the rest, MOM was not competitive nor adequate in estimating skew-normal parameters.

Weibull Simulation

According to the MSE comparison of the location μ and scale σ estimators, WLS performed well, especially for larger sample values (n = 50, 100 and 500). MLE followed closely in performance. For smaller n values (n = 10 and 20), MLE performed better than WLS. For the shape parameter α, MOM outperformed other methods for sample size n = 10, 20 and 50. However, similar to the location and shape parameter, WLS performed better for larger sample sizes of α. It is clear from the simulation that WLS provides the smallest MSE values especially for larger n values. Our results also indicate that LS and PWM are not as effective for estimating unknown parameter values.

CONCLUSIONS

In this paper, we tested for asymmetry and bimodality of wind speed data by fitting three real data sets to various distributions. We focused on modeling wind speed data with skewed, flexible and mixture families of distributions. Accuracy of each distribution was assessed using K-S and R^2 goodness-of-fit tests. Our findings showed that the Weibull, gamma, and skew-normal distributions model wind speed data most accurately. In addition, mixture models such as gamma-Weibull and GEV-lognormal showed an exceptional fit due to bimodal features of one of the NBC data.

Furthermore, we derived parameter estimators for the Weibull and skew-normal distributions using several estimation methods. We demonstrated a comparison between Weibull and skew-normal distributions because of their suitability and accuracy in modeling skewed wind speed data sets. Performance of each estimation method were tested based on MSE values obtained from Monte Carlo simulation. Our simulation results show that for both distributions, WLS method performed the best for all parameters, especially for larger sample sizes. Alongside WLS method, MLE performed exceptionally well for Weibull distribution, especially for smaller sizes of n. For skew-normal distribution, LS method performed competitively and similarly to method of WLS.

As an important indicator of wind energy and power, wind speed data still needs to be studied extensively beyond this. For future research, some other skewed models can be chosen to incorporate missing values of the data set for more accurate results since we had to delete a lot of data. Additionally, further exploration of the skew-normal distribution can be done to find other suitable estimation methods for unknown parameters.

ACKNOWLEDGMENTS

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APPENDIX

PDF		Station 46014 Data	Station 46054 Data	Minneapolis Data
Weibull	k	1.7060	1.9433	2.7177
	c	6.9424	9.0715	10.1697
Normal	μ	6.1947	8.0786	9.0362
	σ	3.7102	4.2343	3.5614
Gamma	α	2.3099	2.5464	6.1487
	β	2.6819	3.1725	1.4696
	ζ	-0.0265	-0.3300	-0.1029
GEV	l	4.4880	6.6753	7.5189
	δ	3.0393	4.2589	3.1075
Lognormal	λ	1.5919	1.8802	2.1177
	φ	0.7627	0.7443	0.4245
	μ	1.0245	8.2121	4.8410
SN	σ	6.3637	4.2364	5.5030
	α	10.0070	-0.0395	3.0494
	μ	1.0244	8.1702	4.8409
ST	σ	6.3635	4.2340	5.5031
	α	10.0083	-0.0271	3.0494
	ν	10994.3	121102.6	420191.2
	μ	8.1705	8.0493	11.0692
ASN	σ	3.4636	4.2343	3.2575
	α	0.7870	-0.0070	0.9091
	μ	4.4990	8.7419	7.6242
ASLG	β	2.0571	2.5411	1.9476
	α	-0.2321	0.0792	-0.2090
	μ	3.5000	10.7000	7.4000
ASLP	σ	3.1740	1.2773	2.5891
	α	-0.4799	0.4045	-0.3000
	μ	7.0650	7.8806	10.3951
BSSN	β	7.9044	7.7092	12.4346
	ψ	0.0701	0.0600	0.0573
	δ	5.9217	6.0595	13.2945

Table 4. Estimated parameter values for skew-flexible models

PDF		Station 46014	Station 46054
GW	α	2.3724	2.3545
	β	1.8737	1.9265
	k	3.4804	4.3934
	c	10.3443	11.8995
	w	0.6398	0.4378
NN	$\mu 1$	7.7943	11.3138
	$\sigma 1$	3.5351	2.5143
	$\mu 2$	2.8527	3.9854
	$\sigma 2$	1.5905	2.8579
	w	0.6504	0.5283
WW	$k1$	3.3190	4.5888
	$c1$	10.1903	12.0697
	$k2$	1.8526	1.7375
	$c2$	4.2435	5.0582
	w	0.4515	0.4514
NW	μ	9.9577	11.4326
	σ	2.7837	2.4811
	k	1.8137	1.7318
	c	4.8309	5.6195
	w	0.3357	0.4784
WL	k	1.9491	3.7792
	c	7.6925	11.3767
	λ	0.8367	1.1531
	φ	0.6201	0.7310
	w	0.8421	0.6482
WGEV	k	1.8675	1.7187
	c	4.4663	5.6235
	ζ	-0.2179	-0.2841
	l	8.6401	10.5227
	δ	2.6740	2.4938
	w	0.6112	0.5174
GEVL	ζ	-0.2453	-0.3290
	l	6.5787	8.8191
	δ	3.3297	3.4483
	λ	1.1133	1.0889
	φ	0.6774	0.7245
	w	0.5933	0.6981
MSN	$\mu 1$	2.9603	13.1379
	$\sigma 1$	1.4119	4.4898
	$\alpha 1$	-0.0001	-1.6750
	$\mu 2$	8.1909	3.2182
	$\sigma 2$	3.2544	1.6409
	$\alpha 2$	-0.0002	-0.0006
	w	0.3816	0.7113
MST	$\mu 1$	8.1934	3.2177
	$\sigma 1$	3.2544	1.6409
	$\alpha 1$	-0.0011	-0.0001
	$v 1$	299707.9	299327.1
	$\mu 2$	2.9604	13.1378
	$\sigma 2$	1.4119	4.4897
	$\alpha 2$	-0.0002	-1.6750
	$v 2$	299960.6	299998.7
	w	0.6184	0.2887

Table 5. Estimated values for mixture models

PDF	Station 46014 Data		Station 46054 Data		Minneapolis Data	
	K-S error	R^2	K-S error	R^2	K-S error	R^2
Weibull	0.0336	0.9958	0.0812	0.9780	0.0360	0.9949
Normal	0.0772	0.9777	0.0598	0.9867	0.0537	0.9887
Gamma	0.0450	0.9945	0.1024	0.9656	0.0244	0.9996
GEV	0.0473	0.9908	0.0575	0.9887	0.0210	0.9991
Lognormal	0.0727	0.9800	0.1303	0.9350	0.0499	0.9951
SN	0.0387	0.9961	0.0599	0.9867	0.0233	0.9994
ST	0.0387	0.9961	0.0598	0.9867	0.0233	0.9994
ASN	0.0658	0.9839	0.0598	0.9867	0.0192	0.9961

Table 6. Model fitting results: skewed and flexible models

PDF	Station 46014 Data		Station 46054 Data	
	K-S Test	R^2	K-S error	R^2
GW	0.0097	0.9810	0.0122	0.9997
NN	0.0302	0.9991	0.0525	0.9976
WW	0.0113	0.9997	0.0783	0.9753
NW	0.0125	0.9996	0.0117	0.9996
WL	0.0266	0.9983	0.0206	0.9987
WGEV	0.0110	0.9997	0.0111	0.9996
GEVL	0.0166	0.9992	0.0195	0.9990
MSN	0.0230	0.9984	0.0204	0.9989
MST	0.0230	0.9984	0.0204	0.9989

Table 7. Model fitting results: mixture models

n		μ	MSE	σ	MSE	α	MSE
	MOM	0.0250	0.0042	1.0263	0.0041	0.9247	0.0042
10	*MLE*	0.0287	0.0042	1.0086	0.0034	0.9270	0.0046
	LS	0.0198	0.0039	1.0340	0.0044	0.9212	0.0041
	WLS	0.0200	0.0039	1.0338	0.0043	0.9209	0.0040
	MOM	0.0242	0.0042	1.0254	0.0042	0.9254	0.0043
20	*MLE*	0.0275	0.0041	1.0161	0.0035	0.9262	0.0042
	LS	0.0181	0.0036	1.0322	0.0040	0.9214	0.0039
	WLS	0.0182	0.0037	1.0297	0.0039	0.9238	0.0039
	MOM	0.0265	0.0043	1.0247	0.0042	0.9245	0.0043
50	*MLE*	0.0247	0.0042	1.0227	0.0035	0.9266	0.0041
	LS	0.0117	0.0032	1.0301	0.0035	0.9250	0.0038
	WLS	0.0132	0.0032	1.0259	0.0032	0.9277	0.0037
	MOM	0.0250	0.0043	1.0240	0.0042	0.9255	0.0043
100	*MLE*	0.0243	0.0041	1.0267	0.0037	0.9253	0.0040
	LS	0.0047	0.0028	1.0266	0.0029	0.9306	0.0037
	WLS	0.0070	0.0028	1.0220	0.0025	0.9317	0.0036
	MOM	0.0253	0.0041	1.0251	0.0042	0.9245	0.0042
500	*MLE*	0.0223	0.0039	1.0376	0.0040	0.9247	0.0040
	LS	0.0198	0.0039	1.0340	0.0044	0.9212	0.0041
	WLS	0.0200	0.0039	1.0338	0.0043	0.9209	0.0040

Table 8. Simulated parameter and MSE values for skew-normal distribution when $\mu = 0$, $\sigma = 1$ and $\alpha = 0.9$

n		μ	MSE	σ	MSE	α	MSE
	MOM	0.0476	0.0770	0.9803	0.1966	0.9495	0.0025
	MLE	-0.0157	0.0022	1.0355	0.0037	0.9408	0.0042
	LS	0.0061	0.0032	1.0365	0.0044	0.9225	0.0039
10	*WLS*	0.0038	0.0030	1.0360	0.0044	0.9246	0.0037
	PWM	0.0695	0.0261	0.8596	0.1530	0.8324	0.0281
	MOM	0.0079	0.0416	1.0173	0.1086	0.9449	0.0023
	MLE	-0.0222	0.0018	1.0375	0.0038	0.9433	0.0043
	LS	0.0019	0.0025	1.0378	0.0043	0.9241	0.0036
20	*WLS*	0.0020	0.0019	1.0349	0.0039	0.9270	0.0034
	PWM	0.0478	0.0117	0.9054	0.0826	0.8509	0.0182
	MOM	-0.0165	0.0174	1.0362	0.0441	0.9378	0.0025
	MLE	-0.0216	0.0012	1.0375	0.0036	0.9435	0.0040
	LS	-0.0038	0.0015	1.0368	0.0036	0.9268	0.0032
50	*WLS*	0.0001	0.0007	1.0327	0.0033	0.9295	0.0030
	PWM	0.0261	0.0041	0.9488	0.0346	0.8714	0.0094
	MOM	-0.0254	0.0091	1.0451	0.0240	0.9350	0.0024
	MLE	-0.0183	0.0008	1.0359	0.0034	0.9408	0.0036
	LS	-0.0079	0.0008	1.0351	0.0032	0.9291	0.0029
100	*WLS*	0.0005	0.0003	1.0314	0.0028	0.9264	0.0023
	PWM	0.0155	0.0019	0.9717	0.0176	0.8833	0.0056
	MOM	-0.0380	0.0033	1.0563	0.0083	0.9351	0.0021
	MLE	-0.0089	0.0002	1.0351	0.0028	0.9353	0.0027
	LS	-0.0088	0.0002	1.0254	0.0018	0.9256	0.0017
500	*WLS*	0.0003	0.0000	1.0206	0.0014	0.9170	0.0010
	PWM	0.0025	0.0004	0.9947	0.0040	0.8976	0.0018

Table 9. Simulated parameter and MSE values for Weibull distribution when $\mu = 0,\ \sigma = 1$ and $\alpha = 0.9$