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Abstract

The Ronald McNair Post-Baccalaureate Achievement Program provides undergraduate students an opportunity to work with a faculty mentor, explore and research in their discipline, while preparing for future graduate school enrollment. The program is named for Ronald Ervin McNair, one of the first African-American astronauts and is designed to increase the number of low-income, first-generation students, or underrepresented students in doctoral degree programs.

The McNair Scholars Program is funded by a grant from the United States Department of Education that helps prepare students for doctoral study and careers in college teaching through a research internship. The documents presented in this journal are a culmination of final reports and projects from McNairs Scholars during his or her program year. Since the first grant was funded at Cal Poly Pomona in 1999, over 200 students have participated in the program.

For more information, please visit:
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Jesus Barriga
Rollercoaster-Energy Transformation

Abstract

Roller coaster passengers do not realize that “as you’re cruising down the track at 60 miles an hour, the ride has no engine” (Annenberg Learner 2013). However, roller coasters are conceived and designed to be motorless. Rollercoaster designs are based on physical laws that govern them. There are many physical laws, but for this matter we will primarily focus on the Law of Conservation of Energy and Energy Transformation. The Law of Conservation of Energy states that energy cannot be created nor destroyed. Energy Transformation is the process of changing one form of energy into another. As a result, roller coasters transform potential energy into kinetic energy and vice versa. This research will focus on energy transformation in loops by validating certain equations. The study will look at different size loops by using the derived equations to calculate the speed of the cart at the top of the loop and the required height to obtain that speed. This research will provide valuable information to prove that roller coasters are designed using these physical laws, as well to inform individuals of how rollercoasters function.

Major Objectives

The overall objective of this study will be to validate certain derived equations.

First I will study the velocity needed at the top of the loop. The equation for this calculation is:

\[ v = rg \]

Where \( v \) represents the velocity at the top of the loop, \( r \) the loops radius, and \( g \) the gravitational constant. The gravitational constant will be used in the units of cm/s^2 because the radius, \( r \), of my loops will be measured Thus, the units match and the velocity will be in cm/s.

Secondly, I will study the height required to obtain this velocity at the top of the loop by using the following equation:

\[ h = 2.5r \]

Where \( h \) represents the height required to obtain the desired speed at the top of the loop and \( r \) the radius of the loop.

Background

Previous research about rollercoaster design has brought up findings that are key to my research. One important finding was that “the purpose of the coasters initial ascent it to build up a sort of reservoir of potential energy” (Harris 2007). This ensures that potential energy is the only type of energy at the peak of the first ascent, which means that kinetic energy is not present since there is no movement. Potential energy is the energy that is stored by virtue of position; however, kinetic energy is the energy that is gained by virtue of being in motion. Additionally, “the conversion of potential energy to kinetic energy is what drives the rollercoaster” (Annenberg Learner 2013). This statement by the Annenberg Learner Foundation is significant because it ensures that looking at the energy transformation for this study is appropriate.

Although the study of the design of rollercoasters using the Law of Conservation of Energy and Energy Transformation has been looked at before, my research will focus strictly on loops and their design. Since energy is not created nor destroyed as stated earlier, this enables me to derive certain equations knowing that the potential and kinetic energy in the beginning must be equal to the potential and kinetic energy in the end. This law yields the following formula:

\[ PK_i + KE_i = PE_f + KE_f \]
loops were approximately that diameter. However, in my findings table you will find 6 loops because I repeated the smallest and biggest loop with double the mass to see if mass was negligible as we assumed it to be.

Finally I was ready to begin taking measurements and performing tests. When recording data I first calculated the height I needed to start from and the velocity I should expect at the top of the loop. A laser was used to measure the speed of the cart at the top of the loop and would record it on the computer. This was possible because as the cart crosses the laser it blocks the red beam from hitting a receiver and the computer records that time and is able to calculate the speed at that designated point. For each diameter I would release the cart from the calculated height three times for consistent results. I repeated this process for all different sized loops in order to see whether the derived equations that disregarded friction were valid.

However, prior to performing actual tests I calibrated the laser by releasing the cart from a random height three times to check the velocity measurements in order to verify that the readings were consistent and that the track was stable.

**Results**

Before I begin my discussion I would like to briefly go over each column and its meaning. The first column is the loop, which shows the diameter of the loop that was being tested in that trial. As mentioned before loops 5 and 6 were repeats with double the mass. Next we have the calculated height, which is the height I obtained using the radius and the formula. After that we have the calculated speed that is achieved using the radius and the formula as well. Next we have the adjusted height, which is what I did when the cart failed to loop. In order to find the adjusted height I dropped the cart at another height until I obtained the calculated
speed. In other words the adjusted height is the height when the cart loops at the speed that was calculated. The height difference is the difference between the calculated height and the adjusted height. This was done to see if there was some sort of correlation between the two. Next we have the ratio, which is the most important part. As seen in the formula the ratio between the height and the radius is 2.5, which occurred when the mass was doubled in the last two loops.

Discussion

After having tested and received results it was very clear whether these equations were valid or not. As we can see from the table there was only a height difference for loops one through four. This means that when I doubled the mass the height that was calculated was able to obtain the calculated speed at the top of the loop and loop the loop. This is important because in the derivation of the equations mass was canceled on both sides. Thus it suggested that mass was negligible but it is clear that mass is not negligible. The reason for this is because although the counteracting forces like friction, air resistance, and others may be minimal they are still present and it takes more than one cart to overcome these forces while traveling down initial lift hill and up the loop. Thus the equations are not valid since mass is not negligible.

Furthermore the loops then yielded different ratios depending on the mass. As mentioned before the height difference means that the cart was unable to loop. Therefore I had to adjust the height in order to obtain a speed measurement. However, loops five and six with double the mass were able to loop without adjusting the height keeping the ratio at the theoretical 2.5. This implies that for double the mass in my model the conventional height to radius ratio works. Since I only used one cart for my model attaching another cart was doubling the mass. However, my research does not suggest that doubling the mass of the cart in other models will yield the same results. In real life roller coaster design due to safety measurements friction, air

The following table shows the results I obtained while testing the equations.

<table>
<thead>
<tr>
<th>Loop</th>
<th>Calc. Height (cm)</th>
<th>Calc. Speed (cm/s)</th>
<th>Adjusted Height (cm)</th>
<th>Height Diff. (cm)</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>D = 39cm</td>
<td>48.75</td>
<td>138.309</td>
<td>66.75</td>
<td>18</td>
</tr>
<tr>
<td>2.</td>
<td>D = 37cm</td>
<td>46.25</td>
<td>134.716</td>
<td>71.75</td>
<td>25.5</td>
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<tr>
<td>3.</td>
<td>D = 29.5cm</td>
<td>36.375</td>
<td>120.290</td>
<td>53.50</td>
<td>17.125</td>
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<tr>
<td>4.</td>
<td>D = 27.5cm</td>
<td>34.375</td>
<td>116.141</td>
<td>49.50</td>
<td>15.125</td>
</tr>
<tr>
<td>5.</td>
<td>D = 39cm</td>
<td>48.75</td>
<td>138.309</td>
<td>48.75</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>D = 27.5cm</td>
<td>34.375</td>
<td>116.141</td>
<td>34.375</td>
<td>0</td>
</tr>
</tbody>
</table>
resistance, and many other forces are taken into account. I made my equations basic to test the fundamentals of physics and energy equations in an ideal system. Thus the equations only worked in my model when the mass was doubled. Further work can be done to quantify at what point will these equations work since it may work with less than double the mass, however it has not been tested.

While conducting this research certain limitations arose in my model. As mentioned before my model consists of an initial lift hill leading to the loop, with no intermediate hills present. This can pose as a limitation because the ride initially does begin with no velocity, whereas if I had an intermediate hill between the transition of the lift hill and loop there ride would have a velocity at the top of the intermediate hill that might change the outcome of my results. Thus, if there was an intermediate hill the measured velocity and height might be more in lined with the theoretical values calculated for the single cart. However for the simplicity of my research I still used my first method and some future work could be using an intermediate hill as a transition and compare values to see if the readings are improved.

Another limitation that posed a challenge was friction. Although friction is disregarded to ease the calculations it is still present between the cart and the track. I am not certain that friction is the reason for my values are not exactly the values calculated but it definitely is a possibility. In order to account for friction and so that I can improve my measurements I have stabilized my model so that the friction does impose track deformation. Thus if the track is stable and does not deform, my reading will be accurate and closer to the theoretical values.

The importance of my findings was to show that the Law of Conservation of Energy and Newton’s Second Law can be used to measure the velocity and height a roller coaster cart needs in order to loop. Although the equations are not valid for certain parameters this does not imply that these physical laws are inappropriate for this study. Thus this implies that friction needs to be taken into account. To conclude, the derived equations were valid when the mass was doubled in my model. The ratio between the height and the radius matched the theoretical value when the mass was doubled as well.

References


Araz Boghozian
Desposition Direction Dependent Failure Criteria For FDM ABS

Abstract

Fused Deposition Modeling (FDM) is a rapid prototyping process which has become a common method for both product prototyping and production due to its low manufacturing cost and speed of build process. FDM is commonly used with different materials such as Polycarbonate (PC), Acrylonitrile butadiene styrene (ABS), PC-ABS blends, and Polyphenylsulfone (PPSF) (Ramanth et al., 2007). ABS is a terpolymer consisting of acrylonitrile, butadiene, and styrene.

Styrene makes up the half of the ABS, and butadiene and styrene, each make the 25% of ABS. ABS is ideal for molding, machining, turning, drilling, milling, sawing, and die cutting. ABS is also used for electrical insulation. ABS is a lightweight, tough, and rigid thermoplastic that demonstrates high mechanical strength and high impact. (Polyhedron Laboratories) Today, numerous manufacturers use ABS for their rapid prototyped models, and also sometimes rapidly prototyped components are actually used as functional parts. Therefore, the understanding of how the process of rapid prototype modeling with ABS takes place and the failure criteria for the rapidly prototyped materials is essential.

There are user-selected parameters in the FDM machine that lets the user adjust the desired value for the raster parameters. Raster orientation, bead width, and the air gap are the parameters which may affect the strength of the material if changed. Raster orientation refers to the angle formed by the raster lines relative to the reference surface of the model. Raster bead width refers to the width of each ABS bead that makes up each layer of the ABS material. Raster air gap is the parameter that controls the gap between the beads of the material. The default value for the air gap is 0 which allows each bead to touch the bead next to it. As the value of the air gap increases, the distance between the beads increases as well. Similarly, a negative air gap will result in beads overlapping each other.

Major Objectives

The major objectives of this research are observing a direction dependency of the mechanical properties of the material on different raster orientations and finding analysis methods based on the methods that have been used for similar class of materials.

Literature Review

ABS has been used widely for modeling and manufacturing purposes and there has been different researches done on ABS. Compressive strength testing of plastics is what manufacturers have done in order to learn how strong the materials behave under different amount of load. The compressive strength of a material is the force per unit area that the material can withstand in compression. American plastics manufacturers generally test the specimens and report compressive yield strength, which is the stress measured at the point where the material yields, and the compressive modulus. The existing researches done on FDM ABS have been in
compression mode, the raster angle variation was not considered due to the complexity that it brings to the research and the angle between adjacent layers of the specimen has not been held constant throughout the manufacturing of the specimens. Therefore, a fixed raster angle [45-45] and zero air gap was considered, and only a change in the build direction was the parameter which they focused on (Ahn et al., 2002). Different polymers such as FDM PC and FDM ABS have been tested in tension, compression, bending, and torsion. A research that has been done on FDM ABS at the University of Malaysia has focused on compression mode but with constant raster angle. They have tested FDM ABS under deflection, flexure, and impact (Fatimatuzahraa et al., 2011) as well. However, to date there has not been an attempt of testing FDM ABS on different raster orientations in compression mode.

**Methods**

The first step was to determine the geometry of the specimen. The most appropriate specimens for this research are cylindrical specimens because the cylindrical specimens are the most suitable shapes for compression testing. If the cylindrical specimen is longer than its right size, it will buckle and the test cannot be processed. If the specimen is too short, the sample will not be compressed enough and the data generated will not be reliable (Intertek Plastic laboratories). Therefore, the right geometry of the specimens should be considered in order to perform the experiment successfully.

Using Solid Works, the 3 dimensional model of the specimen under test with the corresponding sizes was modeled and converted to Stereo Lithographic (STL) file prior to sending the file to Fused Deposition Modeling machine. In order to produce the specimens on different raster orientations, a request along with the dimensions and raster angle specifications of the specimens was sent to a manufacturer to produce the specimens for this research.

When the STL file is transferred to the FDM machine, the FDM machine deposits ABS plastic at a constant speed and builds the cylindrical specimens. In this research, there are specimens with different raster angles. In fact, the goal of this research is to find out if the failure criteria for FDM produced ABS is direction dependent or not. The specimens were produced from 0 degree raster angle to 90 degrees raster angle in 10 degree increments.

Compression testings were performed on a Shimadzu Universal Testing machine in order to analyze the failure criteria for FDM produced ABS plastic. In order to avoid differential lateral expansion called barreling during the compression testing, lubricant was used on top and bottom of the specimens (Instron-compression test). Also, the compression caused by the plate on the model had the potential to produce heat which could affect the data to some extent. The use of Teflon tape on both surfaces of the specimens reduced friction during the compression and the heat did not affect the collected data significantly.

Force vs displacement graphs were then generated in order to calculate compressive yield strength, maximum stress before failure, and the modulus of the elasticity of the material. The mechanical properties of the material were calculated and different failure mechanisms were observed. As the hypotheses were proposed, it was expected that the properties of the material will be direction dependent.
Procedure

In order to choose the correct geometry for the specimens prior to ordering them from the manufacturer, a cylindrical FDM ABS specimen with 1” in length and 0.5” in diameter was built with the 3D printer that is located on campus and compression test was performed on this specimen to determine the maximum load for the corresponding geometry. The maximum load turned out to be 2000 lbs. In order to collect accurate results, each specimen was going to experience compression testing two times. Consequently, a total of 20 FDM ABS cylindrical models (1” length, 0.5” diameter) with raster angles ranging from 0 to 90 degrees in 10 degree increments were ordered from the manufacturer.

Compression testing was performed on a Shimadzu Universal Testing machine on all of the specimens and graphs of force vs. displacement were generated during the testing of specimens. Prior to starting the compression test, the maximum load and the speed of the compression were set to 2000 lbs and 0.1 in/min respectively. The compressive yield strength and the maximum stress before failure of the material were then measured by calculating the stress and the strain at the points of interest. The Young’s Modulus of the materials was also measured by finding the slope of the straight line in the elastic region on the Stress-Strain graph. Figure 6 represents the calculated mechanical properties of the materials on raster angles between 0 to 90 degrees.
Figure 4. The deformation of the specimen on the 90 degree raster angle

Figure 5. Shearing in multiple layers of the specimen on 60 degree raster angle
Data / Results

All the values are in $10^3$ Psi

<table>
<thead>
<tr>
<th>Specimen (deg)</th>
<th>Yield Strength</th>
<th>Max Stress Before Failure</th>
<th>Stress at Fracture</th>
<th>Young's Modulus</th>
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</thead>
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<td>0</td>
<td>6.68</td>
<td>9.2</td>
<td>6.77</td>
<td>314</td>
</tr>
<tr>
<td>10</td>
<td>6.65</td>
<td>7.65</td>
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<td>20</td>
<td>6.44</td>
<td>7.74</td>
<td>4.41</td>
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<td>257</td>
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<td>90</td>
<td>7.56</td>
<td>7.83</td>
<td>6.58</td>
<td>273</td>
</tr>
</tbody>
</table>

Table 1. Calculated mechanical properties

![Figure 6. Raster angle vs. 0.2% Yield Strength](image)
Figure 7. Raster angle vs. Maximum stress before failure

Figure 8. Raster angle vs. Young’s modulus
Discussion

The experimental data that were collected from the compression tests provide valuable results. The variation of strength with raster angle proves that the mechanical properties of material are dependent on raster orientation. Although change in some of the properties was not significant, variation of properties between all the materials on different raster orientation was notable. As it was shown in the table, some materials on a certain raster angles exhibited relatively higher compressive yield strength, maximum stress before failure, and modulus of elasticity. For instance, as it was expected, the material on the 90 degree raster angle displayed the highest compressive yield strength. The reason is that the direction of the constant force applied by the compression machine to the circular cross sectional area of the specimen was along the direction of the beads which prevents the material from shearing and enables the material to deform permanently at a higher stress value. Similarly, the maximum stress before failure that the material could withstand was observed in the 0 degree specimen. This behavior arose from the direction of the beads in the 0 degree specimen, in which the layers of the material are deposited horizontally on top of each other, which enables the material to experience more compression before failure and consequently demonstrating higher stress before failure (See Figure 7). The unusual trend that was observed in the data was the value of the modulus of elasticity of 10 degree specimen (See figure 8). Due to the compact geometry of the specimens, the use of extensometer, which is a device to measure change in the length of the specimen, was not achievable. Therefore, the young’s modulus for all of the specimens was measured by calculating the slope of the elastic region using the force and displacement values for the corresponding elastic limit. However, this method of calculating the modulus of elasticity of the material is not very accurate and reliable. Therefore, an unusual trend in the Young’s Modulus data opens up a new path for more research. Although two more compression testings were performed to have more accurate results, the data for young’s modulus deviated from what was expected even more, resulting in a scattered data which cannot be analyzed and does not have a reasonable conclusion. When the results are compared to the results found from Polycarbonate in tension, it is observed that the PC material showed high yield strength in the 90 degree angle specimen as well. However, unlike ABS that has its high maximum stress before failure in the 0 degree specimen, the 90 degree PC specimen had the ability to withstand maximum stress before failure. From this observation it can be concluded that the behavior of these two materials are similar in some properties but not all. In the tensile testing of the PC material the specimens had the dog bone shapes, enabling the specimen to have an extensometer attached to it for measuring change in length. Consequently, more accurate results were found for Young’s Modulus measurements in the polycarbonate tensile test.

References

Figure 9. Some compression test specimens post-testing
APPENDIX B

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Trial</th>
<th>Point1 (PSI)</th>
<th>Yield Strength (PSI)</th>
<th>Maximum Stress Before Fracture (PSI)</th>
<th>Stress at Fracture (PSI)</th>
<th>Young's Modulus (PSI)</th>
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Table 2. Data recorded for all the trials
APPENDIX C

Figure 11. Graph of force vs. displacement of 0 degree specimen

Figure 12. Graph of force vs. displacement of 30 degree specimen
Figure 13. Graph of force vs. displacement of 60 degree specimen

Figure 14. Graph of force vs. displacement of 90 degree specimen
Lucas De Buren
Analytical Discrepancies In Fiber Model Analysis Of Unbonded Post-tensioned Prescast Concrete Walls

Abstract

This presentation investigates discrepancies in fiber model analyses of unbonded post-tensioned (UPT) precast concrete walls under combined gravity and cyclic lateral loads using the DRAIN-2DX program.

Previous work showed that fiber model analyses of UPT walls with relatively large initial prestress accurately represent the experimental base-shear lateral drift response under monotonic and cyclic lateral loads. It is expected that the base-shear under monotonic loading represent an upper bound to the base-shear lateral load response under cyclic loading. However, for two of these lightly prestressed walls, the analytical base-shear under cyclic loading exceed both the experimental base-shear and the analytical base-shear under monotonic loading. Therefore this research aims to establish a lower bound prestress level for which the fiber model produced acceptable (i.e. No significant over prediction of the monotonic response) base-shear response values of an UPT wall subjected to cyclic lateral loading.

Major Objectives

As is stated in the “Abstract” of this progress report, the purpose of this research is to find an initial prestress level for which the fiber model analysis base shear reaction of a UPT concrete wall under cyclic lateral loading base shear reaction fails to converge to the envelope set by the fiber model analysis of the same wall under monotonic later loading for both East and West loading to failure. The application of the prestress level will be taken into consideration when narrowing down the scope and has been deemed accurate to provide a 2% variance in prestress. Since the prestress level must be applied with a tensile machine consideration must be taken into account when narrowing down the prestress level. Upon determining the lower bound of prestress the further research will be directed towards implementing various alternatives for the fiber model. Such alternatives would be possible metal bracing for the extreme ends of the walls to possibly reduce the over prediction of base-shear response values under cyclic loading for walls with prestress lower than 0.3318 fpi/fpu. Even though the latter objective of this project would be ideal so that a solution to the discrepancy can be provided, it is outside the scope of the original research proposal and not a necessary requirement for the completion of this research project.

Literature Review

The DRAIN-2DX program (Prakash et al., Powell and Campbell 1993) was originally developed at the Department of Civil Engineering, University of California, Berkeley. The program is also supplemented by two elements developed at the University of Illinois at Urbana-Champaign and provided by Professor Mark Aschheim. Element 07, as referred to the program description, is a stiffness- pinching/degrading element intended for reinforced concrete members.

As a supplement to DRAIN-2DX an analytical model was developed by Kurama et al. (1996) at Lehigh University for the analysis of unbonded post-tensioned precast concrete walls. The model was developed with the condition that the walls be subjected to combined gravitational and lateral loads. The analytical model developed by Kurama et al. is based on the fiber beam-column element found in the element library of
the DRAIN-2DX program aforementioned and is thus referred to as the fiber model. The fiber model developed for the DRAIN-2DX program was used by Dr. Perez to analyze the base shear-lateral load response of unbonded post-tensioned precast concrete walls with horizontal joints which are submitted to a combined gravity and monotonic or cyclic lateral loads.

The fiber model requires the analytical stress-strain relationship for unconfined concrete, confined concrete and for the PT steel to be defined in a discrete manner. In order to verify the validity and accuracy of the fiber model in comparison to the experimental wall test results Dr. Perez obtained the analytical stress-strain relationships directly from either the component tests or from material models using the component test results. The stress-strain relationship was obtained by performing material characterization tests on the PT steel, on unconfined concrete cylinders, and on confined concrete hoop design. Establishing the correct stress-strain relationships for each wall set up is crucial for a successful analysis of the walls using the fiber model. Hoop Confined Concrete wall panels were used in TW3, TW4 and TW5 and the stress-strain relationship was analytically obtained using the Oh-Mander Hoop Confinement model (Perez, et al. 2004)

In order to verify the validity of the fiber model’s ability to correctly analyze the cyclic lateral load response of TW4 and TW5 a standard value or response curve had to be set up. The monotonic lateral loads response curves for eastward and westward loads, positive and negative drift values respectively, served as an envelope for the cyclic lateral load response curves. Any breaching of the envelope established by the monotonic lateral load response curves during cyclic load analyses would indicate that the fiber model is unable to correctly determine the lateral load drift response of the test walls.

The PT bar forces are an integral part of the lateral load response of the wall, and thus it is crucial that the fiber model capture the forces that develop in the PT bars if the correct base shear capacity and self-centering behavior of the wall is to be obtained. The correct normalized stress and force in the PT bars had to be determined experimentally using a strain gage and then compared to the fiber model analysis of the PT bars. The fiber model seems to be able to predict the force that develops in the PT bar under cyclic lateral loading. The PT bar forces from the fiber model analyses closely match to those determined experimentally for each test wall.

Along with the PT bar forces, the contact length at the wall base required a comparison between the experimental, fiber model cyclic analyses and closed-form expression. In general the contact length estimated by the fiber model analyses agree well with the contact lengths derived through closed-form expressions and experimentally during the cyclic lateral load response. Furthermore a comparison of the base-shear response values obtained experimentally under cyclic loading for a UPT wall with a prestress of 0.553 fpi/fpu and the analytical fiber model values for the same prestress show there is a good accordance between the two testing procedures.

Methodology

For the purpose of this project the fiber model will be used to determine the prestress level for which it is unable to provide the correct base-shear response values under cyclic loading in comparison to the base-shear response values under monotonic loading. Determining the correct lower bound will require various analyses at decreasing values of prestress, beginning with 0.553 fpi/fpu. (Previously determined to provide the correct base-shear response values under cyclic loading) (Perez et al., 2004)
1. For this project I will be using the DRAIN-2DX software, this software is free for any and every one to use and will be acquired from the following website: http://nisee.berkeley.edu/elibrary/Software/DRAIN2DX-ZIP

2. The files which contain the fiber model developed by Kumara et al. as well as the files required to model the unbonded post-tensioned precast concrete walls under monotonic and cyclic lateral loading will be provided by the research advisor Dr. Perez. These files will also include an executable file, which will to analyze the output data from the DRAIN-2DX software.

   a. In order to fully understand the capabilities of the DRAIN-2DX program and be able to correctly synthesize the processed data I will have to learn about modeling the unbonded post-tensioned precast concrete walls using the software. Over the course of a week or so in early October 2013 I will be working alongside Dr. Perez to master these skills and thus maximize the potential for a successful research project.

3. As stated in the research proposal the base shear response curve created by the software to model the test walls' response to monotonic lateral loading should serve as an envelope to encompass the various base-shear response curves created by the cyclic model analyses. The focus of this section of the project will be to determine the prestress level at which the cyclic model analyses fails to converge within the base-shear response curve.

   a. As proposed by Perez, only two data points within the analyses are known, one for which the prestress level was sufficient and the data converged to the monotonic base-shear response curve and one for which the fiber model failed to accurately represent the cyclic base-shear response values (0.2756 fpi/fpu or 50% initial). In order to narrow the scope of the data an initial set of prestress levels will be set as follows.

      i. 0.553 fpi/fpu (100% of the initial prestress)
      ii. 90% of the initial prestress
      iii. 80% of the initial prestress
      iv. 70% of the initial prestress
      v. 60% of the initial prestress
      vi. 0.2756 fpi/fpu (50% of the initial prestress)

4. Although both the 0.553 and 0.2756 fpi/fpu prestress level base-shear response values are known they will be recalculated to further develop the validity of the initial discrepancy found.

5. For each prestress level mentioned under 3.a an analysis will be executed using the fiber model of the DRAIN-2DX program for both monotonic and cyclic lateral loading.

6. Once the analyses for both monotonic and cyclic lateral loading are completed the data must be processed and analyzed for accuracy. The monotonic base-shear response values will be used as a standard to develop an envelope and compare with the base-shear response values. For the data reduction an executable file provided by Dr. Perez will be used. Once the data has been processed and analyzed then a judgment will be made on the capability of the fiber model to correctly capture the cyclic base-shear response values for the specified prestress level.

7. If the fiber model is able to successfully capture the cyclic base-shear response values and these values satisfy the preset condition that they must lie within the envelope curve set by the monotonic base-shear response values then the procedure described above will
be repeated for a lower prestress level. On the other hand if the fiber model is not able to capture the cyclic base-shear response values then a new set of initial prestress will be defined and then the procedure described above will be repeated for the new prestress levels until the fiber model is once again not able to capture the cyclic base-shear response values.

8. The new initial prestress levels used if the fiber model is not able to capture the cyclic base-shear response values will be set at exactly half-way between the prestress at which the analysis did not satisfy the over prediction requirements and the last known prestress level which did. For example:

   a. If the analyses fail at 80% and the last known converging prestress level was 85% then the new prestress level that will be used to the next set of analyses will be 82.5% of the initial prestress.

9. The process of narrowing down the prestress percentage for which the fiber model analysis fails to converge will be limited to the real life application. This set limit is to be determined when a variability of 2% can be reached. The purpose for this is to prevent any misconception of importance of determining a valid prestress percentage that can be applied to a real wall during construction.

Results

Substantial progress has been made towards the stated goal of determining a lower bound prestress level below which the fiber model fails to accurately predict (i.e. within 5% of the monotonic base-shear response values) the lateral load response of the subject test walls under cyclic lateral loading. Following the procedure laid out in “Methodology” a comparison between monotonic lateral and cyclic lateral loading was carried out for each prestress level. The base-shear response values attained from the analyses were plotted using an Excel to provide a visual representation of the data attained. These charts can be seen in Figures 1.1 – 1.8 below alongside the corresponding prestress levels. Due to the slight over prediction developed in the initial 0.533 fpi/fpu analysis a numerical revision was required to determine the lower bound for which the cyclic base-shear response values surpassed the monotonic base-shear response values by more than 5%. Individual cyclic envelopes were developed for East and West loading using the maximum base-shear values for the initial drift to target values. The comparison of cyclic vs. monotonic envelopes can be seen in Figures 2.1-2.16 below. Furthermore these envelopes were compared numerically using various iterations in MatLab to determine the over prediction percentage of the cyclic base-shear response envelope over the monotonic base-shear response envelope. As a result of these data reduction analyses it was determined that the lower bound for the fiber model in DRAIN-2DX is 0.3318 fpi/fpu. Any lower prestress value will result in an over prediction greater than 5%.

Through plotting the maximum over prediction percentages alongside the corresponding prestress levels a non-linear mathematical formula was developed to estimate the over prediction percentage which will be developed for a certain prestress. For the 0.2756 fpi/fpu (i.e. 50% initial prestress) the maximum over prediction developed on either East or West was 111-percent. This value is well outside the normal expected over prediction and clearly supports the initial premise that at 0.2756 fpi/fpu the fiber model fails to accurately predict the base-shear response values under cyclic lateral loading (Perez et al., 2004).

As stated in the “Literature Review” the PT bar forces are an integral part of the lateral response of the
UTP wall and thus it is crucial that the fiber model capture the forces that develop in the PT bars if the correct base-shear response values and self-centering behavior of the wall is to be obtained. The fiber model seems to not only predict the correct force that develops in the PT under cyclic lateral loading, but also the behavior of the PT bars under loading beyond the elastic limit. At higher prestress levels of the PT bars the fiber model is able to accurately predict the yielding behavior of the bars as well as the loss in prestress and the approximate elongation due to the yielding. The yielding of the PT bars is evenly distributed; meaning that when the easternmost PT yields the westernmost PT bar will yield in the following cycle. Figures 3.1 – 3.4 represent the forces applied to the PT bars under 0.553 fpi/fpu (Figures 3.1 – 3.2) and 0.2756 fpi/fpu (Figures 3.3 – 3.4). As it can be seen at lower prestress there is a reduction in the number of times the PT bars are subjected to tensile forces, which exceed the linear elastic limit, as depicted by the flat point on the curve followed by a loss in overall prestress. The yielding of the PT bars is expected to reduce the self-centering capabilities of the wall under cyclic loading as the PT bars lose their effect on the compressive prestress applied to the wall after going through permanent elongation post-yielding.

However there is no clear evidence that the loss of overall prestress in the wall affects the over prediction developed in the base-shear response values under cyclic loading. Furthermore the initial point of yielding for the PT bars subjected to a prestress of 0.553 fpi/fpu was compared to the initial point of over prediction of the cyclic base-shear response envelope when compared to the monotonic base-shear response envelope. Under this prestress the easternmost PT bar (bar #1) begins to yield at a drift value of 1.56% and the westernmost PT bar (bar #6) begins to yield at a drift value of -1.56% directly after PT bar #1 has yielded. The maximum over prediction at this prestress level was developed at drift values of 1.42% and 1.43% for eastward and westward loading respectively. Comparison of the lateral drift point for which initial yielding occurs and the lateral drift point for which maximum over prediction occurs for all prestress levels is constant with those found at 0.553 fpi/fpu. Therefore we can assume that there is no direct correlation between the over prediction of the cyclic base-shear lateral response values and the yielding of the PT bars as the over prediction occurs prior to the yielding of the PT bars.
Figures
Cyclic Loading Vs. Monotonic Loading Base-Shear Response Envelope

Figure 1.1 (100% Initial Prestress)

Figure 1.2 (90% Initial Prestress)
Figure 1.3 (80% Initial Prestress)

Figure 1.4 (70% Initial Prestress)
Figure 1.5 (60% Initial Prestress)

Figure 1.6 (58% Initial Prestress)
Figure 1.7 (55% Initial Prestress)

Figure 1.8 (50% Initial Prestress)
Cyclic Loading Vs. Monotonic Loading Base-Shear Response Envelope

Figure 2.1 (100% Initial Prestress, East)

Figure 2.2 (100% Initial Prestress, West)
Figure 2.3 (90% Initial Prestress, East)

Figure 2.4 (90% Initial Prestress, West)
Figure 2.5 (80% Initial Prestress, East)

Figure 2.6 (80% Initial Prestress, West)
Figure 2.7 (70% Initial Prestress, East)

Figure 2.8 (70% Initial Prestress, West)
Figure 2.9 (60% Initial Prestress, East with maximum allowed over prediction point)

Figure 2.10 (60% Initial Prestress, West with maximum allowed over prediction point)
Figure 2.11 (58% Initial Prestress, East)

Figure 2.12 (58% Initial Prestress, West)
Figure 2.13 (55% Initial Prestress, East)

Figure 2.14 (55% Initial Prestress, West)
Figure 2.15 (50% Initial Prestress, East)

Figure 2.16 (50% Initial Prestress, West)
Figure 3.1 (0.553 fpi/fpu Easternmost Bar, PT #6)

Figure 3.2 (0.553 fpi/fpu Westernmost Bar, PT #6)
Figure 3.3 (0.2756 fpi/fpu Easternmost Bar, PT #6)

Figure 3.4 (0.2756 fpi/fpu Westernmost Bar, PT #6)
Figure 3.5 (Comparison of lateral drift point of yielding & max. over prediction for PT #1 at 0.553fpi/fpu)

Figure 3.6 (Comparison of lateral drift point of yielding & max. over prediction for PT #6 at 0.553fpi/fpu)
Maximum Base Shear Over Prediction

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Table 4.1 (Maximum Over Prediction at Each Pretress Level for Eastward Loading)

Figure 4.1 (Maximum Over Prediction at Each Pretress Level with Estimating Equation)
### Table 4.2 (Maximum Over Prediction at Each Pretress Level for Westward Loading)

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Figure 4.2 (Maximum Over Prediction at Each Pretress Level with Estimating Equation)
Discussion

Throughout the course of the quarter since the last progress report was submitted there was various unexpected impediments, which required a new understanding of programs outside of the initial scope of this project. Once the cyclic loading base-shear response curves has been developed and plotted against the monotonic loading base-shear response curves a method for the analysis of data points had to be developed. Each analysis using DRAIN-2DX provides a certain limitations and as a result of this the number of data points acquired for the monotonic analysis surpassed the cyclic analysis by, on average, 1800. Therefore a method to increase the comparison rate between the drift values and the resulting base-shear response values had to be considered to decrease the time required to provide an over prediction percentage. To do this two mathematical software, MatLab and Visual Basic, were used for accuracy and reliability. Once the percent over prediction for both eastward and westward loading were computed for the initial case a comparison to a point-by-point computation was carried out to determine accuracy. It was determined that MatLab provided the most accurate and least time consuming method of carrying out the required comparisons and computations. Once again for accuracy and reliability Visual Basic was used at every other prestress level to provide as a safe guard against any loss in accuracy when using MatLab. Both analysis provided results in good accordance with each other and allowed me to reduce the time of the project by approximately two weeks.

Although no prior work was completed which would establish a lower bound prestress level in DRAIN-2DX this research has filled in a gap of knowledge. It was expected that the lower bound resulted somewhere between the two known prestress levels, a one which produced acceptable results (0.553 fpi/fpu) and one which produced unacceptable results (0.2756 fpi/fpu). The results attained are in line with the expectations proposed by the faculty mentor at the beginning of the project.

Further work on this project will be carried out during the summer session at California Polytechnic University as part of this research fellowship. Previous discussion on further development involved providing an alternative wall configuration that could reduce the amount of over prediction developed in the lightly prestressed walls. An alternative wall configuration refers to slight changes in the material composition of the outermost points of interest in the 1st panel of the wall. By adding a stiff metal component at the ends it is expected that the material degradation of the concrete due to “rocking” will not have a significant impact on the over prediction tolerance required in DRAIN-2DX to carry out the analysis. With the application of the “stiff” metal ends the over prediction percentage developed should be reduced, however it is not known by what amount nor if it will actually have an effect on other properties of the wall during the analysis.

Furthermore the modeling of the wall in DRAIN-2DX is not the sole software with the capabilities of producing an idealized fiber model for analysis of a UPT wall. However research into the development of commonly used software to perform a fiber analysis of a UPT wall has yet to be completed. Commonly used software for modeling in both academia and civil engineering practice is SAP2000, known not only for its modeling capabilities but also for the visual representation, which it is able to create of the object being modeled.
References


The Effect Of Garlic On The Modulation Of Candida Albicans Induced Tumor Necrosis Factor-alpha From Murine Macrophages

Abstract

Garlic (*Allium sativum*) has antiparasitic, antibacterial, and antifungal properties, specifically against the yeast *Candida albicans* (*C. albicans*). Garlic is also known to boost the immune system. The immune system consists of innate and adaptive immunity. Macrophages, phagocytotic cells that engulf pathogens and dead cells, play a big part in the innate immunity and are major producers of an important pro-inflammatory cytokine, tumor necrosis factor-alpha (TNF-α), which is released upon the detection of antigens such as *C. albicans*. In our lab we have observed that garlic suppresses *C. albicans*-induced TNF-α from J774A.1 murine macrophages. We first tested to see whether cell density altered the effect of garlic. Thus, macrophages were seeded at four densities: 0.625x10^5 cells/mL, 1.25x10^5 cell/mL, 2.50x10^5 cells/mL, 5.00x10^5 cells/mL. We found that garlic decreases *C. albicans*-induced TNF-α secretion at all cell densities. Next, we wanted to investigate the signaling mechanisms by which garlic suppresses *C. albicans* induced TNF-α, specifically the involvement of the mitogen-activated protein kinases (MAPKs). MAPK activation induces TNF-α secretion from macrophages. We first examined the involvement of ERK1/2 in *C. albicans*-induced TNF-α secretion by treating with pyrogen free water (PFW, the garlic diluent), garlic, and heat killed *C. albicans* with or without garlic in the presence and absence of the ERK1/2 inhibitor. Our preliminary findings suggest that ERK1/2 may not be involved in garlic's effect on *C. albicans*-induced TNF-α secretion. Investigating garlic's effect and its mechanism on *C. albicans* induced TNF-α production will help develop a better understanding of garlic as an antifungal agent, particularly against a *C. albicans* infection, within our innate immune system.

Main Objective

1) To see if the different macrophage cell densities change the effect of garlic.

2) To investigate garlic's mechanism via the MAPK pathways in suppressing the *C. albicans* induced TNF-α secretion from macrophages.

Research

*Allium sativum* (garlic) has been used for medical purposes for thousands of years in many different cultures. A component in freshly crushed garlic, allicin, is known for its antibacterial, antiparasitic, antiviral and antifungal properties, including activities against the yeast *Candida albicans* (*C. albicans*) (Ankri and Mirelman, 1999). Today, some of garlic's uses include helping to prevent atherosclerosis, high blood pressure, high cholesterol, and boosting the immune system (Ehrlich, 2011).

The immune system is composed of an innate and an adaptive immunity. Within the innate immune system, important cells, known as macrophages, phagocytize pathogens and dead cell debris (Mosser and Edwards, 2008). In addition, they release cytokines, proteins that participate in immune cell communication. Macrophages are main producers of tumor necrosis factor-α (TNF-α), an important pro-inflammatory cytokine (Parameswaran and Patial, 2010). TNF-α is involved in a variety of cell functions including cell proliferation, differentiation, and apoptosis (www.ncbi.nlm.nih.gov/gene/7124, 2013). Irregular production of TNF-α have been linked to stimulation of various inflammatory diseases such as rheumatoid arthritis, Crohn's disease, and atherosclerosis (Parameswaran and Patial, 2010).

In our laboratory, we have found that garlic reduces *C. albicans*-induced TNF-α secretion from J774A.1 murine macrophages when these cells were seeded at 0.625x10^5 cells/mL, 1.25x10^5 cell/mL,
5.00x10^5 cells/mL. Presently, we are investigating the mechanism via signaling pathways in which garlic decreases the *C. albicans* induced TNF-α secretion. Our preliminary findings suggest that the mitogen activated protein kinase pathway may not be involved in garlic’s effect on reducing *C. albicans* induced-TNF-α.

**Methods**

An aqueous garlic extract was prepared in pyrogen free water (PFW). The *C. albicans* strain CP680 was suspended in Sabouraud dextrose Bouillon (SAB) and incubated at 25°C. After 24h, the yeast was heat killed in 3mL aliquots in an Erlenmeyer flask over a Bunsen burner flame for 35 seconds, cooled on ice, and flamed for another 20 seconds to ensure death. J744A.1 murine macrophages were seeded in a 96-well plate at four densities: 0.625x10^5 cells/mL, 1.25x10^5 cell/mL, 2.50x10^5 cells/mL, 5.0x10^5 cells/mL. The macrophages were then incubated at 37°C in 5% CO2 for 24h. The cells were treated with PFW, garlic extract, and heat killed *C. albicans* in the presence and absence of garlic. After another 24h of incubation, the cell supernatants were collected and stored at -80°C until the amount of TNF-α was determined by enzyme-linked immunosorbent assay (ELISA).

To examine the signaling mechanism in which garlic suppresses *C. albicans* induced TNF-α secretion, the macrophages were seeded in a 96-well plate at 1.25x10^5 cell/mL. After 24h incubation at 37°C in 5% CO2, the cells undergoing experimental treatment were treated with DMSO and PD, the inhibitor or the ERK1/2 pathway; they were then incubated for 1h. After the 1h, the cells were treated with PFW, garlic extract, and heat killed *C. albicans*; the inhibitor PD and DMSO were then added back into the wells. The cells were incubated for 8h; the cell supernatant was collected and stored at -80°C until the ELISA assay.

**Results**

In the presence of garlic, there is a slight stimulation of TNF-α secretion at all four cell densities compared to the control (PFW) treatment. When challenged with *C. albicans*, there was a dramatic increase in the TNF-α level. However, when the cells were treated with the yeast and the garlic extract, there is a significant decrease in *C. albicans* induced TNF-α secretion across all the cell densities.

We see the same effect of garlic in the presence of the inhibitor PD: there is a significant decrease in the *C. albicans* induced TNF-α. However, in the presence of PD the level of TNF-α induced by *C. albicans*, with or without garlic, is remarkably lower compared to the controls.

**Discussion**

It seems that garlic is able to suppress *C. albicans* induced TNF-α regardless of the macrophage cell densities. Also, so far, our investigation on the signaling mechanism in which garlic suppresses *C. albicans* induced TNF-α secretion suggests that garlic may not or may not exclusively work through the ERK 1/2 pathway. I will also employ the inhibitors SB and SP for the p38 and JNK pathways respectively and observe the effect of garlic on the *C. albicans* induced TNF-α secretion.

In the presence of the inhibitor PD, there is a notable decrease in the *C. albicans* induced TNF-α secretion with or without garlic compared to the control treatments. This may be due to the cell toxicity effect of the inhibitor PD. I will continue to carry out cell viability assays including the XTT assay and possibly along with cell counting, then compare the results to examine the effect of PD on the cells’ viability.

In summary, our findings suggest that garlic reduces the inflammatory response induced by the
C. albicans. This finding is in agreement with those of others who have found that garlic has anti-inflammatory properties (Lang et al., 2004).

References


Gabriela Garza-Vazquez
Acessing Neuromuscular Transmission In Mice With Huntington’s Disease

Abstract

Huntington’s disease (HD) is a degenerative genetic illness that is characterized by progressive and severe cognitive and motor dysfunction. The motor symptoms include chorea (involuntary movement), dystonia (sustained muscle contractions), rigidity (stiffness), and weakness. These symptoms are typically thought to be caused by neurodegeneration. Recently our laboratory has shown that there are defects in skeletal muscle in mice with HD. This project is focused on studying the signals sent from the brain to skeletal muscle, which occurs at the neuromuscular junction (NMJ). In particular, we are studying miniature end plate potentials (mEPPs) and evoked end plate potentials (eEPPs). These signals result in the release of acetylcholine packets from the presynaptic terminal to the postsynaptic terminal (causing a small depolarization). A mEPP results from the release of a single vesicle of acetylcholine. An eEPP results from the release of many vesicles of acetylcholine; this is caused by stimulation of the motor neuron. The signals within a muscle fiber are recorded by utilizing two intracellular microelectrodes, and a third isolated microelectrode for nerve stimulation. From this data, the mean number of vesicles released per nerve stimulation can be found; this is known as quantal content. Quantal content is calculated by taking the mean amplitude of eEPPs over the mean amplitude of mEPPs. By comparing the quantal content of HD mice to wild type mice, we can begin to determine if there are defects in the neuromuscular junction in HD.

Main Objective

The major objectives of this project must be preceded by several other objectives. The initial objective is to successfully isolate the nerve that directly innervates the *levator auris longus* muscle. The next objective is to suction in the nerve, and find if the muscle can be stimulated utilizing the S88GRASS Stimulator. Then, the most important objective is next, which is to record miniature end plate potentials and evoked end plate potentials in wild type mice and mice with HD. Once this objective is accomplished, the final objective is to utilize the equation for quantal content in order to compare the data of wild type mice to HD mice and find if there is indeed a difference between the two averages.

Literature Review

Huntington’s disease is a progressive genetic disorder that results from a CAG repeat causing a mutation in the protein huntingtin. The neurodegenerative symptoms that define HD include behavioral challenges, incoordination, decline in cognitive thinking, chorea (involuntary movement), dystonia (sustained muscle contractions), rigidity (stiffness), and muscle weakness (Walker, 2007). HD is a disorder that is most often studied from a neurological aspect. In order to direct our focus to the muscular symptoms of HD, we must first study the electrical properties occurring at the neuromuscular junction (NMJ), where nerve meets muscle.

In order to initiate a muscle contraction, a motor neuron is stimulated and causes an action potential to travel down the axon. Once the action potential has traveled to the nerve terminal in the NMJ, voltage-gated calcium channels are opened, allowing calcium to enter. This in turn causes synaptic vesicles to release the neurotransmitter, acetylcholine, into the synaptic cleft. Acetylcholine then binds to receptors (ligand-gated ion channels) on the post synaptic membrane. At this point, sodium (a positively charged ion) can enter the post synaptic membrane and cause a depolarization. This typically triggers an action potential, which is propagated along the muscle plasma membrane allowing the muscle to contract (Widmaier, 2008).

Previous work from the Voss laboratory has
shown that there are defects in HD skeletal muscle fibers. It was found that HD mice had hyperexcitable muscle cells due to malfunction of chloride and potassium channels (Waters, 2013). The proper function of chloride and potassium channels is essential for maintaining the resting conditions of muscle; thus, individuals suffering from HD cannot bring their muscles back to resting state. In this project we are investigating if the defects of HD are also present presynaptically. To accomplish this, we must stimulate the nerve of the levator auris longus, and measure mEPPs and eEPPs.

We will be utilizing an equation Dr. Bernard Katz developed in order to measure neuromuscular transmission. His equation for quantal content is how we are able to quantify our data. Quantal content is calculated by taking the mean amplitude of miniature end plate potentials over the mean amplitude of evoked end plate potentials (Katz, 1966). By comparing the quantal content from the muscles of wild type mice to that of HD mice, we can begin to determine if there is also a presynaptic defect in mice who exhibit HD.

Methods

All animal procedures will be performed in accordance with the policies of the Animal Care and Use Committee of California State Polytechnic University, Pomona. R6/2 mice will be used. R6/2 mice are transgenic mice that have a progressive neurodegenerative disorder that simulates the characteristics of human HD (these mice will be coming from our Animal Facilities on campus, we breed them ourselves). They will be 10-12 weeks of age since this is when the muscular symptoms of HD are in full effect and the mice are near death.

These mice will be first anesthetized by inhalation of isoflurane and killed by cervical dislocation. The muscles will be maintained at room temperature, or approximately 21°C.

The levator auris longus (LAL) is the muscle of interest in this experiment due to its great optics. It is located posterior to the ear and extends toward the shoulder blades. Nair, which is a hair removal product, will be excessively rubbed onto the dorsal side (near the base of the skull and around the ears) of the mouse. Once the hair is gone in that area, it will be rinsed off with water and an incision will be made into the skin with surgical scissors, going from the upper back to the ear. The flap of skin will be removed completely and the LAL, as well as the layers of muscle below it, are extracted. It is important that the muscles exposed are kept in sodium buffer (140mM NaCl, 4mM KCl, 2mM CaCl2, 1mM MgCl2, 5mM Glucose, 1mM NaH2PO4H2O, and 10mM MOPS) throughout this procedure. At this point, the muscles extracted can be pinned onto a dish and the layers of muscle that are not the LAL are removed, leaving only the LAL and the nerves connected to it. The nerves that connect to the LAL are near the top of the ear, so it is important to treat this area with care during the LAL surgery. The LAL is then kept in sodium buffer until further experimentation.

Neuromuscular junctions of the LAL will be dyed with Synaptogreen C4 (FM 1-43), which is a fluorescent membrane dye. The dye accumulates at neuromuscular junction (NMJ). All electrophysiological procedures will take place under an Olympus microscope (model number BX51W1). There are two reference electrodes that will be submerged in 3M KCl. The purpose of the reference electrodes is to have a basis of the voltage of the extracellular fluid; it is based on the difference in charge between the inside and the outside of the cell.

The glass microelectrodes that are being used will be pulled using a Flaming/Brown Micropipette Puller (Sutter Instruments, Model P-97). The muscle fibers will then be impaled with two aluminosilicate microelectrodes; one of them a voltage-recording electrode (head stage 1) filled with 3M KCl, and the other (head stage 2)
a current-passing electrode filled with 121 mM aspartate, 5 mM MgCl2, 0.2 mM EGTA, 5 mM glutathione, 5 mM ATP dipotassium, 5 mM diphosphocreatine disodium, 20 mM MOPS, and pH 7.4.

There will also be a third isolated microelectrode (filled with the sodium buffer) capable of suctioning in the LAI’s primary nerve that will be used for the purpose of nerve stimulation. It will be suctioned in using a syringe. This electrode will be attached to the GRASS S88 Stimulator, which will trigger action potentials in the nerve.

Once the nerve is suctioned in and can be stimulated, high magnesium (4 mM) and low calcium (500 µM) buffers, will be utilized to blunt neuromuscular transmission. This will allow for a small depolarization to be recorded without the damaging effects of a contraction (the contraction would cause the fiber to tear if it was impaled by the microelectrodes). These buffers work to halt contractions by dampening the release of calcium at the nerve terminal to reduce acetylcholine transmission across the synaptic cleft. At this point, evoked end plate potentials can be recorded (eEPPs).

Current clamp is the electrophysiological technique that will be utilized, it allows for the voltage to be measured. Clamping will take place near the NMJ. Axoclamp is a computer program that is used to manipulate current for current clamp and voltage for voltage clamp. The purpose of this program is for tuning, it allows you to zero the resistance and capacitance of the electrode. mEPPs (miniature endplate potentials) and eEPPs will both be recorded by means of Clampex. This is a different computer program that gives you a visual interpretation of the current being sent and the voltage being measured.

Results

We found that in wild type mice the mean amplitude of mEPPs was 0.57 ±0.05 mV (n=4149) and the mean amplitude of eEPPs was 0.98 ±0.21 mV (n=1273). The average frequency of mEPPs in wild type mice was 2.64 ±0.40 Hz. The average membrane time constant for wild type mice was 1.16 ±0.05 s and the average input resistance is 0.48 ±0.02 mΩ. The average of quantal content in wild type mice was 1.64 ± 0.30 mV (n=10). We found that in HD mice the mean amplitude of mEPPs was 0.95 ±0.04 mV (n=11825) and the mean amplitude of eEPPs was 2.11 ±0.22 mV (n=4945). The average frequency of mEPPs in HD mice was 2.94 ± 0.20 Hz. The average membrane time constant for HD mice was 1.58 ±0.06 s and the average input resistance was 1.32 ± 0.05 mΩ. The mean average quantal content in HD mice was 2.21 ± 0.21 mV (n=32). This data is presented as mean ± standard error mean.

Figure 1. This is an image of two miniature end plate potentials and an evoked end plate potential.
Discussion

Quantal content is the mean amplitude of eEPPs over the mean amplitude of mEPPs. It allows us to quantify the data to compare the number of vesicles released per impulse between HD mice and wild type mice (Katz, 1966). When analyzing eEPPs, failed nerve stimulations were taken into account. This means that every time there was a failed evoked potential, a 0 was included to obtain the average amplitude (Katz, 1966). The trend showed that there were more failures in wild type experiments, and it brought down the average amplitude of eEPPs. In wild type mice, 25% of evoked potentials failed, and in HD mice 15% of evoked potentials failed.

There was not a significant statistical difference between the two (p=0.111). Although these results were not statistically significant, there seems to be more eEPP failures in wild type muscle fibers compared to that of HD muscle fibers, this can suggest that neuromuscular transmission is increased in mice with HD. There may be some significance to this finding, but it will be explored further in the future by means of gathering more data.

Although all the muscle fibers were analyzed, only the fibers with mEPPs that had a frequency below 5 Hz will be taken into account for the data. The reason for this is that fibers that have a mEPP frequency above 5 Hz are most likely damaged. By limiting the analysis to fibers with a mEPP frequency below 5 Hz, the results should be more accurate. There was no significant statistical difference between the frequencies of mEPPs in HD compared to wild type (p=>0.001). This supports the idea that presynaptic function may be normal.

There was a difference in the input resistance and the membrane time constant between HD mice and wild type mice. These results confirm that the levator auris longus HD muscle fibers are indeed hyperexcitable, as has been shown in the Voss lab previously with different muscle fiber types.

The results revealed that there was a statistically significant difference of mEPP amplitude between wild type mice and HD mice (p=<0.001). The Mann-Whitney rank sum test was used. The mean amplitude for wild type muscle fibers was 0.57 ±0.05 mV and for HD it was 0.95 ±0.04 mV. Since HD muscle fibers had an increased average amplitude of mEPPs, this suggests that there is a postsynaptic change. HD muscle fibers seem to react to the potentials by eliciting a larger response. HD muscle fibers have also shown to have an increased amplitude of eEPPs in comparison to wild type muscle fibers. There was a significant statistical difference (p=<0.001). The Mann-Whitney rank sum test was also used. The increase in mEPP and eEPP amplitude in HD mice is consistent with the muscle hyperexcitability previously identified by the Voss lab. The increased amplitude of mEPPs and eEPPs in HD muscle fibers do constitute a defect at the NMJ; neuromuscular transmission in HD mice differs from wild type mice, possibly causing the increased responses to evoked potential.

By looking at the quantal content, we can find if there is more than just a postsynaptic defect within HD mice, it can suggest whether or not there is a presynaptic defect. There appears to be a minor difference in the quantal content of wild type mice compared to that of HD mice, but the statistics are not significantly different (p=0.121). The Mann-Whitney U test was used. The results showed that the difference was minimal, and collecting more data may yield a significant statistical difference between the two. This find could be due to the fact that there was much variability in the quantal content from fiber to fiber. Since this data is preliminary, the results may only yield a suggestion thus far; a statistically significant difference in quantal content can suggest that there may be a defect at the motor nerve terminals of mice suffering from HD, but we did not find a clear postsynaptic defect and the nerve appears to be undamaged. This further supports that presynaptic function is normal.
Although our results may not allow us to directly infer that there is a difference in nerve terminal behavior, it allows us to begin characterizing the condition of the presynaptic terminal. In the future, as this project continues, we hope to gather more evidence in order to fully assess the characteristics of neuromuscular transmission in mice with HD.

References


Eliza Hernandez
Arthropod Community Response To Nitrogen Deposition

Abstract

Insects play key ecological roles by providing services such as pollination and decomposition. Anthropogenic activity threatens the conservation of beneficial insects and is partly responsible for the observed decline in insect diversity. Nitrogen deposition, a human-accelerated process, poses a threat to insect diversity and thus, their valuable services. Increased N levels have been found to increase insect abundances yet decrease their species richness. The primary focus of this project was to determine the effects of N on the taxonomic richness, diversity, and evenness of insects and other arthropods in a managed grassland experiment at the South Coast Research & Extension Center in Irvine, California. I sampled from ten experimental grassland plots, five of which were treated with elevated levels of N and the other five were exposed to ambient levels of N. The plots contained grasses typical of Southern California grasslands, such as the California native grass, *Stipa pulchra*, and the invasive grass, *Bromus hordeaceus*. To sample soil and litter-dwelling arthropods throughout the growing season, each plot contained two pitfall traps. Arthropods were identified to the family taxonomic level. I expected to find greater arthropod richness, diversity, and evenness in the plots with ambient N compared to elevated N. However, this project indicates that fertilized plots host a greater richness of soil and litter-dwelling arthropod groups.

Literature Review

Anthropogenic N deposition has more than doubled inputs of N to terrestrial ecosystems worldwide via the transformation of unreactive atmospheric N into biologically available forms on land (Vitousek et al., 1997). N deposition has negative ramifications for ecosystems and acts as a driver of accelerated biodiversity loss. N deposition is being addressed from a global perspective since developing countries with rapid industrialization are starting to emit large quantities of N into the biosphere via N fertilization and fossil fuel combustion (Matson, Lohse, & Hall, 2002). These emissions poses a threat to biodiversity hotspots around the world, especially since the average deposition rate across biodiversity hotspots is fifty percent greater than the global terrestrial average and could more than double by 2050 (Phoenix et al. 2006). This study by Phoenix et al. (2006) has also identified that areas with higher floral diversity are likely to receive N deposition at greater rates in the near future and that some of these areas may already be receiving high rates of N deposition.

Effects of N deposition on plant communities are well known with a consensus that N addition decreases plant species richness, increases plant productivity and plant tissue N, and shifts plant communities to a few dominant species (Haddad, Haarstad, & Tilman, 2000; Stevens et al., 2004). A decrease in plant species richness as a consequence of N deposition has implications on the organisms dependent on affected ecosystems. Long-term N loading has been shown to simplify insect communities, decreasing total insect species richness, as a response to decreased plant species richness (Haddad et al., 2000). This study by Haddad et al. (2000) showed that long-term N addition may alter the entire food chain, simplifying both plant and insect communities. The Quino Checkerspot Butterfly (*Euphydryas editha quino*) exemplifies the effects of N deposition in a California ecosystem. The Quino Checkerspot Butterfly was once considered one of the most abundant species of butterflies in southern California. However, it is now locally extinct because its host plant *Plantago erecta* was outcompeted by exotic grasses that were better adapted to higher levels of N (USFWS 2003). In fact, most extinctions estimated to have occurred or predicted to occur are of insect taxa (Dunn 2004). Furthermore, only seventy modern insect extinctions have been documented when thousands are estimated to have occurred (Dunn 2004).
Therefore, extirpations such as that of the Quino Checkerspot Butterfly are of significant conservation concern. Insects are among the most diverse and abundant groups of animals to be found in almost every environment on the planet. They significantly contribute to a number of critical ecological services including pollination, decomposition, biological control, and nutrition for wildlife (Losey & Vaughan, 2006). However, the extinction rates mentioned in Dunn (2004) may affect beneficial insects and thus place the services they provide at risk. These ecological services are imperative to ecosystem function and human well-being. Their combined worth is an estimated $57 billion value per year (Losey & Vaughan, 2006). Continuing studies on the effects of N deposition on trophic structure are extremely important to conserving insects and the ecosystem services they provide. The objective of this project is to observe the direct effects of N addition on soil and litter-dwelling arthropod communities without plant species richness playing a role as seen in previous studies. In this project I test the hypothesis that insect family richness, diversity, and evenness will decrease as a result of N deposition.

Methods

Research Site

The experiment was conducted at the South Coast Research & Extension Center in Irvine, California where ten experimental grassland plots replicating different N conditions (ambient N vs. added N) served as the basis for this project.

Experimental Design

The plots in this experiment consisted of the California native grass, Stipa pulchra, and the exotic grass, Bromus hordeaceus, in varying levels of abundance. Five of the plots were exposed to ambient levels of N and the remaining five plots received elevated levels of N in the form of granular calcium nitrate. The five plots simulating elevated levels of N were treated with 3.5 g/m2 of N on November 19, 2013 and on January 27, 2014, giving a total rate of 7 g/m2/yr of N. Pitfall traps were used to sample arthropod communities. Pitfall traps were constructed and installed as described by Cobb, Delph, and Higgins (2010). Two pitfall traps were installed in each plot, giving a total of twenty pitfall traps.

Data Collection

A test tube containing propylene glycol was placed in each pitfall trap to collect and preserve arthropods throughout the growing season. Test tubes were first placed on December 23, 2013 and collected on January 23, 2014. Test tube samples were subsequently replaced and collected three more times on the following dates: January 23, 2014 – February 14, 2014; March 16, 2014 – April 9, 2014; April 9, 2014 – May 11, 2014. Once the test tube samples were brought back to the laboratory, arthropod specimens in each test tube sample were counted and identified to the family taxonomic level using a dissecting microscope and an insect identification key.

Data Analysis

A general linear model was used to analyze the effects of block, date, N, and N x date on family richness. Additional analysis included counting the number of “N added” plots and “ambient N” plots each arthropod family occurred in across sampling dates. All analyses were conducted with Minitab version 16.2.4 (Minitab, Inc. 2010) using the data gathered from the latter half of the growing season (March 16, 2014 – April 9, 2014; April 9, 2014 – May 11, 2014). These samples had the highest
abundance of arthropods and depicted a more representative picture of the arthropod communities present within the plots.

Results

Block showed a significant effect on family richness (Table 1). More importantly, N showed a significant effect on family richness, indicating a significant difference between fertilized and unfertilized plots (Table 1). Specifically, N addition had a significant, positive effect on average family richness (Fig. 1). Date and N x date did not have a significant effect on family richness. In addition, the occurrence of the family Staphylinidae, also known as the rove beetle family, was higher in plots with added N, suggesting they positively respond to N (Fig. 2).

Table 1. General linear model results of factors block, date, N, and date x N on family richness

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¹ * P < 0.05; ** P < 0.001; Model R² = 0.69
Discussion

The results found in this project are similar to those in short-term N deposition studies. In this project, N addition had a significant positive effect on arthropod family richness. Kirchner (1977) also found that arthropod diversity significantly increased in response to N. Conversely, the long-term N addition study conducted by Haddad et al. (2000) found that total insect species richness decreased where changes in the insect community were significantly correlated with changes in the plant community. On the short term, a significant increase in arthropod diversity may be observed because N increases plant tissue quality and plant productivity but does not have any effect on plant species richness. However, on the long term, although plant productivity still increases, plant species richness significantly decreases. This observed decrease in plant species richness in turn simplified insect communities (Haddad et al., 2000). However, Haddad et al.’s (2000) study investigated the effects of N addition on insects indirectly through changes in the plant community. My project allowed for observing the direct effects of N deposition on arthropod communities, correcting for any changes in plant species richness. The experimental grassland plots in this project modeled simplified systems, consisting of only two species of grass, *B. hordeaceus* and *S. pulchra*. In this case, N addition increased soil and litter-dwelling arthropod family richness. Therefore, in this experiment, nutrient enrichment increased arthropod family richness by possibly having increased plant tissue N and plant productivity, thereby increasing resource quality of the habitat (Kirchner 1977).

Although in Haddad et al.’s (2000) study total insect species richness significantly decreased, not all trophic groups responded negatively to N. Specifically, detritivore species richness significantly increased as N addition increased. In this project, I focused on arthropods residing in the soil and litter, commonly where detritivores are found since they consume decomposing plant and animal material. Similarly, I found that specimens belonging to the family Staphylinidae, also known as the rove beetle family, responded positively to N addition. Species in this family of beetles have relationships with habitats consisting of decomposing plants, dung, and carrion, where they prey upon other insects. Many staphylinids are also important predators on other invertebrates including mites, fleas, and other insects such as flies and mosquitoes. Thus, staphylinids are important to humans as biological control to suppress invertebrate pest populations in numerous crops. More well-known known species of rove beetle in California include the Hairy Rove Beetle (*Creophilus maxillosus*) and the Pictured Rove Beetle (*Thinopinus pictus*). The Hairy Rove Beetle is found on carrion along lakeshores and rivers where they feed on the maggots of flies whereas the Pictured Rove Beetle are found in burrows on the beach where they feed on invertebrates such as sand fleas (Evans & Hogue 2006).

Most importantly, Staphylinidae form a substantial part of the world’s biodiversity, being the largest family of beetles with over 54,000 known species worldwide (University of Florida 2012). In addition, it is the largest beetle family in California, with an estimated 1,200 described species (Evans & Hogue 2006). It is estimated that there are probably 300,000 species of Staphylinidae, which is more than a five-fold increase over the number of described species today (Gaston 1991). As of now, the specimens identified to family Staphylinidae in this project are not identified to species. If these specimens are identified to species, which responded positively to N addition in this project, their ecological role can then be determined and further analysis can be done.

N deposition has negative implications for the insect biodiversity crisis we face today. Addressing this insect biodiversity crisis comes with its fair share of
challenges. Currently, there are more than one million described species of insects. However, it is estimated that there may be between ten and thirty million species of insects inhabiting the planet. There are a myriad of insects left to be described, yet unfortunately, many of them may never be known to exist due to the extinction rates accelerated by anthropogenic activities such as N deposition. Although there is a significant effort in discovering all insect species possible, it is difficult to pinpoint the ecological roles these described insects play. Discovering the ecological roles insect species play is important in emphasizing the need to conserve insect biodiversity. Furthermore, insect conservation efforts are lacking despite the overwhelming evidence that large numbers of insect species are facing extinction (Spector 2009). Invertebrate species conservation is also hindered by the public’s aversion to insects even when the benefits derived from insects are described to them (Kellert 1993).

Despite the challenges insect conservation faces today, we are at a progressive turning point where national and international institutions are interested in protecting insect biodiversity (Spector 2009). As a result, this will allow many scientists to conduct research that will stress and elicit the necessary actions to conserve insect biodiversity. In my project as well as in the study conducted by Haddad et al. (2000) shows that N addition favors certain groups of insects. In the future, as N deposition increases, insects that respond positively to N will have an advantage over those which do not and this may accelerate the loss of biodiversity of insect taxa; this provides further emphasis that insect biodiversity needs to be protected.

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Cynthia McKee
Progression Of Hyperexcitability In Skeletal Muscle – Is Huntington’s Disease A Muscle Disorder?

Abstract

Huntington’s disease (HD) is a progressive and ultimately fatal disorder in which a decline in motor and cognitive function occurs. HD is generally considered a neurological disorder. However, recent findings show diseased skeletal muscle fibers to exhibit prolonged action potential duration, reduced trigger thresholds, and the ability to self-trigger. These defects occur due to a decrease in the resting chloride and potassium conductance in skeletal muscle. As a result, in joint partnership, the Voss and Talmadge Labs are focusing research efforts on gathering data in relation to HD and mammalian skeletal muscle. To examine the role of skeletal muscle in the disease, we utilize the R6/2 transgenic mouse model, which expresses a mutated version of HTT. The focus of this project is to determine the time course over which the chloride channels (ClC-1) defects develop. In order to determine this span of time the Voss Lab utilized electrophysiological techniques to measure individual muscle cell ClC-1 conductance. While the Talmadge Lab employed molecular biological techniques to measure, analyze, and quantify the total inappropriate splice variants in muscle mRNA of exons 5-8, which codes for the ClC-1 channel. At this time the results of the electrophysiological measurements show an unreliable degree of variation. There is a statistically significant difference in the total inappropriate splice variant in mRNA of exons 5-8 between HD and wildtype (WT) in late stage of the disease. However, there is no statistical difference in the total inappropriate splice variant in mRNA of exons 5-8 between HD and WT of ages 35-55 days.

Introduction

Huntington’s disease (HD) is a degenerative, autosomal-dominant, progressive, and ultimately fatal disorder. The distinct phenotype includes chorea (irregular jerky movements), dystonia (abnormal tonicity often resulting in irregular positioning of head and limbs), rigidity, cognitive decline, and disoriented behavior. Adult-onset HD is the most common form of the disorder, with symptoms typically first appearing between the third and fifth decade of life. The less-common form of HD, juvenile-onset, arises prior to twenty and as early as two years of age. Early signs of the disease include irritability, depression, poor cognitive skill, uncontrolled movements, and inability to make decisions. The disease is found to be most common in those with European ancestry, effecting 3 to 7 in every 100,000 people. HD is the result of >40 expanded trinucleotide repeats CAG polyglutamine (polyQ) of the HTT gene that codes for the human huntingtin protein. Though the complete function of this protein is currently unknown, it is thought to play a pivotal role in both growth and development, as well as in excitable cells throughout the body.

Traditionally HD has been approached as a neurological disorder, with research concentrating on the function and degeneration of the brain. Previous examinations have shown atrophy, metabolic and mitochondrial defects, and loss of strength. Recent findings by Waters, et al. from the Voss laboratory at Cal Poly Pomona have shown there is also a significant reduction in chloride channel (ClC-1) conductance and inward rectifying potassium channel (Kir) conductance in the skeletal muscle the R6/2 transgenic mice model. These findings directly correlate with the phenotypic characteristics of membrane hyperexcitability, involuntary contractions, rigidity, and persistent and prolonged contractions; because the resting membrane potential in the skeletal muscle is maintained by ClC-1 and Kir4. Consistent with the decreased conductance, the data also showed aberrant splicing of Clcn1 (gene for ClC-1) mRNA and a reduction in total mature Clcn1 mRNA. A similar mechanism has been reported to cause a decrease in ClC-1 currents in myotonic dystrophy type 1, which is also
cause by an expanded trinucleotide repeat\textsuperscript{11, 12}. The authors also found a decrease in total mature $Kcnj2$ (gene for Kir2.1 channels) mRNA.

**Theoretical prospective**

HD has been traditionally viewed solely as a neurodegenerative disorder and skeletal muscle defects were thought to be only as result of the degeneration of the nerve. The recent findings of ClC-1 and Kir reduction have opened a new opportunity for research of the diseased mammalian skeletal muscle. In order to examine the relationship between the disease progression and the skeletal muscle defects the lab will utilize both electrophysiological and molecular biological techniques. At this time there are a total of 9 polyglutamine related disorders\textsuperscript{2} The data from this project will contribute to a greater holistic understanding of the role that polyQ expansion plays in skeletal muscle degeneration.

**Specific Aims**

The aims of this project was to determine the time course over which the chloride channels (ClC-1) defects develop. Utilizing the R6/2 mouse model, the lab took electrochemical measurements from individual muscle fibers disassociated from the *flexor digitorum brevis* (FDB) and *interosseous* (IO) muscles in both HD and WT. Preceding these measurements, the total inappropriate splice variant and the individual mis-splice variants in the gene Clcn-1 exons 5-8 were measured and quantified.

**Methods**

A description of each buffer is provided at the end of the Materials and Methods.

**Animal Care and Use**

All animal procedures that took place during this experiment were performed in accordance with the Animal Care and Use Committee of the California State Polytechnic University, Pomona. R6/2 mice purchased from Jackson Laboratory and were used for all experimental procedures. Cynthia McKee is approved to handle animals for the electrophysiological experiments. The protocol for the electrophysiological experiments was submitted by Dr. Voss, with Ms. McKee added as a designated approved user on August 21, 2013 under protocol number 13.017.

**Electrical Recordings, Internal and External Buffers**

FDB and IO muscle fibers were surgically removed, pinned to Sylgard-bottomed Petri dishes, and enzymatically dissociated at room temperature under mild agitation for \(\sim 1\) h using collagenase extracellular buffer solution. Fiber dissociation was completed after 1 h resting period at room temperature in extracellular buffer without collagenase.

Fibers were visualized in an Olympus BXX51Wi microscope, and images were acquired with a CCD camera (ST-7XMEI-C1, Santa Barbara Instruments). Fiber surface area and volume were estimated assuming a cylindrical shape with ImageJ (National Institute of Health), and SigmaPlot 11 (Systat Software). Electrical properties were measured under standard current and voltage clamp conditions using two aluminosilicate intracellular microelectrodes (part 30-0110, Harvard Apparatus), an Axoclamp 900A amplifier, a Digidata 1440a digitizer, and pClamp 10 data acquisition analysis software (Molecular Devises). The voltage-sensing electrode was connected with an Axoclamp HSx1 headstage. The current-passing electrode was connected with an Axoclamp HSx10 headstage that was modified to
have a 2-MΩ output resister (HSx5). Both current-passing and voltage-sensing electrodes were filled with internal buffer solution. Data was acquired at 100 kHz. Current and voltage records were low-pass filtered at 2 kHz. After impalement, 20 min was given for equilibration of the electrode solution with the sarcoplasm before data acquisition. EGTA will be used in the internal solutions to prevent contractions.

Biochemical Recordings

Total muscle RNA was isolated and 1 μg of RNA was reverse transcribed. To quantify total Clcn1 mRNA alternatively spliced gene products from exons 5-8, traditional PCR was performed. PCR products were separated and stained with ethidium bromide.

Internal and Extracellular Buffers

Internal solution for GClC-1 (in mM) will be as follows: 17 aspartate, 30 HCl, 30 EGTA, 15 CaCl2, 5 MgCl2, 5 ATP di-Na, 5 phosphocreatine di-Na, 5 glutathione, 20 MOPS, and pH 7.2 with CsOH.

Extracellular solution for action potentials (in mM) will be as follows: 135 NaCl, 2.5 KCl, 5 CaCl2, 2 MgCl2, 5 glucose, 1 NaH2PO4, 10 MOPS, and pH 7.4 with NaOH. Extracellular GClC-1 solution (in mM) will be as follows: 140 HCl, 10 CsOH, 5 CaCl2, 2 MgCl2, 5 glucose, 1 NaH2PO4, 10 MOPS, 0.0002 tetrodotoxin, 0.02 nifedipine, and pH 7.4 with tetraethylammonium hydroxide. 0.4 anthracene-9-carboxylic acid will be added for GClC-1 blocking solution.

Statistical Analysis

All electrophysiological measurements were compared by means of two independent samples using a two-tailed t test, normalized by the Shapiro-Wilk test, and will assess variances based on a folded F variance ratio test. For nonnormal and/or heteroscedastic samples we will used the Mann-Whitney rank sum test. Null hypotheses in all statistical tests will be rejected at α ≤ 0.05. Mean values will be presented as ± SEM.

mRNA Analysis

To quantify total Clcn1 mRNA alternatively spliced gene products from exons 5-8 were stained with ethidium bromide. The gene products were visualized and recorded using an Alpha Innotech camera and ultraviolet light. Statistical analysis was performed on individual sample percent saturation using FluorChem image software.

Results

The electrophysiological data was analyzed with a 2 tailed t test of HD compared to WT in age groups of N to N+9. Age range 20-29 days shows a difference in the mean values of the two groups HD (n= 13) and WT (n=16) is greater than would be expected by chance; there is a statistically significant difference between the groups ($PP= 0.007$). Age range 30-39 days shows a difference in the mean values of the two groups HD (n=33) and WT (n=13) is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the groups ($PP= 0.092$). For the age range 40- 49 a Mann-Whitney rank sum test was ran due to the variation in comparative sample data between the two groups. The results show a difference in the median values between the two groups HD (n=11) and WT (n=28) is greater than would be expected by chance; there is a statistically significant difference ($PP= < 0.001$). Age range 50-59 days difference in the mean values of
the two groups HD (n=17) and WT (n=12) is greater than would be expected by chance; there is a statistically significant difference between the groups ($PP < 0.001$). Age range 60-69 days shows a difference in the mean values of the two groups HD (n=17) and WT (n=9) is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the groups ($PP = 0.224$).

Thus far the preliminary mRNA analysis shows that there is a statistically significant difference of total inappropriate splice variant between the HD (n=6) and WT (n=6) in the late-stage of the disease ($PP = 1.72 \times 10^{-6}$). However, when comparing age groups of between 35-55 days there was not a statistically significant difference between HD (n=5) and WT (n=5) ($PP=0.188$).

**Discussion**

The variation in electrophysiological statistical data suggests further review is needed. This variation could be observed due to the possibility the current mouse model is not appropriate for a longitudinal study. The R6/2 model does exhibit an advanced form of the disease. The rapid progression of the disease is beneficial when studying the late stages of the disease, however may not be suitable for studying the disease progression over time. Due to the inconclusive nature of the data reported the lab is considering performing the same longitudinal study on a mouse model which exhibits a milder form of the disease which progresses over a longer period of time.

The preliminary biochemical data suggests total inappropriate splice variant increases with the progression of the disease. This is what we would be expected as HD is a characterized as a progressive and degenerative disorder. We expect with further analysis, including increased varying age ranges, the Clcn1 mRNA alternatively spliced gene products from exons 5-8 will have less of a varying degree of difference in the earlier stages of the disease; whereas the degree of difference is expected to increase with the progression of the disease.

The overall results and data collected during this longitudinal study of the progression of hyperexcitability in Huntington’s disease skeletal muscle does contribute the comprehensive understanding the role skeletal muscle plays in the motor symptom defects characterizing the disease. Though the model used may not have been ideal for a longitudinal study, we do recognize the severe progression of the disease runs parallel with the increase in total inappropriate mRNA splice variants of exons 5-8 which has not been previously reported for Huntington’s disease.

**References**


Jocelyn Murillo
Abstract

The purpose of my research is to measure qualitatively the impact of the Nicaraguan Revolution on Nicaraguan women in the immigrant community in the United States. It is well known that women played a major role in the “failed” Sandinista Revolution in Nicaragua (1979-1990) and despite recent political setbacks in Nicaragua, women appear to have been politicized, having gained political and social reforms. I wish to measure this process. The parameters of this study will cover the years of the revolution itself, and the post-revolution to the present, which is approximately 1979-2013. Through analysis of primary and secondary sources, as well as interviews of immigrant Nicaraguan women, I hope to gain an understanding of their general attitudes and perceptions of their revolution in regards to gender equality and education. This research is significant because although the literature on Nicaraguan gender relations is extensive, little to no research has been done on the immigrant community in Southern California which has molded a new community and identity. My research will help in filling the gap in contemporary immigrant history, a subject that has been neglected.

Introduction

In my mother’s early teens, she had learned how to rebuild an AK-47 and an M15 rifle. She was later recruited to be a part of a health brigade to vaccinate children in her neighborhood in Managua, Nicaragua. She has worked very hard and has sacrificed much to contribute as much as my father did, who was Mexican. I did not truly realize that I was half-Nicaraguense, half-Mexicana until adolescence. I assumed both my parents came from Mexico, and when I heard of Nicaragua, it seemed like a distant, esoteric place that was probably just like Mexico. But hearing parts of my mother’s story piqued my interest in my mother’s past because I knew practically nothing about Nicaragua. This reality of mine and my desire to recognize my mother and other women like her in History is my motivation for research.

Historical Context

Prior to 1979, the powerful Somoza family ruled Nicaragua as a client state of the United States. Known as one of the most corrupt and repressive regimes in Latin America, the Somoza dictatorship did little to modernize Nicaraguan society. Women were unable to participate in political decision-making, despite the fact that they contributed to Nicaragua’s economy as workers. The traditional Hispanic patriarchy, reinforced by machismo and the Catholic Church, furthered the marginalization of women by reinforcing the submissive role of women as mother and caregiver. Yet, Nicaragua’s backward and dependent economy also forced women into work in the formal and informal sectors to provide for their families, as many men—seeking work or fleeing political violence—abandoned their homes. It was no surprise that women played a major role in manifesting discontent with the Somoza regime. During la revolución, women were encouraged to take up arms as an opportunity to achieve gender equality. Once the Sandinistas overthrew dictator Anastasio Somoza Debayle and the FSLN came to power in 1979, women finally found their place in the public sphere. They served the Revolution as policy-makers, educators, healthcare professionals, and self-help advocates. Unfortunately, the revolution did not survive long. By 1990, the election of Violeta Chamorro of the conservative National Opposition Union proved to be a major setback to revolutionary change and to women’s rights. The Chamorro administration cut many programs that assisted women, once again relegating women to their traditional roles. Thus, the drive for gender equality in Nicaragua stalled in the 1990s and has improved little
ever since. Despite the apparent reversals, there is evidence that Nicaraguan women underwent some degree of politicization as a result of the revolution.

Historiography

Research on this subject has been published very recently, from 2001 to the present. However, there is a lack of scholarship on Nicaragua specifically, so I have expanded the scope of my analysis to examine works written on other similar revolutionary movements, as well. Political scientists, historians, anthropologists, and sociologists have examined revolutionary women in Nicaragua and in other countries and have proposed several interpretations of women’s role in revolution, as well as post-revolution developments.

A political scientist and one of the prominent authors on Nicaraguan scholarship of the Sandinista Revolution, Karen Kampwirth’s *Women & Guerrilla Movements* takes a strong feminist approach in analyzing women and guerrilla participation in Chiapas, El Salvador, and Nicaragua. In studying revolution, it is important to examine all aspects of a given society, not simply social structure (class struggle) and economics. Kampwirth’s assertion is that several factors came into play in the mobilization of women into guerrilla forces. Kampwirth’s goal is not to argue that the reasons women joined guerrillas were vastly different from men’s, but to argue that women’s changing social conditions set the stage for many women to have more access to politicization and mobilization into guerrilla forces. Her conclusion was not surprising, but her work has opened up new possibilities for the future of the study of revolution.

Karen Kampwirth’s second book, *Feminism and the Legacy of Revolution: Nicaragua, El Salvador, Chiapas, is a sequel to Women & Guerrillas* that focuses more on the postrevolutionary period. Kampwirth now examines how and why female guerrillas became feminists and what kind of feminist movements have emerged after the revolutions in Nicaragua and El Salvador. She asserts that female guerrillas who had “mid-prestige” were those that went on to become feminists. Kampwirth’s point is that women joined guerrillas for several reasons, and gender equality was surprisingly not one, but participation in guerrilla warfare paved the way for women to become feminists. Another interesting point that Kampwirth asserts is that feminism and revolution are not naturally linked through her brief analysis of post-revolution developments in Cuba, Iran and Poland, where anti-feminism has taken root. Kampwirth’s scope does not analyze the impact that NGOs had on feminist autonomous groups.

In "Abortion, Antifeminism, and the Return of Daniel Ortega: In Nicaragua, Leftist Politics?" Kampwirth provides an analysis of Daniel Ortega’s reelection and its connection to the anti-feminist movement that has gained momentum in Nicaragua. Upon Ortega’s reelection, a law was soon enacted that banned therapeutic abortions, making Nicaragua one of the few countries that has banned abortion, even in cases of rape and incest. Kampwirth argues that this outcome is the logical conclusion. The anti-feminist movement had organized itself well, and Daniel Ortega needed to garner more support. Ortega’s sudden shift to conservatism is believed to be a “shift to cynicism,” and she argues that the election not been so close, Ortega may not have let the anti-abortion law pass. Kampwirth’s analysis of the divisions in the feminist movement are consistent with her findings in *Feminism and the Legacy of Revolution*.

Jennifer Leigh Disney’s *Women’s Activism and Feminist Agency in Mozambique and Nicaragua* explore women’s organizational theories and practices in Nicaragua and Mozambique. Feminists have cultivated a new definition of feminism that challenges Western feminist thought through the organization of their autonomous
feminist groups. The significance of Disney's research is that feminist agency is crucial to promoting equality in a world that experiences a growing gap in economic inequality. Both revolutions gave women the opportunity to participate, but it ignored an important part of women's lives, the domestic sphere. Disney asserts that in order for social change and feminism to be more effective, economic opportunities and reproductive health must both be considered.

Finally, Rosario Montoya's *Gendered Scenarios of Revolution: making new men and new women in Nicaragua, 1975-2000* is a historical ethnography that examines the effects of Sandinista ideology and the contradictions that arose in the small village of El Tule, Nicaragua. Montoya argues that although the Contra War worsened conditions in Nicaragua that greatly risked the survival of the Sandinista Revolution, the Sandinistas themselves also set the revolution up for failure, as they began to revert to patriarchal structures after having already created new opportunities and roles for men and women. Montoya's work is a reinterpretation of the failures of the revolution in Nicaragua. Even though the Sandinistas restricted El Tule, the people actually went against the Sandinistas at times in order to advance their interests. This work provides insight into the transformations that take place during times of revolution, as well as the legacies that are left behind to confront the wave of neoliberalism that spread throughout Latin America in the late 20th century.

These works are the first lights illuminated on the history of women's participation whether direct or indirect in revolutionary movements. They provide great insight into the extent of women's involvement and the gains (or losses) they've made post-revolution. It is clear that feminist (and anti-feminist histories) are still in the making as the scholarship is so young, and each author I have examined present their theories and arguments well, relying heavily on interviews. Many sub-topics of revolutionary women are addressed, but health care and agricultural workers seem like topics to be researched to contribute to the current scholarship, since these topics were also very important in movements like the Cuban Revolution and in Chile.

**Research Questions**

The purpose of my research is to measure qualitatively the politicization of women in Southern California. Most people who emigrated from Nicaragua did so after the Contra War officially began, to escape poverty and the growing violence. Much of the revolution's achievements had been made by that point in time, indicating that those who left had already been exposed to the revolution and may have carried revolutionary seeds of thought with them to their new destinations. There are few sources on what happens after revolution, in Nicaragua's case. What happened to Nicaraguense diasporic women? Did the revolution affect them? What does it mean to an older Nicaraguense woman in Southern California? What challenges do they face? Where does education fit into their realities?

**Methods**

My methods will involve traditional historical research concerning primary and secondary sources. This research falls under a postcolonial history framework with an added dimension of gender, and an anthropological approach, since I must help create new primary sources through interviews. I conducted six interviews. I met these participants at the annual Feria Nicaraguense hosted in Los Angeles. I interviewed older Nicaraguense women, aged 40+. A couple of sample questions I asked were, "When did you leave Nicaragua? Why?" and, "What was it like adjusting to life in the United States?" The purpose of asking questions like this is to gain a
better understanding of women's perceptions and attitudes towards the Sandinista Revolution, but also to focus on the new life they have created for themselves in the US. The questions are engineered to be open-ended because I did not expect certain results or answers from these interviews. The creation of these new primary sources is what will help me in formulating my final interpretations.

Discussion

There were some common themes that I have noticed in the interviews. The majority of the women interviewed immigrated alone, and although the primary reason was economic, escaping the violence of the revolution or domestic violence was also a major factor. Most of these women are single mothers who lived alone for a while in order to save money and pay for their children's passage into the US. Another trend I have noticed is that half of these women received higher education in Nicaragua, and worked as either a lawyer, a government official, and a psychologist, which are considered prestigious professions. However, in the US they now work low-paying jobs since only very few degrees or certifications from Nicaragua are considered the equivalent of a bachelor's degree. Even so, they are active members of their communities and work to end domestic violence or provide resources for women. The other women who did not receive higher education in Nicaragua also work low-paying jobs in the US, but did not report any involvement in their communities. Of these women, three stated that they did not believe the revolution helped women. Clearly these interviews are not representative of the entire targeted population, but this is a start in attempting to construct a history of the women belonging to the Nicaraguense community.

The interviews, should I get permission to have them archived, are contributions in and of themselves as new primary source materials for future scholarly research in many disciplines. This is also an attempt to find a middle ground between revolutionary ideals and gender equality in literature. The literature on the Sandinista revolution focused largely on the value of revolution in the public sphere instead of the value of gender equality in the domestic sphere. In addition, what happens often in history is that the questions that historians pose are almost always answered from a male perspective first, making women's perspectives secondary. This is why I went straight to asking women in the Southern California Nicaraguense community these questions first. This is important not only because women have long been marginalized from history, but the Sandinista Revolution had a powerful feminist impulse, as I explained earlier.

In looking for spaces or gaps that need to be filled, this research can provide a more useful, and more accurate history. The gap that I focused more on was education, because many of my sources merely glossed over it, but the Literacy Crusade was the Sandinista's centerpiece for their revolution, which improved Nicaragua's literacy rate exponentially, and there is an indication it played a role in education levels of the population I studied. This research is also a contribution to the history of the Nicaraguense diaspora in Southern California, of which very little research has been done aside from statistics. It is important to finally recognize this community, that has been largely ignored, despite being the 3rd largest Central American community in California. This community has molded a new identity, and warrants a voice in history. In the larger picture, this research helps fill in a gap that is central to understanding revolution in its entirety: the post-revolutionary period and women. Dr. Karen Kampwirth, a political scientist and expert on this subject, notes that by focusing on the questions of why states collapse and how revolutions succeed, revolutions succeed, the realities of
revolution and the central role of women are often overlooked, at least until recently. However, the flourishing literature on gender roles in relation to revolution in Nicaragua is only the beginning.

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Amanda Riggle
Abstract

In 2010, President Barack Obama set forth a plan called "Transforming American Education: Learning Powered by Technology" which mandated that technology needed to be integrated into American classrooms to enhance student learning (Ash). The need for technology in the classroom is not only government endorsed but helps improve students’ familiarity with the use of technology in a future job market that is becoming globalized and technology-driven (Ehrlich). In 2013, the Los Angeles Unified School District spent one billion dollars to distribute Apple iPads to over 47 schools in an effort to comply with the directives set forth through President Obama’s plan and ended up recalling the iPads in under a week due to the operating system being hacked (“L.A. Unified”). The purpose of this project is to find ways of meeting the 2010 mandated use of technology within a performance-based classroom teaching Shakespeare by creating learning opportunities in which technology can be incorporated into the classroom through the use of student-generated content. Through examination of other successful classroom models incorporating technology, looking ahead at some proposed, yet still controversial, technology-driven classroom models, utilizing performance approaches to teaching Shakespeare, and studying the new Common Core standards being implemented in K-12 schools throughout the nation, a hybrid of technology and the study of 16th century Shakespearean plays can be successfully implemented in a Common Core classroom.

Major Objective

This project has three major objectives to accomplish. The first objective is to find out what effect technology has within the classroom. The second objective is to find what kinds of technology are being introduced into the classroom. The third objective is to see how this technology can be integrated into a performance-based classroom meeting the California Common Core Standards.

Background and Literature Review

President Barack Obama released an education plan centered on technology within the classroom in 2010, titled “Transforming American Education: Learning Powered by Technology.” The aim of this plan was to make learning more personalized to the student through the use of technology within the classroom, with the main emphasis of this personalized technology-driven classroom model falling on interactivity. The minds behind the mandate also wished to make learning a continuous process that happened on school grounds but could be taken home or accessed from home by students (Ash). The Los Angeles Unified School District introduced iPads into the classroom in 2013 as a way of meeting the 2010 presidential mandate.

While this plan had all the appearances of meeting with the goals of the presidential plan, such as an interactive personalized platform for students to interact with their work, the one billion dollar introduction of iPads into the classroom was met with disaster. The iPads were equipped with a specific interface that kept the students use of their iPads restricted to class-only activities, yet within the first week of the iPads being in the classroom, this platform was hacked and the iPads were withdrawn from use. Outside of the immediate problem with the iPads in the classroom such as the hacking of the student-interface, the LAUSD also lacked specifics on who was responsible for the repairs of the iPads if they were to break or if they were stolen. During the testing of this program, it was also unclear on whether or not students would be able to take the devices home, which defeats the accessibility purposes of the 2010 technology mandate (“L.A. Unified”).

In 2014, the LAUSD changed their plans to
introduce iPads into the classrooms and opted for laptops for the students instead. The new idea shifts from a one-platform-for-all approach used with the iPads to recognizing that students in first grade have very different technological needs from those in twelfth grade and plans to provide adequate laptops for students at their current grade level. This strategy has yet to be implemented, but the LAUSD plans not to exceed their budget of 40 million dollars, unlike the introduction of the iPads which were originally to cost the school district 30 million dollars, which then got expanded to a 500 million dollar contract, only to have another 500 million dollars added to the contract for an upgrade in the Internet connections on the devices (“LAUSD Shifts”). With the introduction of a new technology-based platform in the classroom, models of pedagogy need to be erected to satisfy the 2010 presidential mandate.

This project focuses on integrating technology into a performance-based classroom. A performance classroom teaches literature, usually dramas or playtext, in a deliberate way that takes into account the difference between other forms of literature, such as novels, short stories, and poems (“Performance is More”). Literature is taught in the classroom because it serves multiple functions that benefit students. Reading literature gives students a chance to engage with a text critically and closely, allowing them to understand historic implications of the time period the piece was written in and evaluate the social roles portrayed within the text and compare it to their own (or the social values of their communities) (Beach 35), understand written and oral patterns and their effect (“Performance Approaches” xvi), and engage in stories that teach them to evaluate the multiple roles they play within their lives (Beach 48). Drama, while offering students the benefits of reading literature, has an added value for students because “reading drama engages students in ways that ask them to immerse themselves in the power of the text yet also invite[s] them to develop their own power through rehearsing and shaping that text in performance” (as cited in “Performance Approaches” 82). The performance model of teaching Shakespeare uses the difference in medium of drama to engage students in learning through reading, writing, and performance.

Text written for performance differs from other literary texts when it is read. The performance model of teaching Shakespeare incorporates close reading skills with theatrical consideration for the medium of the play. A play is recognized as being more than just a regular text, for a play is a performance piece, not a novel for reading. When reading a play, students must take more than just the written word into account. In the essay “Performance is More than an “Approach” to Shakespeare,” Dr. Rocklin notes “[c]urrent paradigms in English often define themselves as teaching students to read either with or against the grain of a text, a performance-centered paradigm widens the curriculum by teaching students to read through the grain of a text” (58). Reading a play varies greatly from other literary forms because the text is intended for the stage. This means that, for drama, there are three perspectives a student explores.

With other forms of literature, such as poetry or novels, there are two levels of interaction with the text: that of the author, who conceived and wrote the text, and that of the reader, the one receiving the outputted text. For a play, there are three levels of interaction intended to take place with the text: the vision of the concept by the writer, the enactment of the text through the stage, and the reception of the play by the audience. These three perspectives all affect the way the text can be read, hence a student needing to read “through” a text rather than with or against it. A student reading drama has to learn to take on the active role of director, player, and audience to engage with the text rather than the passive role of reader. The performance model looks
at the three perspectives ever-present within the playtext: that of the author or director, that of the player, and that of the audience to engage students in reading with these new perspectives in mind (“Performance Approaches” 23-60).

Through writing responses to the close-reading questions, students explore the role of the playwright and the playtext within their assignment. Writing down answers to “What is X?,” “What does X mean?,” and “What does X do?” helps students identify the action within the text, reflect on what that action is, and then react to what that action does. Doing this action also helps students identify X, explore the meaning of X, and how the use of X calls forth an action (“Performance Approaches” 10-14). Writing these answers down allows the student to “reflect the potentials of a playtext” (“Performance Approaches” 16). This is a step to envisioning the text as more than just a text, but rather as performance. Once a student explores the function of the text, what is mandated by the text, and what is left open for interpretation, the student can go further in their writing and explore the text through performance and the roles of director, player, and playgoer.

Writing about a playtext as performance teaches students “to move through the phases of conception, enactment, and reception [while asking] what do these words do? What can these words be made to do?” (“Performance Is More” 54). Students are able to experience, through their writing, the different roles that make the middle of the play unlike other literary forms which “illuminate the intentions embodied in the design” (“Performance Approaches” 79). Reading and writing through these different positions engages the students to not only think and engage critically with the text, but also encourages the students to become active participants in the reading and writing experience through the lens of performance. While reading differently and writing through performance are two unique aspects of the performance model of teaching Shakespeare, what truly makes the performance model of teaching unique is the enactment of text.

A dramatic text, like a Shakespeare play, lends itself to multiple interpretations and presentations of the text through performance for “there are few absolute rules about playing Shakespeare, but many possibilities” (“Playing Shakespeare”). Reading and writing about a text through performance leads students to recognize that within a performance there are many choices made by the director as well as the actors that change the way a text is perceived by the audience once it is performed. Physically acting out scenes within a Shakespeare play brings forth more consideration of the medium than reading or writing alone, for now students have to take into account blocking, stage action, the use of props, the verbal interaction of characters, speech patterns, emphasis or de-emphasis of the text, commitment to a character’s disposition, and many other directorial or acting considerations the student might not have engaged in through reading or writing alone.

Through enacting a text on stage (or on a simulated stage), students are able to embody the choices they have made in reading and writing through the text and see how physical action influences the meaning of the original script. The performance model of teaching Shakespeare promotes students to engage with reading, writing, and staging in ways that encourage the student to be both “creative and innovative” (“Performance is More” 62). This activity encourage students to be critically engaged with the text and become more than just passive readers of a story, but rather creates an opportunity for them to enact the creative control granted to directors and players within the actualization of a text to the stage. This critical and creative approach to studying drama corresponds to the unique nature of drama and how it varies from other literary forms for students to study. While all literature is
apt to teach students about history, society, written and oral patterns, and the roles created within literary texts. Drama is one of the only forms that allows students to physically embody and influence the moralities of these literary lessons. While the performance model has been used in many K-12 classrooms, the introduction of the California Common Core State Standards is relatively new to these classrooms.

The California Common Core State Standards were first introduced in 2010, but didn’t enter California schools until 2012 and weren’t widely practiced until 2013 (Ujifusa). The overall goal of the Common Core State Standards within California is to engage students in activities that focus on four key areas of learning, called The Four C’s, or areas related to critical thinking, creativity, communication, and collaboration within the classroom environment. The state of California breaks the Common Core English Standards into two subgroups, kindergarten through fifth grade and sixth through twelfth grade. For the purpose of this research, I will be focusing on the sixth through twelfth grade standards.

The Common Core curriculum provides guidelines and sets expectations for what each student should be able to demonstrate knowledge in by the end of a given grade level. The English classroom curriculum focuses on reading, writing, speaking and listening, and language standards (United 2-8).

While the Common Core English Language Standards focus on many types of reading material, ranging from stories and poetry to nonfiction and expository texts, not many Shakespeare plays are specifically listed in the recommended reading section outside of The Tragedy of Macbeth. The standards do note, however, that these readings are merely suggested and the list of what should be covered in a classroom is much vaster than what they have listed within the Common Core (United 78). The Common Core Reading Standards want students to examine dramatic text, “classical through contemporary” (United 77), for the purposes of having the student “compare and contrast the experience of reading… including contrasting what they ‘see’ and ‘hear’ when reading the text” starting within the sixth grade (United 48). By the time the student reaches twelfth grade, the student should be able to perform a range of analytical skills from analyzing the development of “two or more themes or central ideas over the course of the text” (United 49) to analyzing the “multiple interpretations of a…drama…[and] evaluating how each version interprets the source text” (United 50).

The California Common Core Standards list drama only twice, specifically, within the guidelines. The first under the section dedicated to reading and the only other appearance of drama is under the speaking and listening standards for delivering a monologue in front of a classroom (United 69). While the Common Core does not specifically advocate for dramatic texts to be used within the writing and language standards, nor more than once in the speaking and listening portion standards, its text notes “[t]o become college and career ready, students must grapple with works of exceptional craft and thought whose range extends across genres, cultures, and centuries…[t]hrough wide and deep reading of literature…of steadily increasing sophistication, students gain a reservoir of literacy and cultural knowledge, references, and images” (United 46). Through a performance classroom, many of the basic mandates of the Common Core State Standards, both the ones listed specifically for drama and those that just call for “texts,” can be met within a learning environment that embodies the spirit of the Common Core’s mission of critical thinking, creativity, communication, and collaboration.

Beach, Thein, and Webb, in their book Teaching to Exceed the English Language Arts Common Core State Standards, place an emphasis on teaching beyond the minimal standards set forth within the Common Core. The authors note that the Common Core standards give teachers more flexibility within the classroom than the
Integrating Technology Into Common Core Classrooms

previous standards of No Child Left Behind and that “it is critical that teachers have the autonomy to match learning needs, skills, prior knowledge, student interest- ing, and changing contexts” within a classroom (12). With this flexibility, teachers would be able to teach to the needs of their students rather than teach their students to pass a standardized test. The flexibility of the Common Core allows teachers to select texts outside of the few specific ones outlined within the standards themselves. For a teacher in a performance-based classroom, this allows more dramatic, performance based text to be applied to the Common Core that calls for general text.

The authors also recognize the contribution of the English classroom to the overall goals of The Four C’s in the Common Core in that “studying events in their own lives, and as portrayed in literature, students can reflect on how events are framed in terms of goals, plans, roles, norms, and beliefs, as well as how, in topic, issues, or thematic units, historical, institutional/civic, cultural, psychical, and economic forces shape the framing of events” (35). The study of literary works, such as novels, plays, poems, and short stories, contributes to the critical thinking aspect of the Common Core. But to limit the role of these texts to the realm of critical thinking alone is a mistake. The performance model of teaching Shakespeare also engages students in the other three of The Four C’s. Creativity, collaboration, and communication, for example, are paramount when performing scenes from a play, even on a small classroom scale rather than a full-blown production.

The Four C’s are further developed in the performance model of teaching Shakespeare through the close-reading of the roles and identities of the characters within the plays. Beach, Thein, and Webb state that the “literacy practice related to framing events involves constructing and enacting identities, or roles in events. For instance, to be a daughter/son, friend, student, sports team member, sales/wait person, neighbor, club member, etc., involves particular social practices, traits, beliefs, and attitudes” (48). Close-reading allows the students to engage in these roles outside of themselves and look at the larger picture of events taking place within the play and how it relates to the identity of the players. This awareness of identities and roles, while not explicitly outlined in the Common Core State Standards, is built into the performance model of teaching Shakespeare and engages students within the act of critical thinking on top of creating an awareness of socially constructed roles and identities. The authors note that this process of “[l]earning how to relate to others requires the ability to empa- thies with others’ perspectives, share one’s own feelings and perspectives, and negotiate differences of opinions” (51). A student can see that they are a daughter/sister or son/brother and apply their awareness of the roles they play to the characters within the text for a deeper understanding of both the character and their understanding of the roles they also play. This can be extended further to enhance a student’s empathetic understanding outside of the playtext as well.

The performance model of teaching Shakespeare is a joint venture between teacher and students that fulfills the English Common Core State Standards. While the overall spirit of the Common Core can be summed up in teaching The Four C’s to students (critical thinking, creativity, communication, and collaboration), the specific standards under the model for a sixth through twelfth grade classroom are also met within a performance classroom. The California Common Core Standards are just the foundation for what is to take place within a sixth through twelfth grade classroom, and teachers should be looking to go above the suggested texts and create in-depth lesson plans that embrace the spirit of cooperative learning within a classroom. The performance model offers a breadth of learning opportunities for students to engage in within the classroom beyond the threshold of the Common Core while still
embracing its spirit.

**Method**

The methods employed in this project consist of a literature review and synthesis of performance-based pedagogy, California Common Core Standards, and existing technology-based pedagogical model into three comprehensive lesson plans that include the sections of the Common Core satisfied by the lesson plan, detailed teacher instruction and student objectives, links to online tools, fully developed worksheets and instructions for the projects, as well as what parts of the performance model are being explored within the assignment.

**Results**

**Objective 1:**

Technology in the classroom benefits students overall, but there are some drawbacks. Throughout the American classroom, there are still huge test score discrepancies between socioeconomic classes, and, in fact, “[s]cholars have found evidence that achievement gaps between rich and poor children have been increasing, not closing” (Bowen 24). This gap in academic achievement is further exacerbated when wealthy schools have access to technology that schools in poorer districts lack. This not only denies access to and education in technology, but makes the students in these districts feel as if they are not on equal terms with other participants in society that have had such access (Gee 143). The first step in closing the education gap between the wealthy and the poor is to grant access to technology within all classrooms because “there is promising work to be done, if only we can muster the will to meet challenges that...are technical” (Bowen 27). Technology within the classroom has the potential to be the great equalizer for socioeconomic problems that have plagued education as of late if students across socioeconomic status are given equal access.

In Stacy Ehrlich’s study, “The Use of Technology in Chicago Public Schools 2011,” a positive correlation was found between the use of technology in the classroom and students’ comfort in using technology in other aspects of their lives. Ehrlich’s study acknowledged that low-income students were the least likely students to be exposed to technology in the home, but further showed that even students having access to technology such as computers or tablets at home did not lead to their use in academic activities. The study found that technological literacy began in the classroom and spread to the home, not the other way around (17-20). Access to technology in school not only helps close the achievement gap between socioeconomic classes by providing students with the same access to and education in technology, but that exposure to technology aids a student’s familiarity and use of technology outside of the classroom.

Students should not be left to their own devices to learn technology solely outside of a school environment, even if they have access to technology outside of the classroom. Professor James Paul Gee is an advocate for technology within the classroom and at home but he also recognizes that “[t]ools are dangerous when they control us and we don’t control them. The smarter and more user friendly tools get, the more dangerous they can become if we handle them without reflection” (Gee 182). Students need to be guided both in use of technology and the art of temperance when it comes to technology’s use. Technology is a tool that students should harness to enhance their education, both in and out of the classroom, rather than a distraction that deters from student learning. It is the job of the teacher within the classroom to teach students how to moderate their use of technology and apply its use in the appropriate situations.

Higher education has embraced the use of
technology within its environment and students transitioning from the secondary level of education that lack exposure to technology within the classroom are at a disadvantage in a college setting. For students to academically succeed, technology must become as familiar to them as the classrooms and chairs they have sat in since the beginning of their scholarly pursuits (Relles 477). For low-income students who lack this exposure at home and in a classroom setting, the disadvantage is twofold. While students who have exposure to technology at home may not always have the skills to properly use it as a tool to enhance learning, they still have exposure and foreknowledge in some capacity with technology when they are assigned a technology-based assignment in college. Junior high schools and high schools should not be setting students up to fail in college; instead, teachers at this level should bring technology into the classroom in a way that exposes students to its use and trains them how to use it as a tool. Teachers recognize the power of technology within the classroom in a survey conducted by Gene Martin and John Ritz in which teachers reported that the use of technology in their classroom would have an impact on the academic achievement within their classroom (Martin 39).

Politicians and teachers are not alone in their assertions that technology has a place in secondary education, for as technology advances, students expect to be exposed to technology in the classroom as well (Bowen 68). This holds especially true for low-income students who lack access to technology outside of their cell phone or school or public library computers. While “only a generation ago one did not need to consider new media literacies because writers largely wrote as they had for centuries,” more than just the manner of writing has changed with currently advancing technology (Relles 499). Technology has become the mode of communication between student peers through social networks such as Twitter, Tumblr, Facebook and Instagram. The media, such as movies, television, and news outlets, constantly bombard students with portrayals of new and advancing technology. Students see technology becoming a core component of modern society and these exposures lead to student expectation that training in technology is an intricate part of being a functional, employed member of society (Gee 170).

Objective 2:

Technology in the classroom offers many benefits to student learning and has become an expected part of the educational process through political proclamations, teacher assertions, and student outlooks. The question now shifts away from why incorporate technology into the classroom to how the technology should be implemented within the performance model of teaching Shakespeare in secondary education. From an administrator’s point of view implementing an iPad to every student, such as the Los Angeles Unified School District (LAUSD) did in 2013, shows compliance with 2010 federal technology mandate, but there are many issues that come with technological hardware within a classroom environment. In the case of the LAUSD, many issues arose within the first week of issuing iPads to its students such as confusion as to who would care for the devices, the hacking of the devices, and iPads being stolen from the classrooms (“L.A. Unified”). Responsibility, corruption, and theft are not the only concerns connected with technological hardware. Cost is another huge factor in classroom connected with technological hardware. Cost is another huge factor in classroom technology. The LAUSD spent one billion dollars on their campaign for an iPad for every student (“L.A. Unified”). Other advancing technologies, such as SMALLAB, or a device that digitally records student movement and projects it into a digital environment that the students can then interact with, costs roughly 35 thousand dollars per classroom (Bock). The costs of these hardware-based
technologies are high, and their long-term potential is questionable.

Hardware is constantly advancing. In the span of thirteen years, over four families of iPods have been invented and within those families of iPods, twenty-one different models have been created (“Apple”). That means a new iPod is released roughly a little over every one and a half years. The turn-around rate is even greater for the iPad. The first generation of iPads was released in 2010, and in 2014, there have been four generations along with the creation of a mini iPad. That’s a total of five different devices in the span of four years with newer generations being proposed (“Apple”). Administrative policies aren’t known to move quickly on any level (an example of which being the three years it took for the LAUSD to comply with the 2010 mandate for the integration of technology into the classroom) and by the time a policy is created that settles around the use of a hardware devices, it is likely that the device will be obsolete outside of the classroom. Training students for a device rather than an appropriate way to integrate a broad variety of available platforms for the application of technology is a disservice to student learning.

Because of the progressive nature of technology and the constant turn around in hardware, it does not readily offer a viable solution to the use of technology within the performance classroom. As William G. Bowen notes, author of Higher Education in the Digital Age:

At one point, I was much more inclined than I am at present to believe that a single platform or single tool kit might be appropriate. It now seems clear to me that the notion of a single dominant platform is unrealistic, given the entrepreneurial inclinations of numerous individuals and organizations. I now believe that such a notion is also unwise....Adoption of any specific platform or platforms should be driven by a compelling strategy (57).

Bowens offers a solution to the problem that comes with hardware within the classroom. Instead of trying to design hardware for a classroom or adapt classroom design to a specific piece of hardware, teachers should be allowed to experiment with the implication of technology within their own classrooms to see what works well with their methodology. Many teachers have already found ways of integrating technology into their classroom to little or no cost through the use of online technology.

Teachers in varying literature-based classrooms have found success using these little-to-no cost technologies within their classrooms. Elizabeth D. Weber, in her Commedia Classroom, finds that student-generated wikis, or online encyclopedias, fit well. Joanne T. Diaz uses an online digital archive to explore poetry within her undergraduate literature courses. Dylinda Younger, Jan Duncan, and Latoya Hart published an article titled “Turning into Youtube in the Classroom: Improving Student Assessment Scores through Social Media,” which explores the use of the free video website, Youtube.Com, as a means of increasing student involvement in their own learning within the classroom (4). With the introduction of laptops into the LAUSD school curriculum, online tools become even more accessible for students while taking little to nothing away from the already allocated funds for this classroom technology.

Advancements that have taken place over the past twenty years have made technology not only affordable to the masses, but a viable medium for business, socialization, and education. The mandate for technology socialization, and education. The mandate for technology in the classroom parallels a shift in many states from the No Child Left Behind standards to the Common Core standards, which calls for less testing, more expository writing, and more teacher autonomy in the classroom when it comes to choosing texts. These shifting paradigms offer unique challenges to the performance classroom. While there are many technologies available and currently being used in classrooms across the United States, not all of these technologies fit well within the performance model of teaching Shakespeare.
Objective 3:  
*Twelfth Night Wiki Project*

Grade Level: 8th Grade.

California State Common Core Standards Satisfied:

Reading Standards 8th Grade: Key Ideas and Details 1-3 and Craft and Structure 4-5 (United 48). Writing Standards 8th Grade: Text Types and Purposes 1 a-e, 3 a-e, 4-9a (United 56-60).

Speaking and Listening Standards 8th Grade: Comprehension and Collaboration 1a-d, 2-4a, 5-6 (United 66-7).

Language Standards 8th Grade: Conventions of Standard English 1a-b and 2a-c (United 71).

Knowledge of Language 8th Grade: 3a (United 72). Vocabulary Acquisition and Use: 4a-d, 5a-b, 6 (United 73).

Lesson Objective:

Students will engage with the text of Twelfth Night on a critical level to build an online database that reflects their learning. Students will explore themes, motifs, characters, character development, plots, staging, word choice, performance choices, props, setting, and more within the parameters of the wiki. Students will write, edit, comment, and critique each other’s wiki posts to build a stronger wiki community. Students will be expected to use proper citations and grammar conventions within their online wiki community. At the end of the wiki project, students will orally present their assigned portion of the wiki in class.

Instruction/Procedure:

**Week 1:** The teacher will introduce the project to students at the end of the first week of instruction centered on *Twelfth Night*.

The teacher will list the different themes, motifs, symbols, characters, scenes, and excerpts of dialog to be explored within the wiki on the board (or projected onto the board through a Power Point or similar application) and students will be asked, depending on the size of the class, to sign up for a topic as a group or as an individual and take responsibility for a portion of the wiki project.

The teacher will hand out a worksheet to get students started on their first wiki entry.

The teacher will inform the students of the tasks they are to complete for the first part of the wiki project.
The teacher reminds students that they are also to comment on each other’s work and give positive feedback to help with the creation of the wiki.

The teacher will set aside a class period to take the students to the computer lab or library so they can update their section of the wiki with the teacher’s assistance.

**Week 2:** The teacher will give feedback on the student’s progress on the first week’s assignment. The teacher will pull aside any students who are behind and ask if they need additional help with the wiki project. If the students don’t have access to technology at home, the teacher can have the students physically write out their section of the wiki for the teacher to add to the wiki later.

The teacher reminds students that they are also to comment on each other’s work and give positive feedback to help with the creation of the wiki.

The teacher will give the directions for the second week and give an example on the board using Maria’s letter to Malvolio as an example:

1. **What does your section mean?**

   It means that Maria, Toby, and Sir Andrew are plotting against Malvolio to make him look like a fool. It also means that Malvolio is buying it. Overall, this means that Maria, Toby and Sir Andrew dislike Malvolio and want him to be humiliated and that Malvolio thinks he is above his servant station and worthy of being Olivia’s mate, which makes him easy to humiliate.

2. **What does your section do?**

   The letter from Maria to Malvolio sets Malvolio up for a prank. While the prank begins as a plot by Maria, Toby, and Sir Andrew, it has the potential to involve Olivia since they are trying to fool Malvolio into believing Olivia likes him.

3. **What would happen if your section was cut from the play?**

   There would be no subplot with Malvolio ending up in prison and it would also change the ending of the play. Malvolio would no longer have a strong reason to be mad at everybody and keep information from the group that would lead to Viola’s clothing.
Week 3: The teacher will give feedback on the student’s progress on the second week’s assignment. The teacher will pull aside any students who are behind and ask if they need additional help with the wiki project. If the students don’t have access to technology at home, the teacher can have the students physically write out their section of the wiki for the teacher to add to the wiki later.

The teacher will inform the students that they are to prepare a five minute presentation on their information included on their section of the blog.

The teacher will set aside class time for the presentations to take place.

Closure (Check for Understanding, Independent Practice)

The teacher checks the wiki posts every night and gives feedback to students in class the next day.

The teacher will use one wiki entry to prompt discussion on that day’s section of Twelfth Night.

The teacher sets aside class-time every morning to check with the student to see if they have any questions on their part of the wiki or on the project in general.

The teacher will ask students questions during their presentation on their section of the wiki.

Lesson Plan adapted from Folger Shakespeare Library’s Shakespeare Set Free: Teaching Twelfth Night and Othello and Performance Approaches to Teaching Shakespeare.
## Wiki Project

Each student, or assigned group of students, will be responsible for one part of a wiki project centered on the Shakespeare play *Twelfth Night*. In addition to the wiki section you are responsible for, you will also be required to comment on two other wiki sections of the project. And section you are responsible for, you will also be required to comment on two other wiki sections of the project and give feedback. Feedback should be positive and constructive. The teacher will monitor all feedback given on the wiki project. You will be allowed to work on the wiki project from home, but we will also set aside class-time to work on the wiki project as well. The following are the wiki sections and the questions each section should answer. I will pass around a signup sheet. Please make note to yourself which section of the wiki you are responsible for.

<table>
<thead>
<tr>
<th>Themes</th>
<th>Characters</th>
<th>Scenes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Love</td>
<td>Viola</td>
<td>Act I, scene i</td>
</tr>
<tr>
<td>Ambition</td>
<td>Orsino</td>
<td>Act I, scene ii</td>
</tr>
<tr>
<td>Folly</td>
<td>Olivia</td>
<td>Act I, scene v</td>
</tr>
<tr>
<td></td>
<td>Sebastian</td>
<td>Act II, scene i</td>
</tr>
<tr>
<td></td>
<td>Malvolio</td>
<td>Act II, scene ii</td>
</tr>
<tr>
<td></td>
<td>Feste</td>
<td>Act II, scene iv</td>
</tr>
<tr>
<td></td>
<td>Sir Toby</td>
<td>Act II, scene v</td>
</tr>
<tr>
<td></td>
<td>Maria</td>
<td>Act III, scene i</td>
</tr>
<tr>
<td></td>
<td>Sir Andrew</td>
<td>Act III, scene iv</td>
</tr>
<tr>
<td></td>
<td>Antonio</td>
<td>Act IV, scene i</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Act IV, scene iii</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Act V, scene i</td>
</tr>
</tbody>
</table>

### Motifs

- Letters and Tokens
- Disguises Mistaken
- Identity

### Symbols

- Gifts
- Clothing
- Songs
Week 1:

Themes, Motifs, and Symbols will add the following information to their wiki by the end of week 1:

1. Define your theme, motif, or symbol (e.g. anger is a negative emotion).
2. Three scenes that involve your theme, motif, or symbol.
3. How those scenes reflect your category.
4. What characters are involved and how they are interacting with one another.
5. One modern movie or television shows that uses your theme, motif, or symbol.
6. Compare *Twelfth Night* to the modern movie or television show.

Characters will create a profile including the following by the end of week 1:

1. Name, age, occupation.
2. Physical description (e.g. height, weight, hair, and eyes).
3. Favorite style of clothing.
4. Favorite hangout.
6. Favorite song.
7. Favorite person.
8. Favorite car.
9. Favorite thing to do on a Saturday afternoon.
10. Greatest achievement.
11. Top five things on this person’s mind.
12. List three personality traits.
13. What quotes back up these personality traits? Give the act, line, and scene numbers.
14. What two actors would you put in this role?
15. What qualities make these actors right for this character?

Scenes will add the following information to their wiki by the end of week 1:

1. A short summary of the scene.
2. On a plot diagram, where would this scene be (e.g. rising action, resolution, etc.).
3. The characters within the scene.
4. The central action taking place.
5. How you would stage the scene.
6. What props would be used within the scene.
7. What parts you would cut from the scene for time if this were going on stage.
8. How those cuts affect the rest of the scene.
Week 2

All students will answer the following questions within their section of the wiki:

1. What does your section mean?
2. What does your section do?
3. What would happen if your section was cut from the play?

Week 3

Students will prepare a five-minute in-class presentation for their section of the wiki and present to the rest of the class.
**Romeo and Juliet Digital Archive and Blog Project**

Grade Level: 9th-10th Grade.

California State Common Core Standards Satisfied:

Reading Standards 9th-10th Grade: Key Ideas and Details 1-3 and Craft and Structure 4-5 (United 49).

Writing Standards 9th-10th Grade: Text Types and Purposes 1 a-e, 3 a-e, 4-9a (United 61-64).

Speaking and Listening Standards 9th-10th Grade: Comprehension and Collaboration 1a-d, 2-4a, 5-6 (United 68-9).

Language Standards 9th-10th Grade: Conventions of Standard English 1a-b and 2a-c (United 74).

Knowledge of Language: 3a (74). Vocabulary Acquisition and Use: 4a-d, 5a-b, 6 (United 75).

**Learning Objective:**

Students will engage with the first two quarto versions of *Romeo and Juliet* on a critical level and compare and contrast the different versions of the play, what the additions or omissions of text does for the play, critically analyze why the changes were made to the play, and write blog posts about four scenes in which changes were made. All blogs will be held to conventional language standards and appropriate knowledge levels of language. Students will write a final paper on one scene in which they talk about what cuts they would make to one of the scenes they wrote a blog about if they were directing the play and pressed for time. The students would then do an oral report or staging of their scene based on their paper.

**Instruction/Procedure:**

**Week 1:** The teacher will introduce the project to students and show them how to access and use a digital archive in class.

Two websites available for the teacher’s use include the British Library’s collection of Shakespeare quartos and folios which are digitally archived versions of the text students can flip through and compare, accessible at: Special-1.BL.Uk/Treasures/SiqDiscovery/UI/Search.aspx.

And the University of Victoria online Shakespeare library with quarto and folio texts in digital text format: InternetShakespeare.UVIC.ca/Library/Texts/Rom/
A teacher may also work with the school librarian help set up a digital archive of books available in the library, including the first two quarto versions of Shakespeare texts.

The teacher will also set up a blogging platform for the students to access throughout the project. This can be done using free blogging sites like Blogger.Com, WordPress.Com, Tumblr.Com, or a blogging platform the school has set up already for students to access.

The teacher will provide the students with four or more examples of changes between quarto 1 and quarto 2 of Romeo and Juliet. The students will use the digital archiving website as a tool to look for the changes between the quarto versions of the play.

**Suggested sections for comparison:**

The Title Page and I.i.1-22  
II.iv.1-20  
II.vi.6-37  
III.iii.-45  
V.iii.100-20

The students will, in the blog, answer the following questions, with a minimum of a paragraph response to each question, about the changes:

1) What text has been added or deleted?  
2) What does the text do in the scene it is included in?  
3) What does the absence of the text do in the other version?  
4) Why do you think these changes were made?  
5) What affect do you think this change makes in the rest of the play?

The teacher will instruct the students to write two blogs by the end of the week exploring two scenes made available to them. Students will be required to comment on two other blog posts by fellow classmates. The teacher will monitor the student comments to ensure they are constructive and appropriate.

**Week 2:** The teacher will open class discussion by bringing up one or more observations in the student blogs about the changes between the quarto versions of Romeo and Juliet.

The teacher will instruct the students to write two blogs by the end of the week exploring two scenes made available to them. Students will be required to comment on two other blog posts by fellow classmates. The teacher will monitor the student comments to ensure they are constructive and appropriate.
Week 3: The teacher will open class discussion by bringing up one or more observations in the student blogs about the changes between the quarto versions of Romeo and Juliet.

The teacher will introduce a three page paper assignment in which the students will choose one blog as the starting point for a paper which addresses the following question:

1) If you were to direct *Romeo and Juliet* and had to make cuts and changes for time, what choices would you make? Explain your reasoning.
2) Would you start with the quarto 1 or quarto 2 version of the play?
3) How would your cuts in the scene you have chosen affect the rest of the play?

Lesson Plan adapted from Folger Shakespeare Library’s *Shakespeare Set Free: Teaching A Midsummer Night’s Dream, Romeo and Juliet, and Macbeth, Performance Approaches to Teaching Shakespeare, and The Shakespeare Handbooks: Romeo and Juliet.*
Digital Archive and Blog Project

Over the next three weeks, our class will be comparing the differences between quarto 1 (Q1) and quarto 2 (Q2) of Shakespeare’s play *Romeo and Juliet*. Each student will be given login information and a password for our class blog. If you lose this information, please see me. Each student will be responsible for posting an individual blog answering the following question:

1) What text has been added or deleted from Q1 to Q2?
2) What does the added text do in the scene it is included in?
3) What does the absence of the text do in the other version?
4) Why do you think these changes were made?
5) What affect do you think this change makes in the rest of the play?

In addition, each student will be responsible for constructive commentary on two other blog posts. For this assignment, you will be viewing Q1 and Q2 on the British Library’s collection of Shakespeare texts, which you can access through:

Special-1.BL.Uk/Treasures/SiqDiscovery/UI/Search.aspx

If it is too difficult for you to read the text in the digital archive, you can read a modern, typed version of Q1 and Q2 through the University of Victoria online Shakespeare library through:

InternetShakespeare.UVIC.ca/Library/Texts/Rom/

Your assigned scenes are as follows:

Week 1: The Title Page and I.i.1-22
Due by:________

Week 2: II.iv.1-20, II.vi.6-37, and III.iii. 1-45
Due by:________

Week 3: V.iii.100-20
Due by:________
Directorial Debut Essay Prompt

Using your blog posts as a starting point, you will write a three-page paper in MLA format that answers the following questions:

1) If you were to direct Romeo and Juliet and had to make cuts and changes for time, what choices would you make? Explain your reasoning.
2) Would you start with the quarto 1 or quarto 2 version of the play? Why?
3) How would your cuts in the scene you have chosen affect the rest of the play?

Due by:_________
King Lear YouTube and Vine Project

Grade Level: 12th Grade.

California State Common Core Standards Satisfied:

Reading Standards 11th-12th Grade: Key Ideas and Details 1-3 and Craft and Structure 4-5 (United 49).

Writing Standards 11th-12th Grade: Text Types and Purposes 1a-e, 3a-e, 4-9a (United 61-64).

Speaking and Listening Standards 11th-12th Grade: Comprehension and Collaboration 1a-d, 2-4a, 5-6 (United 68-9).

Language Standards 11th-12th Grade: Conventions of Standard English 1a-b and 2a-c (United 74).

Knowledge of Language: 3a (74). Vocabulary Acquisition and Use: 4a-d, 5a-b, 6 (United 75).

Lesson Objective:

Students will be able to develop characters based on the playtext King Lear and cite specific textual evidence to support those interpretations. Students will also explore how the medium of the play differs from that of other literary texts and how words written for the stage are different when delivered than when read flat on the page. Through in-class discussions and video projects, students will explore how Shakespeare’s meanings become more or less apparent to an audience through different acting exercises. Students will work in groups to record different scenes from record different scenes from King Lear to show how delivery affects the audience’s understanding of the playtext using advice from John Barton’s BBC series, Playing Shakespeare.

Instruction/Procedure:

Week 1: The teacher asks students to volunteer to read roles or assigns roles for Act I, Scene i, lines 39-309 and Act 1, Scene ii, lines 1-20 from the play King Lear. The teacher purposefully avoids giving context to the scene and has the students do a cold reading.

The teacher asks the students at the end of the reading the following questions:

1. What is going on in Act I thus far?
2. What is being set up in Act I?
3. What is each character doing in Act I?
The teacher leads student discussion and concludes that, without understanding the characters within these two scenes, it is hard to follow what is going on in the act or the play as a whole.

The teacher assigns students a character to investigate using the Character Development sheet. The students will explore I.i.1-309 and I.ii.1-20 using this worksheet.

The next day, the teacher will have the students move into groups based on their assigned character and discuss what motivation their character has within the scene and what textual evidence there is to support their interpretation.

The teacher moves from group to group to discuss their character and offers feedback or support when necessary.

The teacher then breaks the groups exploring a single character up into groups exploring the whole scene, with one person from each character group present at least. The students then discuss their original character’s motivation and the textual evidence. The teacher will also further instruct the students to discuss how these characters and their motivation within the scene would interact.

The teacher leads the class in another reading of I.i.1-309 and I.ii.1-182 either by assigning roles, having students reprise their roles, or asking for volunteers.

The teacher leads another class discussion asking if the student’s perception of Act I changed from their cold reading to their researched reading, and leads the students through a discussion exploring why.

The teacher will play Episode 1 of Playing Shakespeare, found on Youtube.Com, and lead a class discussion on how John Barton’s instruction can be applied to King Lear. The teacher should be sure to bring up Barton’s comments on Shakespeare’s hidden directions and Hamlet’s instructions to his acting troupe.

**Week 2:** The teacher hands out the King Lear Video Project assignment sheet and asks students to sign up for groups. The teacher goes over the instructions with the class and asks if there are any questions on the assignment, including the due date.

The teacher leads a cold reading of III.vii.1-106, asking for volunteers or by assigning roles. The teacher asks the students at the end of the reading the following questions:

1. What is going on in Act III thus far?
2. What is being set up in Act III?
3. What is each character doing in Act III?
4. What changes have happened since Act I?
5. What reasons are there for these changes?
The teacher leads the class discussion and assigns students a character to investigate using the Character Development sheet. The students will now explore III.vii.1-106 using the worksheet.

The next day, the teacher will have the students move into groups based on their assigned character and discuss what motivation their character has within the scene and what textual evidence there is to support their interpretation.

The teacher moves from group to group to discuss their character and offers feedback or support when necessary.

The teacher then breaks the groups exploring a single character up into groups exploring the whole scene, with one person from each character group present at least. The students then discuss their original character’s motivation and the textual evidence. The teacher will also further instruct the students to discuss how these characters and their motivation within the scene would interact.

The teacher reintroduces the students to Barton’s directions from Episode 1 of Playing Shakespeare, adding some additional details in the Acting Out Shakespeare handout.

The teacher discusses Barton’s tips and asks how they would further help develop the characters and what effect the development of character has on the play. The teacher is looking for students to connect the audience’s understanding of the play to the actor’s ability to interpret and deliver the playtext.

The teacher leads the class in another reading of III.vii.1-106 either by assigning roles, having students reprise their roles, or asking for volunteers.

The teacher leads a class discussion on the difference in the cold reading to the researched and developed reading.

**Week 3:** The teacher has the students move into their King Lear Video Project groups to discuss their plan and project thus far and checks in with the students on their progress with the assignment and reminds students of the due date of the assignment.

On the day the assignment is due, the teacher has the students move into their project groups and plays the 30 second to 2 minute videos, allowing the student groups to lead the discussion about their video choices.

The teacher provides oral feedback during the discussion as well as written feedback on the video project.

Lesson Plan adapted from Performance Approaches to Teaching Shakespeare.
Character Development: King Lear

Character Name: ____________________  Act: ____  Scene: ____  Lines: ______

What is your character’s background (e.g. age, occupation, favorite things)?

__________________________________________________________________________________________________
__________________________________________________________________________________________________
__________________________________________________________________________________________________
__________________________________________________________________________________________________
__________________________________________________________________________________________________
__________________________________________________________________________________________________

What three quotes (or two quotes, if your character has less than four lines) point to personality traits of your character? What are these traits (name them, specifically – e.g. smart, cunning, sad, etc.)?

__________________________________________________________________________________________________
__________________________________________________________________________________________________
__________________________________________________________________________________________________
__________________________________________________________________________________________________
__________________________________________________________________________________________________
__________________________________________________________________________________________________
What two actors would fit as this character and what qualities do these actors possess that make you think they are right for this part?

__________________________________________________________________________________________________

__________________________________________________________________________________________________

__________________________________________________________________________________________________

__________________________________________________________________________________________________

__________________________________________________________________________________________________

__________________________________________________________________________________________________

In a paragraph, describe what motivates your character throughout this scene:

__________________________________________________________________________________________________

__________________________________________________________________________________________________

__________________________________________________________________________________________________

__________________________________________________________________________________________________

__________________________________________________________________________________________________

__________________________________________________________________________________________________

__________________________________________________________________________________________________

__________________________________________________________________________________________________
What specific textual evidence lead you to this interpretation (cite line numbers)?

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

What five thoughts is this character having throughout this scene?

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
King Lear Video Project

For the past week, we have been using the play *King Lear* to explore how context, background, and character development affect an audience’s understanding of a text. In a group of no less than three and no more than six, you will work together to produce thirty seconds to two minutes of video exploring how the delivery of the lines in *King Lear* effect an audience’s understanding of the play. Your group has two options to accomplish this task:

**Vine:**

Your group will produce a minimum of five videos using the free app Vine. Each video should feature the same lines from *King Lear* being delivered in a multitude of ways. Each member in your group should be featured in at least one video. In class, you will play your videos and lead a discussion on how the delivery of the line in each video changes the meaning of that line, the character delivering that line, the scene in which that line is in, and what effect this has on the play as a whole.

**YouTube.Com:**

Your group will produce one video, a minimum of 30 seconds to a maximum of two minutes, exploring a scene within the play *King Lear*. Each character will make a character choice and stick to it for the duration of the scene. Each member in your group should be featured in the video in some capacity, even if they don’t have lines. In class, you will play your video and lead a discussion on how the delivery of the lines in each video changes the meaning of the lines, the character delivering them, the scene in which the lines are, and what effect this has on the play as a whole.

Projects will not be judged on staging, costume, props, or effects. These videos are only about the delivery of the lines. You may stage the lines any way you wish, but a simple cold reading (e.g. your group sitting in front of the camera and reading the lines) will suffice.

Each group will also turn in a one page paper with all group member’s names on it explaining the choices made within the video in MLA format (refer to MLA guide).

You may choose any Act/Scene/Lines from *King Lear* to explore except those we covered in class: I.i, I.ii, and III.vii.

**Tip:** You may ask for another copy of the Character Development sheet to help develop your character within this project. You should also refer to your Acting Out Shakespeare handout to help make choices about the characters and the lines.

Due Date: ________

Group Members:
Acting Out Shakespeare

John Barton is a director known for his work with the Royal Shakespeare Company after co-founding it with Peter Hall in 1960. Barton directed Royal Shakespeare Company productions for over 40 years and has been given much credit for the success the company has celebrated. In the series Playing Shakespeare, Barton and actors explore ways of interpreting Shakespeare’s text and how an actor and director’s interpretation and delivery of the text affects the audience’s understanding of character. Below are some quotes from Barton’s BBC series that will be helpful in your King Lear Video Project.

Quote: “Each actor and his experience is worth many books.” – John Barton
In my own words:

Quote: “What is our motivation? Our objective or our aim or our intention?” – Ben Kingsley
In my own words:

Quote: “Though we are exploring something complex, we ought to make it simple.” – John Barton
In my own words:

Quote: “I don’t believe that most audiences really listen to a complex text unless the actor makes them do so.” – John Barton
In my own words:

Quote: “Until we love individual words, we won’t love language and if we don’t, we won’t be able to use it properly.” – John Barton
In my own words:

Quote: “Each new word in a sentence qualifies what has gone before or changed the direction of that sentence.” – John Barton
In my own words:
Quote: “There are few absolute rules about playing Shakespeare, but many possibilities.” – John Barton
In my own words:

Quote: “Suit the action to the word, the word to the action.” – Hamlet from Hamlet
In my own words:

Quote: “It’s so easy to play a kind of summary of a speech and not to discover it for the first time it is spoken line by line.” – John Barton
In my own words:

Quote: “A set speech must move and take the audience with it.” – John Barton
In my own words:

Extra Credit: Go to Youtube.Com and watch Playing Shakespeare Episode 2: Using the Verse or Episode 3: Language & Character. Write a brief synopsis on the back of this page, including three quotes you found particularly helpful and name two scenes which were acted out using Barton’s advice.
Discussion

For the performance classroom, there are methods of integrating technology through the use of digital platforms that fit well with the model. These recommendations are not based on hardware, outside of a computer and projector within the classroom, nor are they based on any specific use of software. Instead, these methodologies represent technological concepts that can be executed through different digital means and platforms. The first proposed technology-based addition to the performance model of teaching Shakespeare within a secondary school setting comes in the form of wikis. A classroom wiki is defined by Elizabeth D. Weber, author of "Lighting Their Own Path: Student-Created Wikis in the Commedia Classroom," as the following:

[A] series of collaboratively created web pages that may contain text, images, videos, and links. In a classroom context, the wiki is usually thematically linked to the specific course content. The instructor establishes the parameters for the wiki (desired scope of project, teacher-produced content, pages assigned to students or groups of students), and then the pages are individually or collaboratively created and edited by the students as well as by the teacher. Completed wikis may look quite sophisticated, but they are designed for ease of use by the non-tech-savvy; the technical side of setting up a wiki requires no more expertise than creating, naming, and saving a document (126).

The wiki creates a collaborative online environment for students to research, contribute, and create content. This content isn’t limited to the realm of writing for students can incorporate images, videos, links, and cited material into the wiki content. The wiki is a powerful online tool for any classroom for its collaborative and creative nature allows students to take possession of the content they contribute and connect it with the materials they are studying. These wikis are also free to create, and there are many websites available for hosting such as PBWorks.Com, WikiSpaces.Com (Weber 129). Weber further notes that, “the most successful aspects of the wiki are how effectively it allows students to pursue and share individual research, how personally invested in the project many of them become, and how spontaneously students collaborate with each other and comment on each other’s work” (126). The use of the wiki in the classroom meets the spirit of the Common Core for it encourages collaboration, critical thinking, creativity, and cooperation at every level of its creation.

The wiki fits in well with the performance model of teaching Shakespeare because it allows students to explore Shakespeare’s text on a magnified level and build a community around sharing their explorations. Depending upon the theme of the classroom wiki, students can explore and build a community around a Shakespeare play, characters, modern performances, history of performances, film adaptations, open and mandated choices within the text, the differences between the quarto and folios of the same play, and so much more. The power of the wiki comes from its flexible nature. The expansive nature of the wiki allows students to build upon the content continuously throughout the course. The teacher can control and edit the content while students can contribute and build off of each other’s knowledge at their own volition. At the end of the wiki project, the students will have a community full of wealth of information they took ownership of through the act of creation, which will overall help them feel more connected to and deepen their understanding of the text.

Blogs, or online journals, can also offer a lot to the performance classroom while engaging with the spirit of the Common Core. Gee, in his book The Anti-Education Era: Creating Smarter Students through Digital Learning, advocates for an online space he calls an
“affinity space” which are “places where people can go to share resources and values and flexibly form and re-form in different groups. The place or space can be an Internet site, a real place, or a combination of the two” (166). Gee goes further and notes that these spaces are “key examples of synchronized intelligence” where students of different skill levels enter, by choice, and share a common interest or endeavor because they have a passion for what they are entering the affinity space for. Blogs are places where students can engage in critical thinking, creativity, and often, depending upon the assignment, collaboration and cooperation. Outside of the classroom wiki, blogs fit well with his vision of an affinity space for blogs allow students to coordinate their concepts within a play in a concentrated forum.

Blogs, like the wiki, can change thematically and be used by the teacher within the performance classroom with a great degree of flexibility and there are many free platforms available for the execution of the classroom blog, such as WordPress.Com, Blogger.Com, and Tumblr.Com. The degree of interaction between students and their blog posts can also be controlled by the teacher. For some assignments, students can have public blogs in which they can view and comment on each other’s works, and for other assignments student blogs can remain private and only viewable by the teacher. This allows for a great variety of subject matter to be covered, from collaborative material like interpretations of a specific action and its overall impact on the rest of the play to connecting with themes on a personal level and writing about how those themes are prevalent in modern day or the student’s own life.

The performance model of teaching Shakespeare recognizes the nature of a playtext in that it is both the potential for action and the written word. Because Shakespeare’s texts have multiple versions, and because editors have, overtime, added punctuation, entrances, exits, and asides (amongst other stage directions within the plays), the version of the play used in the realization of the play greatly affects the performance of the play. For students to explore this varying nature of the playtext within a single play, digital archives can allow students to make side-by-side comparisons of the text and visually explore these differences. The digital archive is used by Joanne T. Diaz, author of “The Digital Archive as a Tool for Close Reading in the Undergraduate Literature Course.” Her classroom explores the use of digital archives to engage students within close reading exercises with multiple versions of the same text. Her classroom’s focus is mainly on poetry, but Shakespeare’s playtext can be used in much the same fashion.

Close reading is an approach to text that is often used in the performance classroom, and this exercise in reading also enhances a student’s critical thinking skills. Diaz uses EEBO, or Early English Books Online, to host her archive of poetry. The use of this already creative archive for the performance classroom is ideal, because, as Diaz states:

EEBO is the most recent manifestation of a decades-long campaign to salvage early modern English artifacts. In the 1930s, Eugene Power, concerned about the survival of valuable books in the British Museum, founded University Microfilms International to preserve these artifacts on microfilm. Early English Books was the result: a microfilm edition of the thousands of printed works listed in the Short Title Catalogue, a remarkable inventory of all of the letterpress materials published in English, in both Great Britain and its dependencies, between 1473 and 1700(426).

Students can, through the use of these archives, explore the different quarto and folios of Shakespeare’s texts and engage in close reading with well-preserved, archived versions of their text. This can be replicated in the classroom, but in the digital forum it is easier for students to compare and contrast pages side-by-side on a screen rather than flipping through a book containing

[references]
the multiple versions of the playtext or holding two books side-by-side to compare. The digital archive, as well as the blog and the wiki, replicate aspects of the performance model while fitting with the mission of the common core all while being a tool that enhances student learning.

One drawback to EEBO is the price. If a school already has access to it, then price would not be an issue, but in many cases, EEBO may be out of the price range of teachers within a classroom. While EEBO has an extensive digital archive, there are alternatives that are readily available online with free access. For Shakespeare texts, the British Library has a digital collection of Shakespeare’s plays, both in quarto and folio forms, available for people to access without charge. An additional benefit of this site is a feature that allows students to select more than one text to view in a comparison window. There are also multiple websites, such as The University of Victoria online Shakespeare library, that offers plain text versions of the quarto and folio versions of Shakespeare’s plays. These plays are clearer and easier to read on the computer, for students who may have problems reading the text on the digitally archived book pages.

The performance aspect of the performance model of the Shakespeare classroom is based in the physical and visual actualization of the playtext into a play, and sites like Youtube.Com and applications like Vine allow students to create video-based content that is easily shareable in any classroom. Dylinda Younger, Jan Duncan, and Latoya Hart explore the use of Youtube.Com within a classroom in their article, “Tuning into Youtube in the Classroom: Improving Student Assessment Scores through Social Media.” The authors state that:

One important aspect of effective online teaching is that learning involves the student’s ability to take responsibility for their learning through interactive means (Richardson, 2006). Because YouTube is a free online tool that requires very little technological savvy or experience, it stands to reason that the incorporation of this tool in online classrooms would be helpful for students who are preparing to enter the education field (4).

Stated simply, online videos allow students to create sharable content with little or no technological foreknowledge. These video projects can be collaborative and cooperative in nature, but can also be individual projects that just express the creativity and critical thinking skills of the student or students involved.

The creation of these online videos also offers the students multiple approaches to take throughout the creative process, depending upon teacher instruction. For example, if a teacher assigns something straightforward like the blocking and acting out of a scene, the students can simply replicate a stage performance on video. But the teacher can take advantage of the power of the medium of video to go further than mere staging. Students can create video montages of a soliloquy from Hamlet done by multiple actors in different performances and compare and contrast how the soliloquy is delivered within the same project. The students can also use a similar montage to explore costuming, staging, casting, and a number of other performance-based aspects that the performance model explores within the classroom. Making these reports visual instead of on the spot oral or performance-based allows students more control over the delivery of the content and how it is viewed by the audience. While in-class performances offer students a chance to collaborate on some aspects of what goes into a performance from an actor’s perspective, a director’s perspective, or an audience member’s perspective, online mediums like YouTube.Com gives students the chance to pursue all three aspects of performance in one project.

Technology is a tool that can be used by teachers in the performance classroom to enrich the learning
environment for the students as well as meet the standards set forth by the Common Core. While there is a plethora of hardware-based technology out there, some specifically designed for the classroom and some that classrooms attempt to adapt for the sake of education, some of the best tools for the classroom are available on the internet, which makes them widely available for both student and teacher use. These online tools can be used to replicate and enhance many aspects of the performance model, such as exploration of the medium of drama and close reading. It is important to carefully weave technology into the classroom because it is through the classroom use of technology that students can learn how to use technology as a tool rather than allow it to hinder them from their future studies and careers.

References


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performed. Both the book and the digital archive can be
used to read and perform with one another. Both the
materials allow for a great variety of subject matter
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