The Density Bias

- The density bias occurs from over- or under-estimation of numerosity based on stimulus spacing.
- Human infants and some primate species preferentially choose densely arranged food or inedible items of equal or lesser value than a comparison set (perceived as more numerous), but human adults show the opposite effect in non-foraging tasks.
- Sensitivity to density during foraging has proven to be an important variable in the balance between quantity discrimination and processing time (optimal foraging theory). A density bias can lead to more calorie intake obtained via less effort.
- Whether the density bias emerges across domains (computerized or edible stimuli) and age groups will shed light on factors impacting quantity discrimination abilities and foraging habits.
- The current project will build off of previous comparative work with nonhuman primates and extend this research to the developmental domain.

Previous Comparative Work

- Parrish et al. (2017) reported the density bias among capuchin monkeys (Sapajus apella) and rhesus monkeys (Macaca mulatta) using a computerized relative quantity task.
- Parrish et al. (2020) reported the density bias among capuchin monkeys using natural, edible stimuli using a two-choice discrimination task.
- In both studies, monkeys preferred denser to sparser sets of equal quantity in line with previous work on infants and callitrichids.
- There also was a facilitative effect in choosing the larger food set in mixed trials (sparse vs. dense) if the larger set was densely arranged (Dense More).
- These results suggest that the density bias emerges across multiple domains and presentation formats for some primate species.

Food Density (Parrish et al., 2020)

In control trials for both spatial layouts, monkeys performed above chance in selecting the larger set.

- There also was a facilitative effect in choosing the larger food set in Dense More trials and a disruptive effect in Sparse More trials.
- Capuchin monkeys displayed a density bias in Equal trials, preferring dense arrays to sparse arrays.

Food Density (Parrish et al., 2017)

Both species of monkey performed better in Dense Control vs. Sparse Control trials (density aids quantity discrimination).

- Discrimination of true quantitative differences was enhanced when the larger set was densely arranged (Dense More).
- Capuchin monkeys displayed a density bias in Equal trials, preferring dense arrays to sparse arrays.
- Rhesus macaques did not display the density bias at group level, but individual differences.

References

Comparison of Methods of Generating Photon Radiation in Hadron Scattering with Varying Quark Mass
Matthew Dittrich and Dr. Scott Yost
The Citadel: Department of Physics

Abstract
In this study, we examined the effect of different methods of generating photon radiation in hadron scattering at Large Hadron Collider (LHC) energies for various types of quarks. We used two sets of parton (quarks and gluons) distribution functions (PDFs) to represent the momentum distribution of the quarks and antiquarks inside the colliding protons. The first PDF neglects any photon emission from the quarks, but the newer LuxQED accounts for the effect of photon emission on the quarks momenta. Lastly, we use a program called KKMC-hh which accounts for the photon radiation and is intended for high precision LHC studies.

Background
The Large Hadron Collider (LHC) is the largest ring of the CERN complex (see Fig 1). Here, beams of protons are smashed together at over 99.999% the speed of light with a center of mass energy of 8 TeV. When these beams collide, particles of different charge, mass, and momenta will be created. It is the job of the physicist to examine the data and determine what is happening during these complex collisions.

For theorists, simulating these collisions (using parton distribution functions [PDFs]) is an extremely useful method to uncover what is happening and what is significant at these higher energies. These PDF functions are based on experimental results, and they give us the probability to find a quark in a hadron as a function of the fraction of the quarks momenta in the proton.

For our research, we are specifically interested in the different methods of generating photon radiation in hadron scattering simulations. As shown in Figure 2, we will be simulating the collision where a quark and an anti-quark annihilate each other to produce two leptons (muon and antimuon).

Results
We should first examine Table 1 as this clearly depicts the relative contributions and their shifts due to ISR. On average, there seems to be around a 0.5% shift due to ISR and there is an average 0.1% difference between LuxQED and KKMC-hh. From Table 1, we should also note how the up quark has the biggest contribution, and it has the highest average shift from photon corrections. This makes sense as the up quark would be the most common quark during a proton-proton collision. Also, the up quark has twice as much charge as the down quark, so it should have a greater effect from photonic radiation. This same case can be said for the charm quark. It displays a large effect from photonic radiation (approximately 0.8%) due to its higher charge. Lastly, we should notice how the strange quark has a positive shift for LuxQED (this can also be seen in Fig 7). For future work, we will investigate to see if the strange quark displays this behavior with other parton distribution functions.

Table 2 shows that there is not a significant change in the invariant mass of the muon pair from the effects of initial state radiation. We have small, but negligible shifts. It should be noted that for most of these shifts, the error is comparable to the actual shift.

Discussion
Three Approaches to Photon Radiation
- **no ISR:** Traditionally, photon radiation from the quarks has been neglected because the effect is less than 1% of the force between quarks and gluons. This approach uses NNPDF parton distributions with no photonic corrections.
- **LuxQED:** A version of NNPDF now exists with "LuxQED" corrections to account for photon radiation from the quarks along the beam axis. This approach uses these distributions with no photons from KKMC.
- **KKMC-hh:** This is a precision event generator for electroweak and multi-photon radiation in Z production and decay. Standard NNPDF distributions are used, and photon radiation is simulated by KKMC-hh which, unlike LuxQED, is not limited to collinear radiation.

Acknowledgements
I would like to especially thank Dr. Yost for teaching and mentoring me throughout this project. I would also like to thank the Citadel’s Department of Physics for providing material and support when needed. Lastly, I would like to thank Dr. Garner and the Citadel SURE program for funding this project.

References
The Citadel: Department of Physics.
The shortage of minority health professionals in the United States is a long-standing problem. Because racial and ethnic minority youth are less likely to have college educated role adult models, they may have a disproportionate lack of access to the cultural capital that is required to develop and implement plans for achieving a college degree. Hispanic youth, especially, may experience the social and economic consequences of immigration and acculturation. Educational disparities across race and ethnicity and SES emerge as early as grade school and may have lasting effects. Insufficient preparation and low achievement before secondary school can hinder a student’s ability to complete higher level math and science courses necessary for science related degree programs. Under-represented minorities (URM) and low-income students are more likely to have problems related to preparedness and less likely to have access to high quality science teaching and curricula than other students. Middle and high school students of color are more likely to rely on counselors and other school resources for information about colleges and careers. Yet these resources are likely to be inadequate or unavailable in Title I schools. There are a number of psychological barriers for URM to achieve these resources are likely to be inadequate or unavailable in Title I schools. There are a number of psychological barriers for URM to achieve STEM related degrees. These include self-efficacy, identity threat, values orientation, motivation and self-regulatory processes. Cognitive skills such as attention, concentration, goal awareness, self-monitoring toward goal progression, and problem solving are also barriers. Self-regulation above all others predicts academic performance and retention.

HYPOTHESIS

There are barriers that prevent underrepresented minorities from being accepted into STEM majors in college.

METHODS

A search of the literature was conducted using the databases of PubMed and PubMed Central using the key terms careers in health, minority groups and developmental stages. Thirty articles met the inclusion criteria. A review of abstracts narrowed the number to 18 final articles. Inclusion criteria included middle and high-school students. Articles that described studies done once the student had been admitted to college were excluded.

DISCUSSION

A key finding across all studies was the lack of continuity of services. Programs were implemented that provided a week long summer immersion on college life or time-limited tutoring programs. However, the literature did not support ongoing and sustainable programs that provided support from early identification of minority students interested in STEM majors through to college acceptance.

| 1. Financial burden |
| 2. Family support |
| 3. Quality of pre-college advisement |
| 4. Self-sufficiency |

References


Phytogeography analyses of Coccoloba uvifera (L.) sampled across the Caribbean Basin

Benjamin K. Scott, Logan A. Dix, Derek P. Webster, Isabella Gustafson1, Dr. David M. Donnell, & Dr. Danny J. Gustafson, Department of Biology, The Citadel, Charleston, SC 29409. 1Science Marine, University of South Carolina, Columbia, SC 29208

Abstract
Coccoloba uvifera (sea grape) is a tropical member of the Polygonaceae family and a significant component of coastal habitats along the Atlantic, Caribbean, and Pacific coasts of the neotropics. This native tree species occurs at the beach—forest transition where it provides important habitat and food for animals, stabilizes habitat during tropical storms, and has been shown to improve sea turtle nesting success relative to nesting on exposed beaches. We analysed chloroplast DNA collected from C. uvifera leaves from mainland (Belize, Panama) and island (Aruba, Antigua, Trinidad, Tobago, and the Bahamas) locations across the neotropics. Five plastid DNA sequences (four intergenic regions and ndhIntron) were concatenated for each of 33 individuals, yielding individual concatenated sequences approximately 4701 base-pairs in length with 21 variable and potentially informative sites. Eleven insertions/deletions (INDELS) were assessed by the simple gap coding method. Haplotype network analysis identified 19 haplotypes from the 33 individuals sampled. Genetic relationships among haplotypes were complex, although plants from Belize and the Bahamas were generally different from Aruba, Antigua, Panama, Trinidad, and Tobago plants. Haplotype sequence one was shared by six plants (Aruba-1, Antigua-2, Trinidad-1, Panama-3), while sequence two (Trinidad-1, Tobago-3) and sequence three (Aruba, Trinidad, Tobago) were only shared among Lesser Antilles Islands. Bayesian Phylogeographic Coalescent Analysis indicates two broad groups (Bahamas, North and Central America; Lesser Antilles and Aruba) approximately 1.2 mybp (million years before present), with significant island/source spatial structure within the last 50,000 to 300,000 ybp. There was a negative relationships between sequence diversity and hurricane frequency.

Background
Coccoloba uvifera (L.) is a member of the Polygonaceae (buckwheat) family and is a significant vegetative component of coastal habitats along the Atlantic, Caribbean and Pacific coasts of the neotropics (Parrotta 1994). This dioecious tree grows in the harsh salt environment at the transition between beach and forest, it provides physical protection of beach habitats during tropical storms, and it is important habitat and food for animals (little and Wadsworth 1964). The wood has been used for carvings (local art), limited artisan furniture, red sap to tan leather, and the edible fruits are consumed directly or made into jelly and wine (Little and Wadsworth 1964). The wood has been used for carvings (local art), limited artisan furniture, red sap to tan leather, and the edible fruits are consumed directly or made into jelly and wine (Little and Wadsworth 1964). The wood has been used for carvings (local art), limited artisan furniture, red sap to tan leather, and the edible fruits are consumed directly or made into jelly and wine (Little and Wadsworth 1964). The wood has been used for carvings (local art), limited artisan furniture, red sap to tan leather, and the edible fruits are consumed directly or made into jelly and wine (Little and Wadsworth 1964).

Methods
The genetics of C. uvifera are complicated by unresolved phylogenetic relationships within the genus, the complex ploidy level (2n=132), and the potential for hybridization with closely related species (Graham and Wood 1965). In angiosperms, the chloroplast and mitochondria are maternally inherited and the degree of genetic structure shaped by organelle DNA is a record of seed dispersal. In this study, we used five genes to characterize the genetic structure. Haplod network analyses were conducted on 49 individuals from 11 sources, with 4700 base pairs and 15 individuals (Leigh and Bryant 2015). Bayesian phylogeographic coalescent analysis was performed using version BEAST 2.6.

Results
• Chloroplast nucleotide diversity was negatively correlated with total number of hurricanes passing within 300 km (1980-2019) (Table 1).
• Coalescent theory suggests that ancestral haplotypes will be broadly distributed and shared by multiple individuals relative to more derived haplotypes. Haplotypes from the island sources (Antigua (AG), Aruba (AW), Jamaica (JM), Trinidad (TR), Tobago (TO)) account for 22 of the 26 individuals represented by 11 haplotypes.
• Haplotype network analysis indicates two broad genetic associations, with Yucatan peninsula samples (Mexico, Belize), Bahamas, and Florida samples segregating from the other sources (Fig. 4).
• Bayesian Phylogeography Coalescent Analysis indicates two broad groupings dating back 1.2 mybp. Genetic structure at the island or source level occurred within the last 50,000 to 300,000 ybp.

Hypotheses
1. Hurricane will effect chloroplast genetic diversity.
2. Hurricane will effect Coccoloba uvifera L genetic structure across the Caribbean.

Table 1. Chloroplast genetic diversity measures based on 10 sources and the number of hurricanes (cat.1-5) passing within 300 km (1980-2019). There was a significant negative Spearman’s correlation (r= -0.709, P=0.01) between nucleotide diversity and hurricanes.

<table>
<thead>
<tr>
<th>Source</th>
<th>Haplotypes</th>
<th>Polymorphic</th>
<th>Nucleotide Diversity</th>
<th>Hurricanes</th>
</tr>
</thead>
<tbody>
<tr>
<td>AG</td>
<td>7</td>
<td>3</td>
<td>3.76E-04 (1.00E-04)</td>
<td>36</td>
</tr>
<tr>
<td>AW</td>
<td>5</td>
<td>3</td>
<td>3.83E-03 (1.36E-03)</td>
<td>29</td>
</tr>
<tr>
<td>BS</td>
<td>5</td>
<td>5</td>
<td>2.37E-03 (1.52E-03)</td>
<td>55</td>
</tr>
<tr>
<td>JM</td>
<td>5</td>
<td>3</td>
<td>5.74E-04 (2.42E-04)</td>
<td>28</td>
</tr>
<tr>
<td>PA</td>
<td>4</td>
<td>4</td>
<td>2.49E-04 (1.90E-04)</td>
<td>30</td>
</tr>
<tr>
<td>TR</td>
<td>5</td>
<td>5</td>
<td>6.15E04 (4.45E-04)</td>
<td>16</td>
</tr>
<tr>
<td>TO</td>
<td>4</td>
<td>5</td>
<td>2.05E-02 (0.00E-02)</td>
<td>60</td>
</tr>
</tbody>
</table>

Figure 2. The number of Hurricanes (Cat. 1-5) since 1900. Colored lines represent each hurricane’s path. https://coast.noaa.gov/hurricanes/

Figure 3. The distribution of cpDNA haplotypes within and among Coccoloba uvifera populations sampled across the Caribbean Basin. Five non-coding chloroplast genes (4684 bps) and 15 INDELs were used to haplotype 49 individuals sampled from 11 locations across C. uvifera’s home range. Pie charts represent the number of haplotypes per source.

Figure 4. Haplotype analysis based on sequence and INDEL relationships. Each hash mark shows a mutation separating those that share that haplotype. This research was funded by grants from The Citadel Foundation.

References

Acknowledgements
The authors thank Billy Ellison, Helga Haplin, Henry Hill and Grace Wihart for extracting genomic DNA and Dr. Howard Diamond (Climate Science Program Manager at NOAA’s Air Resources Laboratory) for providing the hurricane data. This research was funded by grants from The Citadel Foundation.
Enterococci and Fecal Coliforms are all potentially harmful bacteria. Through sampling and monitoring the levels of these bacteria in the increasingly frequent floodwaters of the Charleston area. These bacteria are found in the waste of humans and animals and can live and multiply in brackish waters.

Vibrio have no government regulation for

\[ \text{VIBRIO} \]

Fecal Coliforms, Vibrio parahaemolyticus, V. vulnificus, V. cholerae, and Enterococci are all potentially harmful bacteria. Through sampling and monitoring the levels of these bacteria in the increasingly frequent floodwaters of the Charleston area. These bacteria are found in the waste of humans and animals and can live and multiply in brackish waters.

**Health Implications**

- **Vibrio**
  - Are capable of inflicting serious harm onto the body by breaking down bodily tissues in open wounds, sepsis, gastroenteritis from ingesting infected shellfish.
  - Enterococci
  - Indicators of fecal contamination, rarely cause illness in those exposed to this bacteria.
- **Fecal Coliforms**
  - Naturally found in the body in the intestines and other digestive tract locations but can cause illness if the body is unfavorable exposed, and some species can cause blood infections and wound infection, meningitis, diabetes, UTI, etc.

**Nuisance Flooding**

Occurs throughout the city of Charleston, oftentimes completely engulfing roads and side walks, more importantly areas where the sewer systems run throughout the city.

- Charleston is approximately 19.6 feet above sea level on average. This low elevation allows storm and tide flooding to occur frequently in many areas throughout the city.
- King Tides and storms result in flooding and the inoculation of coastal waters that recede back into surround waterways with Vibrio, Enterococci, and Fecal Coliforms
- Through climate change increasing the sea levels, nuisance flooding is 300-900 times more likely to occur now.

**Methods**

Methods for collecting samples, processing samples, and recording data are based on limitations directly decided on by Standards Methods For Examination of Water and Wastewater.

**Outcomes**

Our main goal is to produce quantitative results on the findings of the various bacteria to produce a interval by which we can examine how contaminated water is surrounding Charleston

- The results can allow us to present this and raise awareness to the public health and water quality agencies governing.
- The results will reveal that we have safe levels of bacteria within our floodwaters and the levels do not pose a potential health hazard.
- Either of the results will lead to future research based on the implications of increasing sea levels and more potential for coastal water contamination.

**Resources**

- Charleston Area Sea Level Rise, gis.charleston-sc.gov/interactive/SLR/
- "Bacteriologic Water Quality in the Charleston Area Sea Level Rise, gis.charleston-sc.gov/interactive/slr/.
- "Climate Change: Global Sea Level: NOAA Climate.gov." Climate Change: Global Sea Level: NOAA Climate.gov.
as%20neonatal%20meningitis
as%20neonatal%20meningitis
- "Public Health Implications of Increasing Sea Levels and More Potential for Coastal Water Contamination." https://emedicine.medscape.com/article/217485-overview#:~:text=Escherichia%20coli%20is%20one%20of,
as%20neonatal%20meningitis
- Lorem
The COVID-19 Pandemic has been felt across the world. The virus has left us with many questions regarding the effectiveness of social distancing and lockdown orders along with the growth of the virus. Through this project, we attempt to understand these questions in two parts:

1. Develop periodic mathematical models using the data reported in the southeastern region: NC, SC, TN, GA, and FL to determine the effectiveness of social distancing protocols in these states.

2. Create a dynamic mathematical model using the same data to predict the future trends of COVID-19.

Our project focuses on the states of North Carolina, South Carolina, Tennessee, Georgia, and Florida from March 4th to July 20th 2020. Our goal is:

- To determine the effectiveness of social distancing measures and lockdown orders
- To predict the behavior of the Coronavirus in these five states.

Our project consists of two main steps:

- Develop the periodic linear, quadratic and exponential models using regression method with data reported by the COVID Tracking Project [12] for the five states and use the developed models to analyze the effectiveness of social distancing measures and lockdown orders.
- Develop a dynamic mathematical model to predict the future growth of the Coronavirus in these five states.

## Introduction

Our project consists of two main steps:

1. Develop periodic linear, quadratic and exponential models using regression method with ten consecutive data points $(x_i, y_i)$.
2. Develop a dynamic mathematical model to predict the future growth of the Coronavirus in these five states.

### Lockdown Efficacy

The table below gives the mathematical model chosen for each state for each period $L$ is the linear model, $Q$ is the quadratic model, and $E$ is the exponential model. The graphs to the right are examples of three periods for a selection of the states and are representative of the models developed in the five states. The first graph showcases COVID-19’s exponential growth in NC before the lockdown was implemented. The graph below showcases the lockdown’s effect on the growth rate in SC during the lockdown; the growth shifted from an exponential increase to a constant increase, as seen in the linear model. The final graph shows how the growth of the virus’ infected population increased post-lockdown in Florida. Though the rate was not as great as before the lockdown, the rate is substantially more than during.

The effectiveness of the lockdown is highlighted by extending the linear models to the end of the test period on the 20th of July. In the table under Lockdown Efficacy, we see that the cases would have been substantially less than the total cases from after the lifting of the lockdown. We conclude that the lockdown is shown to be effective while in place.

Due to the changing conditions surrounding the virus, such as the imposing and lifting of the lockdown, the periodic models are not able to accurately predict the future behavior of the virus. Therefore, we created the dynamic model. The dynamic model was successful in predicting the COVID-19 trends. It was able to accurately predict the next approximately 17 days given 10 previous consecutive days of data. The longevity of the dynamic models, when combined with its inherent accuracy, allows the future behaviors of the COVID-19 virus to be modeled successfully, giving us better understanding of how the virus will spread.

In the results section, we show that our developed models fit well with the given data. However, each of these models could not give us a clear projection of the growth rate of the infection from one period to the next and the future. In order to have more accurate predictions, we created a dynamic model.

### Dynamic Model

The goal of the dynamic model is to closely predict the future trends of the coronavirus based on previous data. For this model, we developed an algorithm that was implemented in the software MatLab. The steps for the algorithm are as follows.

1. Create linear, quadratic, and exponential models using the regression method with ten consecutive data points $(x_i, y_i)$.
2. Calculate $R^2$ value for each regression.
3. Choose one of these models $f(x)$ is chosen for this period.
   a. This model is exponential if the $R^2$-value of the exponential model is at least .02 greater than the $R^2$ value for the linear model .
   b. This model is quadratic if the $R^2$ value of the quadratic model is at least .01 greater than the $R^2$ value for the linear model.
   c. This model is linear if the exponential and quadratic models are not chosen in (a) and (b), respectively.
4. The chosen model is then tested with data from the days after this period and a relative error $|y_i - f(x)|/y_i$ and an absolute error $|y_i - f(x)|$ are calculated. The model is continued for the next day if the relative error is less than 10% of $y_i$ or the absolute error is less than 6. Otherwise, a new model is generated starting at the current day.

In the results section, we show that the algorithm gives accurate predictions in line with the data.

## Methods

### Periodic Models

The first type of model created for each state was a periodic mathematical model in three periods for the growth of the COVID-19 virus:

1. Before the lockdown and social distancing was implemented.
2. During lockdown
3. After lockdown and during protests

The goal is to see how well the regression model fits the data. If the $R^2$ value is 1, then the model fits the data perfectly.

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## Results

The data, $(x_i, y_i)$, presented in our work is from the COVID Tracking Project [12] where $x_i$ is the ith day since the start of the earliest COVID-19 infection in the five states and $y_i$ is the number of cases per 100k population in the state on the ith day.

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In the results section, we show that the algorithm gives accurate predictions in line with the data.
Efficient Detection of Phishing Emails using Email DNA of a User

Cadet Jared Johnson, Cadet Eric Lilling, Dr. Shankar Banik, Dr. Deepti Joshi

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ABSTRACT

Social Engineering Attacks are getting more common for public and private domains. Spear Phishing is one type of social engineering attack where an attacker poses as a legitimate entity to influence the actions of a user in an organization by sending phishing emails. Usually spear phishing emails contain links that are intended to compromise user information for malicious purposes. Current tools detect phishing emails by scanning for embedded links or attachments. But they fail to detect a phishing email that does not contain any links or attachments. In our research we propose to develop an email-DNA for each user that will uniquely identify the user through their writing features, habits, styles, and composition. After we develop the email-DNA, we will deploy our model on a real dataset to test its efficiency and effectiveness. We will use Python tools and Enron and Monkey.org Phishing Datasets.

BACKGROUND

Everyone writes differently, while responding to colleagues or addressing their superiors. We seek to take advantage of this fact to cut phishing and spearphishing attempts off at the source: at the user’s end, before a phishing attempt has the chance to do damage.

METHODOLOGY

For our project, we first conducted literature review of publications regarding authorship attribution and deriving stylometric features from a user’s writing. Next, we located a set of data that we could use to test any models that we created with. The dataset that we used was the Enron Email Database. Now, we are utilizing Python to generate a model to extract stylometric features from the users in our dataset.

IDENTIFIED FEATURES

- Average Email Length
- Average Word Length
- Average Words per Sentence
- Average Sentences per Email
- Average Word Complexity with Stopwords
- Average Word Complexity w/o Stopwords
- Vocabular Richness
- Commonly Used Words by User
- Number of Line Breaks
- Number of Lines in Email
- Number of sentences
- Number of Characters in Words
- Number of Alphabetic Characters in Words
- Number of Upper-Case Characters in Words
- Number of Special Characters in Words
- Number of Digits in Words
- Number of Connective Clauses
- Number and Type of Writing Errors

LITERATURE REVIEW

Most of the literature that was relevant to our research had the focus of “authorship attribution”, which focuses on being able to “attribute” a particular piece of writing to an author. The most integral piece of literature to our research was A Survey of Modern Authorship Attribution Methods by Efstathios Stamatatos, which lead us to numerous other documents regarding authorship attribution as well as numerous breakthroughs in stylometric features and their effectivity. This paper also detailed the tools that Stamatatos used to create these features, which was extremely helpful with the implementation of code. Another author of note is Moshe Koppel, who is included in multiple papers regarding authorship attribution. In Exploiting Stylistic Idiosyncrasies for Authorship Attribution, Koppel and Schler highlight something that we had not considered before, utilizing common errors by the user to better identify them. Our literature review is still ongoing, as we continue to flesh out further stylometric features that will help us grasp a better understanding of how to identify who is and is not the author of an email.

FUTURE WORK

In the future, we seek to further the generation of Stylometric features for each user in our dataset as well as collecting and generating metadata for each user. These pieces will allow us to generate a more robust and effective model for our EmailDNA. After the model is created, we should be able to deploy it on a more active scenario and be able to bring a stop to the majority of phishing attempts in the cyberspace.
Abstract
Charleston is known for its coastline and rivers. The banks of these rivers are blanketed in a uniquely sticky soil known as Pluff Mud. Sufficient research does not exist on the geotechnical properties of Pluff Mud. Further pioneering geotechnical data on this soil could allow the material to be considered for construction, environmental, geotechnical and other engineering and scientific applications. Six samples, shown in Figure 1, were collected to represent Charleston County, Dorchester County, and Berkeley County. Laboratory soil tests were conducted to estimate index properties, organic content, compaction properties, specific gravity, shear strength, consolidation, and shrinkage/swell potential.

Sampling Methods
Potential sample locations in each county were identified by satellite imagery. Each site was investigated during low tide. All the samples were collected in the intertidal zone where the soil is above the water level at low tide but underwater at high tide. Care was taken to avoid collecting samples within the root mat of the Spartina grasses. Locations where the root mat had eroded to reveal the Pluff Mud beneath were ideal sites to sample as illustrated in Figure 2.

Testing
The first step in testing was to determine index properties. Figure 4 shows samples prepared by drying and sieving for Atterberg limits, hydrometer, specific gravity, and organic content.

Additional samples were cast and slowly dried to create pucks which were then coated in wax for shrinkage testing by submersion as shown in Figure 5 below.

Work in Progress
We are continuing to perform compaction, shear strength, and consolidation testing. We are also preparing a paper with the goal of beginning the publication process at the end of the Fall 2020 semester.

References
2. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
3. ASTM D7928 Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis
5. ASTM D2435 Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading
Cooling Effects of Street Trees in the Urban Heat Island (UHI) of Charleston, SC

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Civil & Environmental Engineering, The Citadel

Abstract
The effects of the UHI of Charleston comes from its rapid growth in population. Because of the rapid growth, the city experiences changes in climate through its rising sea levels and increased flooding. Sensors are mounted on live oak and crape myrtle trees to quantify the changes in air temperature, relative humidity, and dew point. They are then calculated into the Rothfusz regression to get a heat index. The heat index gives a better indicator of the body's perceived temperature or the "Feels Like" temperature. The heat index for the trees is relatively similar. The crape myrtle heat index is 36.08°C and the live oak heat index is 35.93°C. Street tree findings could prove useful for city planning in cities experiencing growth.

Methodology
The area of focus is near Hampton Park, near downtown Charleston, SC. The selected trees are located on the south side of the park, along Moultrie Street. Trees with mounted sensors are on the residential side of the road. The two selected trees are the Lagerstroemia, or the Crape Myrtle, and the Quercus Virginiana, or the Southern Live Oak. These trees are two of the most common street trees in Charleston. Both trees have distinctive features, such as its canopy size and height, that are hypothesized to create variances in the data. Data is collected through mounting sensors on the tree near the south side of Hampton Park. The sensors are mounted vertically on the tree to prevent any alterations to the tree. Each sensor is mounted with arbor ties and 2x4's to secure them onto the tree in a way that minimizes harm to the tree. Each sensor has a radiation shield to collect raw data, eliminating direct sunlight. Sensors attached to the trees log data from the HOBOware app in 30-minute intervals daily. After extracting the data from the app, it is then uploaded through HOBOware software on a computer. Plots of data are created in the software and uploaded as a .csv file to compare plots side by side in Excel.

Results/Discussion
Data is collected daily throughout the month of August at 3 P.M. This time was chosen because it is deemed as the hottest part of the day. Collected data is then calculated into a heat index to describe the relationship between the relative humidity and the temperature. Temperatures of the crape myrtle tree and the live oak tree prove to be statistically similar. Average temperatures for the crape myrtle and the live oak trees are 30.05 °C and 29.97 °C, and the heat index is 36.08 °C and 35.95 °C respectively. This data shows the effects of the tree and the consequent evapotranspiration from it. Both trees are significant in reducing the temperatures due to their canopy. The crape myrtle has a denser canopy than the live oak, but the oak trees are taller. Readings from both trees could be similar because of their proximity to one another.

Conclusion
For Charleston, this information proves vital in efforts to mitigate heat waves in the summer. Implementing street trees could be a sustainable, aesthetic, and economic solution to climate change in the city. As Charleston continues to increase in population size, changes must be made to combat the climate change from its UHI. We plan to install more sensors on the south side of Hampton Park on crape myrtle and live oak trees with light poles for control variables. This would make for a better analysis because it could prove the results as statistically significant.

Introduction
Charleston, South Carolina is a popular tourist location and a popular relocation destination. The Charleston Metropolitan area has increased by nearly 20% since 2010 [1]. Changes in the Charleston area climate cause adverse effects unique to the marsh system surrounding the local area. Events such as rising sea levels, beach erosion, and coastal flooding are phenomena exacerbated by the change in climate [2]. This study is to understand the effects of street trees and aid in city planning for growth in future cities. In this study, the air temperature, relative humidity, and the dew point are analyzed at different parts of the day to quantify the differences between the effects of the live oak and the crape myrtle tree. Trees are predicted to provide a decrease in the air temperature and increase the relative humidity through evapotranspiration.
Abstract

Detecting a drone’s position and speed can be very difficult to determine using traditional radar. However, the motor noise outputted by the drone can be used to determine its speed and relative position. Analyzing the doppler shift of the motor noise as a drone passes over a microphone array allows for relative speed to be determined. With further analysis, position can also be deciphered through the data set. Developing new and accurate means of drone detection is becoming more prevalent than ever in today’s society. This project not only serves as a fantastic learning experience but also can lead to future product development for both civilian and government markets.

Methodology

• In ideal conditions our theoretical data proved to be a great reference for what we could expect our experimental data would look like.
• Our car trials proved that the doppler shift was detectable and coincides with the theoretical data.
• Using an app called SpectrumView we were able to visualize the doppler shift. (Fig 2.)

Introduction

• The purpose of this project is to gain a better understanding of how we can use the Doppler effect to determine the speed of an object.
• COVID-19 has had a significant impact on our project. However, working around the obstacles we still managed to obtain accurate data that would support our hypothesis.
• Using a sophisticated microphone array provided by Wave Sciences we were able to run experimental trials using a car to determine how the doppler effect could be shown using the equipment provided.
• Theoretical data helps us to predict what the doppler shift should look like when executing our experiments.

Results

• Our results did show a correlation between the theoretical data and our experimental data.
• Our data shows that we can concentrate on the range 0 - 2000 Hz, which will give us more resolution.

Future Plans

• We want to accurately predict the speed from the shape of the spectrum and the size of the Doppler shifts.
• We will model the rise and fall in intensity as the car passes; removing this signal will let us isolate the Doppler component of the input.

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• Nagar, Introduction to Python for Engineers and Scientists

Acknowledgements

• I would like to thank Dr. Briggs for his continued support and guidance throughout this project.
• I would also like to acknowledge Mr. Keith McElveen for his contributions to this project as well as letting us use his microphone array.
• Lastly, thank you to The Citadel Physics department for their expertise and help on this research project.
Commercial Sex – A Commodity for Sale at America’s Truck Stops?

Ashley Towers, Dr. Jordana Navarro, Dr. Thomas Holt

Overview

With the advent of the Interstate Highway System in the 1950s, truck stops expanded from small gas stations providing diesel fuel to major service areas with fuel, food, rest areas, personal hygiene facilities, recreational activities, and sometimes even medical and religious services – all intended to meet basic needs of motorists and truck drivers relegated to a life on the road. However, 24-hour operations, typically located in sparsely populated areas with quick access and egress routes, the transient nature of truck stops, and general air of anonymity create an environment that can be conducive to illicit activity. Commercial sex work at truck stops combines a vulnerable population with the opportunity to engage in sexual acts for profit, and a population willing to pay for commercial sex despite associated risks.

By identifying hot spots of sex work activity at truck stops, analysis to identify socioeconomic factors, outreach program accessibility, and the availability of other social services can aid local stakeholders in addressing risk factors that exploit vulnerable populations and necessitate intervention. Hot spot identification of sex work activity can also aid law enforcement in highlighting areas with a need of greater police presence, serving as a deterrent to purchasers of sex workers and controllers (“pimps” or traffickers) in exploiting vulnerable populations.

Literature Review

In reviewing related literature, a lack of perspective from truck drivers self-reporting deviant sexual activity exists. Many studies and research include acknowledged first person accounts by sex workers as participants in the commercial sex industry, yet reporting from truck drivers typically involves secondhand accounts of things they’ve “seen” or “heard”; often this is due to fear of job loss, as many companies that employ long-distance truck drivers (LDTD) have policies against purchasing commercial sex. This research project aims fill a gap in the literature, using chatter posted directly by truck drivers and motorists soliciting commercial sex.

Geographic information systems (GIS) have proven to be useful and effective when applied to criminal justice and security studies, yet GIS is rarely used in social science investigations despite being well suited to aid in understanding and visualizing social problems. This research aims to illustrate the utility of GIS in addressing commercial sex work at truck stops as a social problem.

Hypothesis

Hot spots of truck stop commercial sex work activity will appear in areas with socioeconomic risk factors and few social services.

Methodology

Secondary data of online chatter from web forums dedicated to truck drivers and motorists seeking sex workers and communicating subcultural norms, obtained with permission of Dr. Thomas Holt and MSU School of Criminal Justice, will be mapped using ArcGIS – a geographic information system (GIS) – in order to conduct a geospatial investigation that models the spread of sex work at truck stops. Hot spot analysis will be conducted to model hot spots of sex work activity, which can then be investigated to identify any correlation between hubs of sex work and ecological factors, socioeconomic factors, or social service resource availability.

It is important to acknowledge that not all sex workers enter the commercial sex industry by their own agency. Sex trafficking is a problem that deserves concentrated attention and effort. This research aims to identify risk factors that influence agency where vulnerable populations may view sex work as the only viable option for employment.

Subcultures are defined by shared norms, values, and argot. Within the trucking industry, drivers who engage in sexually deviant activity in online forums and at truck stops likely display common normative behaviors and language. At truck stops, sex workers and truck drivers often communicate over citizens band (CB) radio; truck drivers can inquire about the availability of commercial sex, or sex workers can put out a net call advertising services and truck drivers respond. CB can also be used to alert one another about the presence of security or law enforcement. Sex workers can also roam truck stop lots knocking on cab doors to solicit commercial sex services. Sex workers who frequent truck stops are sometimes referred to as “lot lizards”.
The detection of *Mitryganine Speciosa* an screening tests

Bereasha Washington and Michael Dorko

**Introduction**

*Mitragyna speciosa* commonly known as Kratom, is a plant that originates in Southeast Asia and is part of the Rubiaceae family. The consumption of Kratom ranges from chewing and smoking the leaves to making a powder for tea or putting it in capsule form.

Traditionally, Kratom has cultural uses in countries like Thailand and Malaysia. Medically speaking the Thai and Malay people used *mitragyna speciosa* to treat digestive issues, muscle pain and as a cough suppressant. These users say that the consumption of Kratom in its many forms contributed to a better appetite, higher work output, better tolerance of the sunlight and even aiding in the reduction of addiction to other drugs. In small amounts, Kratom can give cocaine like effects. In large amounts, Kratom can give morphine like effects.

**Legality**

Kratom is illegal in Thailand in all forms of possession and distribution while in Indonesia, it’s completely legal to grow and distribute Kratom all over the world.

In many countries that are part of the EU such as Denmark, Sweden, and Poland it is banned because it is considered to be a controlled drug.

In the United States, Kratom is under surveillance by the DEA and is on a list of concern in hopes that it will be banned in the future once all of the hazards of it become known. However, kratom is illegal to buy, sell, use or possess in Alabama, Arkansas, Indiana, Rhode Island, Vermont and Wisconsin.

**Screening Tests**

Kratom Alkaloids predominately being tested for detection are: speciogynine, speciociliatine, paynantheine, 7-hydroxymitragynine and mitragynine.

DuquesnoisLevine test: a purple product in a chloroform layer is achieved when the Kratom alkaloids are exposed.

High Performance Liquid Chromatography Ultraviolet Detection (HPLC-UV): can determine minute amounts of Kratom in urine.

Solid Phase Extraction & Liquid Chromatography quadrupole/time of flight Mass spectrometry: identified 5 alkaloids in urine using deuterated internal standards; fully validated for forensic use.

**Methodology**

Our goal is to design a screening test whereby a chromophore or fluorophore reacts with the alkaloids in Kratom, so that when a spot test is run, the alkaloids related to Kratom can be identified. We would like to discover various functional groups and fluorescent probes that can interact with the Kratom alkaloids to produce ultraviolet and visible spectra that would distinctly identify the presence of Kratom metabolites. We would like to be able to make a readily available test for law enforcement to be used in a forensic environment such that rapid and definitive results would be obtained without the need for advanced and costly instrumentation.
THE UNTOLD STORY OF ARTHUR B. MITCHELL, THE CITADEL FIFER
In recent years, The Citadel has increased its commitment to gaining a deeper understanding of its intricate relationship with the black community. In Oliver J. Bond's, *The Story of The Citadel*, he alludes to a black employee. This employee is described as the “colored fifer” for the Corps of Cadets and is named Mitchell (Bond 1936, 136). Bond also stated that Citadel cadets attended Mitchell’s funeral. This research project sets out to learn more about one of the earliest known black employees of The Citadel, who worked during a period of tenuous race relations.
HYPOTHESIS

The brief historical accounts of Arthur B. Mitchell do not fully articulate the mental, social, and economic challenges a black individual faced during the tenuous period prior and after the American Civil War. This research seeks to give a deeper understanding of the life of Arthur B. Mitchell by correlating social history with the events of his life.
LITERATURE REVIEW
Synopsis

This text details the social circumstance of the black population of Charleston, South Carolina during the antebellum and postbellum period. Charleston society was unique due to the size of its free and enslaved black population which dwarfed the size of its white population until the year 1860. Powers describes how the road to freedom was marked with difficulty for members of the black community. The post-war reality was stark for many black citizens of Charleston, as they struggled to gain financial stability. Powers’ work expertly details the trials and obstacles of the individuals within the black community both before and after the Civil War.
Charleston’s black population also included a significant number of free blacks. The close proximity between enslaved and free blacks became a concern for those that wanted to maintain social order. As the Civil War approached, the opportunity of freedom became less and less common. New laws made it more difficult to emancipate a slave and the freedom of non-enslaved-black-Charlestonians’ more precarious.

“In the year 1848, Charleston slaves were involved in at least 38 different occupations…[which] included the needlecraft trade for women and brick layers, blacksmiths, carpenters, tailors, bakers, plasterers, coopers, shoemakers, and miscellaneous trades for men.” (p.10)

“In 1842 the newly chartered South Carolina Military Academy, also known as the Citadel, was established her. Charlestonians understood that the nature of a society predicated on slavery made a well-trained military cadre essential for survival.” (p. 33)

“After that year [1820], slaves could only be emancipated by the state legislature, free blacks were prohibited from immigrating to the state, and those already there had their egress and ingress severely restricted.” (p. 39)

ECONOMIC STRUGGLES

“The Charleston City Council attempted to freeze the wages of free blacks. According to its regulations, the maximum amount that they could be paid for a full day’s work was one dollar.” (p. 44)

After the Civil War, “[n]orthern Radical Republicans promoted the freedmen’s right to vote, extending the franchise to them…[but] the governor reminded the audience that highest court in land had excluded the Negro from the rights of the citizenship under the Constitution.” (p. 80)

“When writing about Reconstruction in the 1930s, W.E.B DuBois observed that blacks desired “economic enfranchisement” and “real abolition of slavery.” (p. 100)

Black Charlestonians struggled to obtain autonomy and become full citizens of the United States. Prior to the Civil War, a select group of free blacks experienced economic success. However, newly freed slaves struggled to obtain economic stability.

Bernard E. Powers, Black Charlestonians: A Social History, 1822-1885 (Fayetteville: University of Arkansas Press, 1994), 44, 80, 100.
SEARCHING FOR BLACK CONFEDERATES: THE CIVIL WAR’S MOST PERSISTENT MYTH BY KEVIN M. LEVIN

Synopsis

In this text, Kevin Levin refutes the argument that black people served as soldiers in the Confederate Army. He uses primary sources and the context of the antebellum and postbellum period to support his claims. Through extensive research, Levin proves that black individuals did not serve as soldiers despite the emergence of this myth through the propagation of the Lost Cause narrative in the 20th century. Equally important is Levin’s explanation for post-Civil War behavior of black individuals that served the Confederacy.
The Lost Cause Narrative was a leading cause of the false narrative about the Civil War and the role African Americans played. Due to misremembering, race relations continued to be strained after the war.

“The Lost Cause narrative certainly made it easier for ex-Confederates to approach the war as something other than a complete and humiliating defeat, but it did so at the price of distorting the violent nature of slavery...Stories of loyal camp slaves served both as a reminder of what white Southerners chose to believe about race relations before the war and as a lesson to newly freed people that they were expected to conform to a society still defined by white supremacy.”

The belief that black Americans fought for the Confederacy arose decades after the war however, information from Confederate soldiers’ journals, proves that enslaved African Americans did not serve as soldiers. Likewise even when faced with the opportunity to enlist enslaved African Americans, Confederate leaders rejected it due to a commitment to white supremacy.

“Many people today who accept the existence of black men in Confederate ranks are unaware that this mythical narrative does not date to the war years or even to the postwar period extending well into the twentieth century.” (p. 4)

“After receiving two promotions, Lieutenant Colonel Edward Porter Alexander ‘acquired two appendages’: a ‘very pretty bay mare with a roan spot on one hip’ and ‘a 15 year old darkey named Charley--a medium tall & slender, ginger-cake colored, & well behaved & good dispositioned boy.’” (p. 20)

“For many Confederates, the proposal to enlist slaves accompanied by limited emancipation undercut the very rationale for waging war, namely the protection of slavery and white supremacy. ‘If we offer the slaves freedom as a boon,’ said one Virginia congressman, ‘we confess that we are insincere and hypocritical in saying that slavery was the best state for negroes themselves.’” (p. 39)
METHODOLOGY: PRIMARY SOURCE ANALYSIS

Newspaper Articles

Census Records

Death Records

Public Records

Freedmen's' Bureau Records
Mitchell began working at The Citadel in 1844 until the start of the war. He took up his post once more in 1882.

From his funeral announcement we learn that he was Major and belonged to 1st Regiment N.G. of S.C.
Arthur Mitchell is listed as a musician
He is head of household
He lives with his wife, daughter and another woman that may be a renter or relative
Him and his family are designated as “B” for black which suggests he is not a member of the free black upper class
His family lives in the 8th Ward of the city
Arthur is listed as being 36 years old and his wife is listed as being 28 years old
Arthur is listed as a Cooper and a member of Engine No. 7. This list is recorded in 1864, the following year after Mitchell abandoned his post as a military musician. There could be several possible reasons for his departure from the military: more job stability in Charleston, higher wages, turning tides of the war.

Descriptive List of Free Negroes Belonging to City Engine No. 7 [Copy 1]” Lowcountry Digital Library, The Charleston Museum Archives, 1864; Charleston Museum Fire Records, 25067].

Like many black men of the south, free or enslaved, involvement in the Confederate War effort was dictated by force or economic necessity.
In 1866, Mitchell states that his age is 40.

The Freedmen’s Bureau considers Mitchell’s complexion to be “Brown” not “Black” like in other records.

His residence is located on Calhoun St.

Mitchell’s parents names were Elizabeth and John. In 1866, only his mother survives.
1870 CENSUS (CITY OF CHARLESTON)

- Arthur’s profession has changed to Cooper. This coincides with the period in which The Citadel remained closed after the war.
- His age is listed as 40.
Arthur is still working as a Cooper
His wife is the only person in the household that remains illiterate
His family has moved to the 5th Ward of the city (legible street number, illegible street name)
Arthur’s age is listed as 45, his wife’s age is listed as 44. Their changing ages suggest both do not know their birthdates.
Upon his death, Mitchell’s age is recorded as 67 years old

His last home was located at 43 Reed St in the 9th Ward of Charleston

His death occurred on November 2\textsuperscript{nd} 1893

WHERE DID ARTHUR MITCHELL LIVE?

Throughout adulthood, it seems that Mitchell moved several times. In the 1860 Census, his home is listed as being in the 8th Ward. In 1866, his home was located on Calhoun Street, in the 6th Ward. In the 1880 Census, his residence has moved to the 5th Ward. His final home is located on Reed Street in the 9th Ward.

Mitchell was Free prior to Civil War.
He had one daughter, Mary and a wife, Martha.
He was literate throughout his adulthood.
He worked at the Citadel before and after the War.
He worked for the Confederate Army (he was not a soldier).
He had other jobs while the Citadel remained closed.
He died from a typhoid related illness.
• In the article, “His Last Tattoo”, Mitchell is called “faithful” and held in high esteem by his “white friends”. This language coincides with Kevin Levin’s argument that many white Southerners assumed that African Americans were loyal to their cause. However, the documentary evidence indicates that many were not and in the case of Mitchell shed little light he really was. Such words it simply describe how he was perceived by others.

• The funeral announcement, does not describe Mitchell in a subservient position, instead it refers to him as a Major in a military regiment. This announcement was likely written by family or personal friends who chose to depict Mitchell in a different light than the author of “His Last Tattoo”.

IMPLICATIONS: POST AND COURIER
IMPLICATIONS: CENSUS

- Census records provide an understanding of how Mitchell was categorized by Charleston Society. He is labeled Black not Mulatto which most likely disqualified him from being a member of the black aristocracy of Charleston.

- We learn that Mitchell is literate but his wife is not. This suggests she experienced a different upbringing, possibly Mitchell was born free and she was not.

- There is no mention of another child, unlike the Freedmen’s Bureau records. This suggests that his son died during his infancy before his life could be recorded on a census record.
He does not list any previous master which could suggest he was born free, however, the last location of enslavement is Charleston S.C.

Mitchell’s description is “Brown” which could speak to the way different races addressed color. If Mitchell is considered brown by other black individuals he may actually have been a lighter complexion than other black people in Charleston. However, he may not classify as mulatto due to societal standards of the time.

In the 1860 Census, Mitchell’s residence is listed in the 8th Ward, by 1866, his address has been moved to Calhoun St. which runs perpendicular between Ward 6, 5, 4, and 3. Mitchell and his family changed residences several times as shown by this deposit record and census records.
In the following year after Mitchell departed from military duty, he is listed as a member of Engine No. 7 in 1864.

It is likely that Mitchell returned to Charleston for better employment opportunities. As the war effort ramped up, more positions that were previously not available to black people began to open, including positions on fire departments.

Newspaper Article from 1956 states that black individuals were able to join the department in 1882. However, the list Mitchell appears on, is dated 1864. It is possible the department was disbanded and reinstituted in 1882 or the article is a result of poor investigative journalism.

The caption for images of black firemen, designate the group as “black fire engine” and “black hook and ladder”. This could suggest that black firemen organizations were completely separate from white organizations. The article from 1956, states that the fire departments remain segregated but all firemen receive equal benefits.
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- South Carolina. Charleston County. 1880 U.S. census, population schedule. Digital images.
Deterministic Model of Reactive Strength Index-Modified

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Faculty Mentor : Christopher J. Sole

Department of Health & Human Performance
The Citadel –The Military College of South Carolina
The Vertical Jump

• Popular assessment of human muscular performance.

• Reliable measure of power, reactive strength, fatigue, and explosiveness.

• Important performance component in many sports.

Moir, et al. (2008)
Sole et al. (2018)
* Jump Height : max vertical displacement

* Time to Takeoff : interval between initiation of jump and moment of takeoff
Start of Movement

Takeoff

Unweighting

Braking

Propulsive

Time to Takeoff

Flight Time
Start of Movement

Unweighting

Takeoff
Start of Movement  

Braking  

Takeoff
Start of Movement

Propulsive

Takeoff
Start of Movement

Takeoff

Unweighting

Braking

Propulsive

Takeoff
What is a Deterministic Model?

- A modeling paradigm that determines the relationships between a movement outcome measure and the biomechanical factors that produce such a measure.

- Clarifies key performance parameters.

- Explains relative importance of factors that influence the outcome of a movement task.

Chow et al. (2011)
What can a Deterministic Model tell us about RSImod?

• Narrow down the factors that are directly responsible for reactive strength and stretch shortening cycle characteristics.

• Shows the relationship between the result of the performance and the factors that affect them.

• The purpose of this analysis was to use a deterministic model approach to illustrate the mechanical factors that contribute to RSImod.
$RSI_{mod} = \frac{CMJ \text{ Jump Height} (m)}{\text{Time to Takeoff} (s)}$

- **Time to Takeoff**
  - Unweighting Phase
  - Braking Phase
  - Propulsive Phase

- **Jump Height**
  - Velocity at Takeoff
  - Net Impulse

- **CM Depth**
  - $\Delta$ in Braking Velocity

- **$\Delta$ CM Velocity**
  - Braking Impulse
    - Braking Force
      - Time
    - Prop. Force
      - Time
**RSI_{mod}** = \( \frac{CMJ \text{ Jump Height (m)}}{\text{Time to Takeoff (s)}} \)

- **Time to Takeoff**
  - **Unweighting Phase**
    - CM Depth
  - **Braking Phase**
    - Δ in Braking Velocity
    - Braking Impulse
    - Braking Force
  - **Propulsive Phase**
    - Δ in Prop. Velocity
    - Prop. Impulse
    - Prop. Force
    - Δ CM Velocity
- **Jump Height**
  - Velocity at Takeoff
  - Net Impulse
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Conclusion

• Deterministic Models can be used to break down movements into their biomechanical factors.

• By breaking down and reviewing the determinants of RSImod, practitioners can improve an athlete’s overall performance.
Next Steps

• Conduct research that:

  • Compare how eccentric, isometric, and reactive strength affect the RSImod score.

  • Focus on specific phases (unweighting, braking, and propulsion) of the vertical jump.
References


Thank you!