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Effects of Climate Change on Aphid-Borne Plant Virus Trends in South Korea

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Abstract

Agricultural productivity is significantly affected by plant viruses, commonly transmitted by aphid vectors. The changing climate has led to unequivocal effects on various ecological processes, in particular, on the intricate interactions between aphids, viruses, and plants, and the behavior of aphids. Although South Korea has historically experienced low occurrences of aphid-borne diseases, this study shows the rising trends in plant diseases and emergence of novel viral species due to climate change-induced alterations in the environment, emphasizing the threat to global security even in places where agricultural circumstances have remained relatively constant. By examining the underlying mechanisms of climate change's influence on aphids and the transmission of plant diseases, this paper contributes to the deeper understanding of the environmental challenges posed by environmental conditions from anthropogenic practices.

Contents

1 Introduction

1.1 Global Food Security

1.1.1 Effects of Climate Change on Abiotic Factors and Agricultural Crops

The goal of traditional agriculture is to increase yield rate by maximizing resource efficiency. However, ongoing anthropogenic activity and climate change is associated with several environmental impacts that subsequently affect agriculture.

A changing climate (e.g. temperature, rainfall, frost-free periods) leads to longer growing seasons, which call for alterations in agricultural practices.[22] For instance, farmers can harvest more crops that require longer maturing periods over shorter ones. On the other hand, farmers may use more water resources to prevent certain species susceptible to higher temperatures from drying out. With precipitation predicted to become more frequent as climate change occurs in the United States, crop yield is further affected by soil erosion, nutrient runoff, and a rise in sea level. In coastal communities, sea level elevation may threaten agricultural resources because of the effects of more frequent rainfalls on agricultural land loss, saltwater intrusion, and water contamination. Agricultural specialists are facing a greater challenge to global food security within the context of a growing population.

1.1.2 Effects of Abiotic Factors on Biotic Factors and Agricultural Crops

One of the largest fields of interest in the agricultural field is plant-infecting pathogen control as plant diseases hinder horticulturists and farmers from achieving the maximum-yield goal and meet crop demands. Other than fungi and bacteria, plant viruses are constituents of plant-infecting pathogens, in which the majority rely on biotic vectors to transmit and survive. With approximately 80% of plant viruses depending on insects as biotic vectors for transmission [13], plant viruses can lead to drastic economic losses annually as they can cause the plant systemic infection, infect the entire plant body, and reduce crop quality and yield.[3] In severe cases, plant viruses can even lead to plant death. When plant virus pandemics or large-scale epidemics occur in staple crops, they threaten food security. A representative case of viral pandemics and epidemics was in 2014, which led to an estimated global economic impact of 30 billion US dollars annually.[26]

In addition to the globalization of crop trade [16], a direct human intervention, viral transmission can be influenced by changes in the environment, arising from climate change. The rise of global temperatures means that plant viruses may become more difficult to control.[15] Increasing temperatures, varying precipitation patterns, and, additionally, rising atmospheric carbon dioxide and ozone concentrations affect virus-vector-plant interactions at different stages of transmission.

1.2 Objective

This study particularly deals with the plant virus insect vector aphid (family *Aphididae*), the most common insect vector.[21] Aphids are known to cause both direct damage on all plant parts due to its sap-sucking and honeydew production and indirect damage on plants through plant virus transmission.[30] Although the *Aphididae* family are a small insect group, approximately 450 of the 5,000 species are associated with crop plants and 100 are successfully adapted to the agricultural environment such that they pose significant economic consequences.[2]

The study then reviews how aphid-vector viral transmission behavior is altered by climate change.

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In the analysis and discussion section of the paper, this study analyzes the trend of aphid-transmitted plant disease occurrences in South Korea as climate change prolongs over time and assesses Korea's aphid-borne virus control methods in terms of the "6-3-4 Verification Standard" of the Regenerative Organic Certified (ROC), an effective sustainability verification program widely used by organic farms and companies.[7]

2   Literature Review

2.1   Transmission Mechanism of Aphid-Borne Plant Viruses

Plant viruses have the same basic mode of infection as animal viruses: the virus enters the cell and initiates viral genome expression using the host cell's proteins. Although some virion genetic material exists in double-stranded DNA (dsDNA), most viruses have genomes made of RNA either ssRNA positive or negative. Understanding the genetic material of plant viruses is important in the diagnosis of viruses, which can point to the further development of particular control methods.[25] Interactions between the virus and insect occur in three stages as organized [32] : the virus encodes structural proteins on its surface to facilitate transmission to its vector, the virus then binds to the specific sites in or on the vector binding site and is retained until transmission to plants, and the insect vector transmits the virus to the host plant. [9, 12]

Plant viruses can be transmitted from plant to plant through two mechanisms: horizontal transmission, in which transmission occurs within individuals of the same generation, and vertical transmission, in which transmission occurs from parent to offspring. However, only some persistent-propagative viruses can be vertically transmitted. [28] Most aphid vectors hold non-persistent viruses, which are spread by horizontal transmission. Non-persistent plant viruses can employ one of two transmission mechanisms: capsid-only or helper-dependent.[8] The horizontal viral transmission process can be described with steps called "acquisition," "inoculation," and "retention." [9] The mechanisms behind each step explain the intracellular responses of the plant cell under viral attack and can vary depending on the different transmission mechanisms.

Plant viruses can be classified into three modes of viral transmission: persistent - which further branches into "circulative, non-propagative," and "circulative, propagative" - semi-persistent, and non-persistent.[8] The three modes describe the retention period and mode of the plant virus in an insect vector with persistent having relatively long periods with the virus found in the vector's hemolymph, and non-persistent having short periods and rapid dispersal with the virus retained in its stylets.[18]

Studies support the "Vector Manipulation Hypothesis," which states that viruses alter the host plant's phenotype or vector's behavior in a way that to improve viral transmission.[14] This is expressed through the modes of transmission: viruses that are transmitted on circulative pathways attract and retain insect vectors, increasing settlement, reproduction, and proliferation of vector colonizes. On the other hand, viruses transmitted on non-circulative pathway repel vectors, causing the "acquisition" stage of transmission to become rapid and "retention" period short.[4] When environmental changes occur, due to climate change, interactions between the vector, plant, and virus are are influenced, thus altering the behavior of the viral transmission pathways that viruses take.

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2.2 Aphid-Virus-Plant Interactions Under Climate Change

2.2.1 Insect Vector Aphid and Plant Interaction

Due to their capacity of reproductive potential, one of the reasons that allow them to rapidly adapt to the agricultural environment and pose serious crop loss, aphids vectors sensitively react to abiotic stresses including temperature and equivalent CO_2 (eCO_2, which refers to Global Warming Potential weighted greenhouse gas emissions, expressing the combination of greenhouse gas emissions as a unified metric).[17, 10] When abiotic stresses are acted on, aphid feeding behavior is altered, affecting agricultural performance. Aphids have specialized stylets that allow them to feed on plants' phloem sap. When plant physiology changes as the environment is altered, aphids adapt their feeding behavior. For instance, under drought conditions, crops undergo a rise in phloem resistance, possibly due changes in solute concentrations in the phloem sap that alter phloem viscosity. This hinders aphids from obtaining the required nutrients from the plant.[14] Aphids can occasionally ingest xylem sap, in addition to phloem sap, to replenish their water balance within high solute concentrations and water pressure of the phloem sap. [15] Drought conditions show higher aphid reproductive capacity than that of non-drought conditions in some cases. In other cases of saturated water conditions, aphids expressed greater number of stylet punctures on soybean plants than that of drought fields. This may explain the highest levels of Soybean mosaic virus (SMV) infection when compared with drought-stressed and well-watered soybean plants in a study by Nachappa, Punya and et.al.[19]
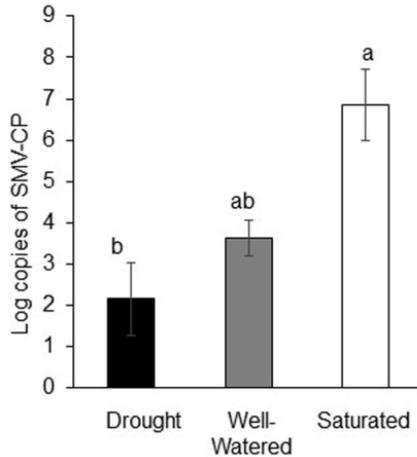
Figure 1: Saturated Water Environment Enhances Virus Infection and Drought Reduces Virus Infection Based on SMV Infection Levels.

Studies show that eCO_2 concentrations both positively and negatively affect plant physiology. The positive effects of e CO_2 are increase in plant height, aboveground biomass, photosynthetic rate, light-use efficiency, and water-use efficiency.[23] On the other hand, the negative effects of e CO_2

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include plant biochemistry variations (an increase in carbon to nitrogen ratio due to the reduction of nitrogen in the leaves). Although the effects of e CO_2 exposure is species-specific, many studies show an increase in phloem sap consumption by aphids to compensate for the decrease of nitrogen levels of plants under CO_2.[30] This indicates that elevated concentration of carbon dioxide alters feeding behavior of herbivorous insects, including aphids, causing in higher viral transmission efficiency from the insect vector to the host plant.[5]

2.2.2   Virus and Plant Interaction

Temperature is known to significantly affect viral transmission. In the case of *Potato leafroll virus* (PLRV), higher temperatures at 26 degrees Celsius, as opposed to 12 degrees Celsius, during acquisition or inoculation by aphid species *Myzus persicae* to plant species *Physalis floridana* displayed a greater number plant infections.[34] This phenomena can be explained by the tendency of the virus's latent periods in the insect vector to be shortened at higher temperatures, increasing the speed of viral movement from the gut to the salivary glands in the stylet.[29] The optimal temperature at which acquisition and inoculation of viral transmission occurs, according to a study on the *Banana Bunchy Top Virus* by the vector *Pentalonia nigronervosa*, is 25 degrees Celsius. However, based on studies on the *Potato virus* Y-O (PVY-O), *Potato virus A* (PVA), and *Potato leafroll virus* (PLRV) by *Myzus persicae*, transmission rates can also vary around the optimal temperature depending on the virus-host system.[29]

As seen in section 2.1.2, water stress influences viral transmission in varying degrees. Based on understanding of the *potato virus Y* (PVY) and *potato leafroll virus* (PLRV) by *Myzus persicae* Sulz. and *Aphis gossypii* Glov. respectively, however, when under a combination of temperature and relative humidity, the efficiency of viral transmission is elevated more compared to when under a change in just one variable.[27] Temperature was set to 25 degrees Celsius and compared with symptoms of transmission at 30 degrees Celsius. Relative humidity was set to 50% and that at high relative humidity of $80 - 90\%$. The pair of abiotic stress was seen to increase virus transmission by $30 - 35\%$ as shown in the figure below.[15]

Considering the Global Climate Observing System's detection and attribution of atmospheric humidity over time, which shows the recent increase in atmospheric humidity, in response to anthropogenic global warming [36] and Singh M.N. and et al.'s study on PVY and PLRV under high temperatures and high humidity, aphid-borne viral transmission has potential to become an even greater threat to food security at current rates of climate change.

2.3   Aphid Vector Migration Under Climate Change

In addition to the changes in viral transmission in aphid-virus-plant interactions, climate change and the warming of the planet can also alter the migration practices of aphids, affecting the pattern of plant virus transmission, causing a threat to global food security.[34] Based on a 60-year-long analysis on the migration of three aphid vectors *Myzus persicae*, *Aphis gossypii*, and *Sitobion avenae* in China, migration dates were moved earlier and the last migration dates were delayed. This indicates that the occurrence and migration seasons of aphids are prolonged as global warming occurs.[34]

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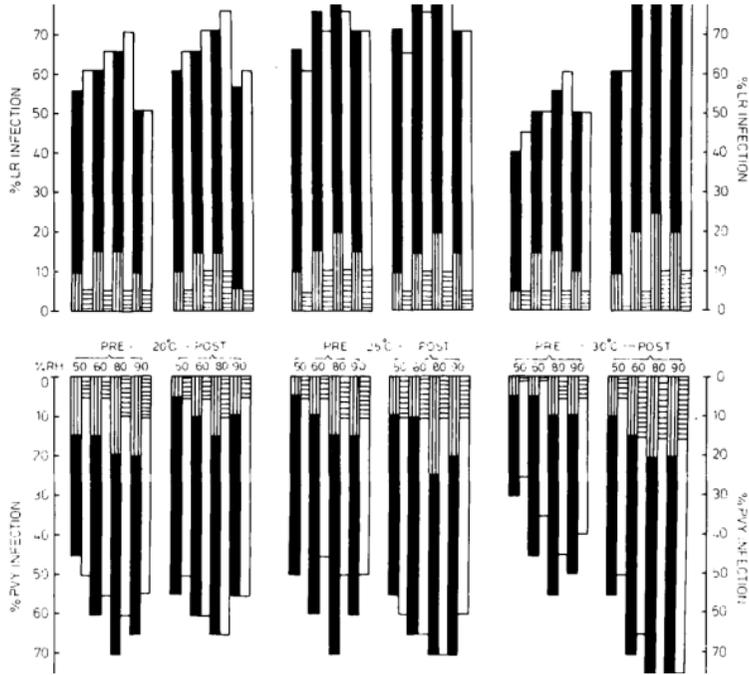
Figure 2: GHB concentration in urine per time interval between 16 healthy participants after a small dose.[15]

■ *M. persicae* (HV III, VII) efficient clones irrespective of the virus.
▥ *M. persicae* (HV XII) inefficient clones irrespective of the virus.
□ *A. gossypii* (HV I, X) efficient clones of PVY/PLRV respectively.
▤ *A. gossypii* (HV II, IX) inefficient clones of PLRV/PVY respectively.

3   Methodology

This literature review assesses and organizes previous studies on aphid-borne plant diseases to understand the mechanisms of viral transmission and the effects of climate change on such pathways. In order to measure the sustainability of current aphid-borne plant disease control methods, this study briefly assesses control methods under the "6-3-4 Verification Standard" of regenerative agriculture. As a quantitative assessment of sustainability may not be applicable to qualitative measures, this study compares the effectiveness of control methods utilized in previous studies and historical cases categorically similar to Korea's current methods and describes its impacts under the given sustainability criteria.

The "6-3-4 Verification Standard" of regenerative agriculture refers to the "Six Principles of Soil Health," Three Rules of Adaptive Stewardship," and "Four Ecosystem Processes." The "Six

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Principles of Soil Health" include the following: context (production and financial goals, current and historical parameters, community dynamics, etc.), minimize disturbance (minimizing disturbance of all types including tillage, synthetic, chemical, and manure), armor on the soil (keeping the soil covered with organic materials, plants, and microbes), diversity (maintaining diversity of plant species, microbial species, and other wildlife species), living roots year-round (maintaining live roots to improve soil quality, water infiltration, and carbon sequestration), and livestock integration (incorporating grazing ruminants to enhance soil biology). The "Three Rules of Adaptive Stewardship" include the following: rule of compounding (states that management practices play a role in the cascading effects of nature), diversity (fosters highly diverse ecosystems over monoculture practices), and disruption (follows that the environment is resilient and flexible to challenges and such disruptions can improve soil health). The "Four Ecosystem Processes" include the following: energy cycle (refers to sunlight for photosynthesis and optimizing sunlight capture), water cycle (refers to water from rainfall, snowmelt, or irrigation and optimizing water infiltration and retention), mineral cycle (refers to nutrients from soil, rocks, rain, the atmosphere, and organic materials and maintaining quality soil biology to replenish materials), and community dynamic (refers to diversity in the ecosystem including plants and other wildlife species and improving ecosystem functions).[1]

4   Analysis and Discussion

4.1   Aphid-Borne Plant Disease Trend in Korea

The introduction of new aphid-species, aphid-borne viruses, or aphid-borne viral transmission in South Korea is consistent with the cases from other countries.[1, 34] The occurrence of aphid-transmitted viruses in South Korea is found to be low but at rising rates. In 2020, two plant viruses *Cucurbit aphid-borne yellows virus* (CABYV) and *Cucurbit chlorotic yellows virus* (CCYV) had already been identified on a watermelon farm in Uiryeong.[23] Additionally, in the same year, South Korea reported their first case of *cucurbit aphid-borne yellows virus* (CABYV) occurring on the bitter melon crop (Momordica charantia),[1] indicating the evolutionary range of CABYV. However, in 2022 , based on genomic sequencing by Macrogen (Seoul, Korea) of the symptoms from the watermelon crop Citrullus lanatus, one of the most popular crops in the country, they detected the first occurrence of *melon aphid-borne yellows virus* (MAYBV), a novel virus to South Korea only having been detected in cucurbit crops in China, Taiwan, and Thailand previously.[30, 5, 35]

Although aphid-borne plant viruses are not of significant threat to food security in South Korea at the moment, there is potential for aphid population growth and, thus, aphid-borne viral transmission expansion. One reason associated with the increasing trend of aphid-transmitted plant diseases is due to the expansion of global crop trade as briefly stated in section 1.1.2. For instance, in New Caledonia, 17 of the 33 species of aphids have been newly recorded and presumed to have been introduced to the island through human activity over the last century.

However, a more significant and relevant factor that may explain the increase of aphid-transmitted plant diseases is climate change, both on the micro-level and macro-level. As seen in section 2, abiotic stressors created by environmental changes affect the interactions in aphid-virus-plant relationships. On the macro-level, environmental changes also alter the behavior of aphid migration. Accordingly, the spread of plant viruses is unequivocally becoming an increasing threat, calling for appropriate control methods.

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4.2 Sustainability Assessment

4.2.1 Assessment of Aphid-Borne Plant Virus Control in Korea

To address the threat of aphids causing aphid-borne plant diseases, countries are deploying control methods on different levels. On the plant level, researchers are inducing immunization to improve plant resistance genes. The most common method is "introgression of resistance genes from cultivated or wild species into susceptible related crops by backcrossing," which take two approaches: active resistance, using resistance proteins encoded by dominant alleles to cause the death of infected cells, and passive resistance, using recessive alleles to encode host factors of viral infections. While plant breeding is another option to enhance resistance, compatible resistance genes have not been found. Other methods can include genetic engineering using tools such as CRISPR-Cas9, yet resistance can still be ineffective for certain viruses over time. The inoculative mechanism can be exploited in cross-protection, although not understood. When the virus has already been introduced, plants can be sanitized and become virus-free with thermotherapy, chemotherapy, electrotherapy, and tissue culture. These methods require further studies to be assessed under criterias of soil health and ecosystem cycles.

South Korea commonly utilizes pesticides to control aphids and aphid-transmitted plant diseases. In the case of the 2020 watermelon outbreak of MABYV, the farmer responsible for the watermelon farm had previously controlled transmission with pesticides.[23] Current protocols by the National Institute of Agricultural Sciences in South Korea implements agricultural measures such as pre-harvest interval (PHI) and maximum residue limit (MRL) to secure pesticide safety. Under the principles of soil health, South Korea is currently addressing the "minimize disturbance" aspect of the verification criteria.

5 Conclusion

5.1 Summary

Agricultural yield is heavily influenced by plant viruses, which is commonly transmitted by aphid vectors. With unequivocal effects of climate change, global food security is at an even greater threat as both aphid behavior and aphid-virus-plant interactions are altered. This study reviews the mechanisms and ways in which climate change is altering aphid-related crop damage in order to address the control methods.

Aphid-borne diseases are low in South Korea, however, with the effects of climate change on aphid behavior, this study shows rising trends of plant diseases and introductions to new viral species, emphasizing the threat of global climate change to food security regardless of relatively constant agricultural circumstances.

5.2 Limitations & Future Work

After reviewing the mechanisms of aphid-transmitted plant viruses and summarizing current control methods under the "6-3-4 Verification Standard" of regenerative agriculture, this study attempts to assess the control mechanisms using qualitative analysis. However, due to the limited number of case studies on the effect of pesticides, the most common type of aphid control in South Korea, this study suggests the prioritization of policy implementation, which is yet to be assessed. Further works may include specific studies on the rate of aphid elimination and the environmental effects

of aphid pesticides in order to accurately analyze under the regenerative verification standard and combat further climate change and food security.

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How does the effect of caffeine differ depending on one's sleeping time?

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Abstract

Modern people consume caffeine through drinks such as coffee and energy drinks, trying to reduce fatigue and improve productivity and brain function. In addition, people want to increase the dopamine level by consuming caffeine and maximize concentration and learning ability. In order to detect how people could consume caffeine in a more effective way, this study suggests that sleeping time could affect the caffeine performance. Therefore, an attentional test, Sustained Attention to Response Task (SART) was done after an equal amount of caffeine intake with two different groups that had slept for different hours. As a result, there was no significant difference between the performance of the two groups- this indicates that neither the greater amount of sleep improves one's concentration level nor the smaller amount of sleep decays one's concentration level.

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1 Introduction

1.1 Background

Caffeine is one of the inseparable factors in modern people's lives. People usually consume caffeine from beverages such as coffee, energy drinks, and tea, not only because they like coffee or energy drinks but because caffeine makes people feel less tired and helps boost productivity and brain function. 100 milligrams of caffeine can keep one awake for about 4 to 10 hours depending on the tolerance. As caffeine begins to decrease in the body by half after a given period of time, the term half-life is used to measure its duration in the body. Caffeine has a half-life of four to six hours, according to the Food and Drug Administration (FDA). In other words, up to six hours after consuming caffeine, half of the caffeine is in our bodies and helps us stay alert [2]. About half of the caffeine is released from the body about 5-6 hours later and caffeine usually remains in the body for up to 10-12 hours after ingestion. Upon caffeine intake, the gastrointestinal tract absorbs more than 99% of caffeine within 45 minutes. Caffeine gives a powerful stimulus to the nervous system and keeps the body on alert. It stimulates many organs, but the central nervous system effect is especially important. In daily cases as sleep disturbance, which is the main function of caffeine, the inhibitory chemicals released by activation of the adenosine make one feel relaxed and fatigued. Caffeine acts to block adenosine receptors, and caffeine, which has a chemical structure similar to adenosine, adheres to the adenosine receptor, reducing inhibitory chemicals and releasing excitatory chemicals. When adenosine functions decrease, arousal, sleep reduction, shortening reaction time, and performance improvement occur [9].

Sleep is also essential for a healthy life. During sleep, the body supports healthy brain functions and strives to maintain physical health. Especially for children and adolescents, sleep helps the growth and development of sleep. Sleep also has a big impact on behaviors (thinking, learning, working, and relationship with people) while awake. Sleep affects people's body, heart, metabolism, circulatory system, respiratory system and immune system [13]. People's bodies are affected by the effects of sleep and circadian rhythm by hormone secretion. Having a proper sleep pattern is important for controlling various hormones such as estrogen, insulin, leptin, melatonin, growth hormone, sex hormone, and progesterone. Sleep has an important effect on hormones' effective functioning. It also removes metabolites and potentially toxic compounds accumulated in the brain while awake, and the role of integrating memory is also a benefit of sleep [12].

1.2 Literature Review

Taking a lot of caffeine can cause side effects such as insomnia, nervousness, fast heart rate, and headache, so if one wants to eat caffeine healthily, one should always take only the right amount of caffeine. The Food and Drug Administration (FDA) has announced that 400 milligrams of caffeine are the recommended daily intake for caffeine without side effects. However, this depends on how sensitive it is to caffeine or the body's metabolic ability [4].

Caffeine increases the concentration of dopamine, a neurotransmitter. Dopamine also serves to make one feel pleasure, satisfaction, and motivation; and helps with many physical functions. Neuromodulators regulate the activity patterns of nerve cells and allow the brain to respond in various ways. They are produced in various nerve cells in a specific area of the brain and distributed throughout the brain. Therefore, neuromodulators coordinate the overall activity patterns of the brain according to situations inside and outside the body. Dopamine is involved in a variety of things, including learning, motivation, impulse, exploration, choice, and attention. Dopamine can

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play various roles as it is distributed to various areas of the brain that each plays different roles. For example, in the frontal lobe, which plays an important role in working memory, dopamine is involved in attention concentration, but in the hippocampus, which plays an important role in event memory, dopamine is involved in memory, Dopamine is secreted into brain regions involved in attention, concentration, and movement learning, adjusting one's activities to be a favorable pattern for obtaining rewards. It also gives pleasure and happiness by increasing the dopamine concentration in the pleasure center. Caffeine increases dopamine, which helps concentrate and learn, however, excessive dopamine causes sleep disorders and indigestion due to mental concentration, and impulses to stimulate the eyes, and repeating these behaviors will require more caffeine to pursue greater stimulation [7].

There is a study which mainly covers about caffeine and sleep in adolescents, and the effect of regular caffeine intake on sleep behavior and sleep brain waves in children and adolescents. Investigating the effect of high caffeine intake on sleep physiology and the association between sleep habits in youth was the goal of this study. 50 participants were conducted telephone screening after approximately 800 teenagers were recruited using paper and personal advertising through schools, soccer clubs, boy scouts, and personal contacts. According to the exclusion/inclusion criteria and personal interests to participate, 32 subjects aged 10 to 16.9 years were eventually included in the study. Sixteen of the subjects (8 males, 11.9 to 16.8 years old) reported habitual consumption of caffeine at least twice a day over the past three years. Standardized in-lab screening telephone interviews were conducted to identify and evaluate caffeine intake and sleep habits. Caffeine consumers contrasted with 16 healthy age and gender-matched control subjects, who refused to regularly consume caffeine. Most caffeine consumers confirmed caffeine intake in both morning and evening, but no sleep disorders were reported.

During the week before the evaluation, participants followed a stable bedtime schedule identified by wrist actigraphy and bedtime diaries. They also obtained a week-long report and intake of caffeine-containing foods and beverages. Subjects were instructed to consume caffeine according to their habitual use, and along with a screening questionnaire, the report was used as a quantitative measure of the frequency and amount of caffeine consumed. Furthermore, Socioeconomic Status (SES) and chronotype were evaluated. In the morning after the sleep assessment, subjects evaluated morning fatigue using a Visual Analog Scale (VAS). The VAS was accompanied by a line with an endpoint that marked the two extremes of the category (comfort vs fatigue). Subjective evaluations byline have been converted to percentage values in the range of 0% to 100% for analysis.

The attention task was performed after the morning after the recording night. Subjects stared at a white cross against a black background on a computer screen, listening to 300 regularly presented acoustic stimuli (roughly 80 dB, 880 Hz) for four minutes. 10% of these stimuli exhibited random deviations in frequency (988 Hz). Participants were instructed to respond to abnormal stimuli as quickly as possible with a mouse click. Mathworks, Natick, MA, and USA were used for task indication and attention variable "reaction time" (lapse time between stimulus indication and mouse click).

Sleep assessments include hdEEG, electromyogram (two chin electrodes), and electrooculogram, and were scheduled according to individually reported habitual bedtime, with all participants waking up in the morning according to their scheduled wake-up time. Five subjects in the caffeine group were evaluated on weekend nights (Friday to Sunday morning), 11 on weekday nights, 4 on weekend nights in the control group, and 12 on weekday nights (Sleep (NREM) Sleep Stages 2 and 3). They

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then validated the normality of the data distribution using a nonparametric KolmogorovSmirnov test (compared to the expected distribution) for one sample, and investigated the homoscedasticity through the Levene test. With large frequency bands within SWA ($1 - 4.5$ Hz) and alpha ($8.25 - 9.75$ Hz), caffeine consumers had lower absolute EEG power than the control group during the first two hours of NREM sleep. A stochastic weight averaging (SWA) was performed overnight to investigate whether this effect had persisted. By morning, the difference between groups had disappeared. The Alpha activity also showed in this convergence in EEG power. For further analysis, they focused on the SWA frequency range during the first two hours of NREM sleep, since the overall group difference was most pronounced in early sleep and low frequencies. The SWA topography is shown to be quite symmetrical between two groups of hemispheres with local maximum and minimum values. Group differences prevailed over a large area, resulting in lower SWA for caffeine consumers. SWA was significantly reduced in 33% of all electrodes and decreased by an average of $20\% \pm 9\%$ in all electrodes and targets. The greatest effect was predominant in the frontal lobe, central and occipital regions. Topographic comparisons of alpha activity also showed pronounced group differences in similar areas, indicating reduced power for caffeine consumers in the anterior frontal lobe, central, top of the head, and occipital regions.

As a result, first, their findings show that regular caffeine intake in young subjects is associated with late and short bedtimes. Second, caffeine-consuming subjects exhibit reduced SWA and alpha activity that most strongly affects the frontal, central, and occipital regions. Finally, the decrease in SWA is mainly seen at the beginning of the night, which is consistent with the findings of adults. Their results suggest that only minor changes occur in sleep structure and continuity, and that regular caffeine intake in adolescents may result in late bedtime and reduced sleep depth, as measured by SWA(Aepli A. et al) [1].

2   Methodology

In this study, 100 people who are of international age from 13 to 19 from Soo Jung International Ministry, which is located in Seo-gu, Incheon were initially given a Google form survey. The survey was progressed from May 1st to May 9th, 2023. This survey included questions about the average hours the 100 individuals get to sleep a night. The answer choices were: $4 \sim 5$ hours or less, $5 \sim 6$ hours, $6 \sim 7$ hours, $7 \sim 8$ hours, $8 \sim 9$ hours or more. 15 responded $4 \sim 5$ hours or less, 14 of them responded $5 \sim 6$ hours, 32 of them responded that they usually sleep about $6 \sim 7$ hours a night, 22 of them responded $7 \sim 8$ hours, and the other 17 responded $8 \sim 9$ hours or more. With this survey result, 30 participants for the study were determined. 15 of them were the ones who chose that they sleep $4 \sim 5$ hours or less from the survey; and the other 15 were randomly selected from the ones who answered that they sleep $8 \sim 9$ hours or more from the survey. According to the American Academy of Sleep Medicine, it is known that recommended hours of sleep per day for 13-18 year old adolescents is 8 to 10 hours [8]. And this is the reason why the participants that have been chosen are the ones who sleep enough, and the ones who do not get enough sleep- to have a clear comparison of the effect of sleeping time with caffeine functioning by studying participants with dramatically different sleeping time. The randomly selecting progress from the second 15 people was done by using a random name picker and eliminating the other two out of 17 people who have responded to the ' $8 \sim 9$ hours or more' answer choice.

The first 15 participants who chose $4 \sim 5$ hours or less were named as 'Group Less'. And the other participants who chose 8 9 hours or more were named as 'Group More'. On May 13th, 2023, both Group Less and Group More were asked to have a certain amount of sleep that night. Group

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Less participants were each asked to sleep 4 hours, while the Group More participants were asked to sleep 10 hours. This has fluently proceeded since the participants have been sleeping similar amounts usually as well- they weren't just asked to suddenly sleep more or less than they usually do. Their sleeping pattern or cycle already has been used to sleep particular hours. Following, the next day, which is May 14th, 2023, the 30 participants were given the same can of The Original Green Monster Energy drink from Monster Beverage Corporation. This can of energy drink is a 500ml can which contains 180mg of caffeine, 80mg per 8fl.oz.serving [8]. All 30 participants were given the energy drink at 11 A.M. in the morning. It is known that the caffeine functioning reaches its maximum after an hour of the consumption [11]. Therefore, the participants were then tested on their concentration level at 12 P.M. the same day in order to determine the results of caffeine consumption as it improves concentration.

The participants' concentration level was measured with the attentional test, Sustained Attention to Response Task (SART). The Sustained Attention to Response Task (SART; Robertson et al. 1997) is a Go/ No-Go duration task [5]. In this task, the participants are instructed to respond to repetitive and frequent stimuli, which is typically a digit from 1 to 9 (Helton et al. 2011), as quickly and as accurately as possible within a certain amount of time. The frequent stimuli obtain about 89%, whereas there are 200 out of 225 . The participants of SART are first given a training block which contains 18 trials. After the training block, the real test is given, which is approximately 4.3 minutes with a total of 225 single digits appearing for each 250 ms. The No-Go, or the infrequent digit is, most of the time, number 3; which means that the participants of SART should not be pressing the spacebar when the number 3 appears on the screen. Meanwhile, if a Go digit is shown on the screen, the participants should respond before the next digit appears. The digits are present for 250 ms and the mask for 900 ms; the mask is the circle with a cross in it. And each digit is written in five different font sizes- 48 point, 72 point, 94 point, 100 point, and 120 point. The digits will appear as white on a black background.

SART is a reasonable material that could be used to measure one's concentration level since the participants should be highly focused on the digit and cerebrate to determine whether they should press the spacebar or not- they should have quick responses. And therefore, the performance level of this test could signify one's concentration level. The SART is widely used in measuring working memory, sustained attention, and impulse or inhibitory control. The individuals should be remaining sufficiently attentive to their responses.

3   Resutls

After each training block and the real test block, the results are shown on the screen. The SART result shows the number of Go and No Go trials, the number of Go and No Go mistakes, and the percentage of the mistakes. The two scatter plots below each indicate the real test results (not the training block) from Group Less and Group More. After the results are shown, the SART provides data analysis. The data analysis contains seven columns, which are each name of the block, number of blocks, go (1) or no-go (0) trial, digit (1-9), size of the font (1-5, from smallest to biggest), response outcome (0 as incorrect, 1 as correct), reaction time in milliseconds.

Go Trials More	No Go Trials More	Go Trials Less	No Go Trials Less
10	40	20	40
15	32	15	60
1	60	20	56
30	20	30	32
20	60	10	28
1	20	20	48
0	12	1	40
15	60	25	72
10	16	3	20
20	24	10	36
0	40	5	40
5	20	30	56
3	40	10	24
4	12	0	20
1	40	5	20

The percentage of mistakes of both Go trials and No Go trials of each participant are aligned in the table above. The left two columns are the results of Group More participants while the right two columns are the results of Group Less participants. For a better analysis, the mistake percentages of the Go and No-Go trials were added together- this refers to the total mistake percentages of both groups. And there are scatter plots on the next page which indicate the total mistake percentages of each participant by group.

Group More Mistakes

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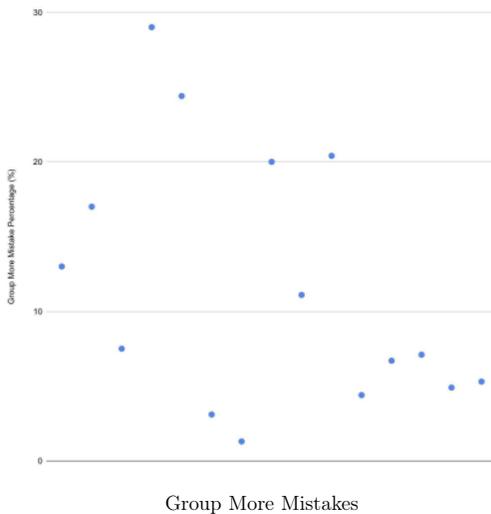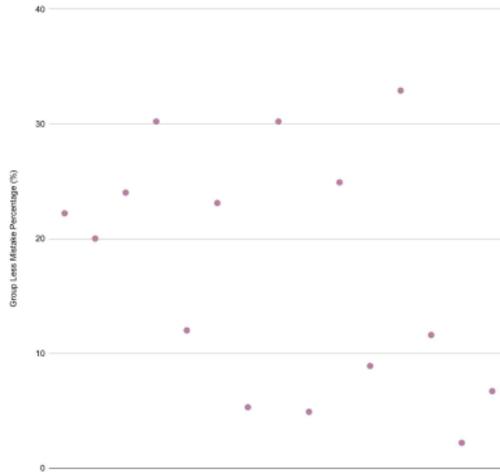
Group Less Mistakes

The null hypothesis of this study is that there is no relationship between sleeping time and the performance of an attentional test. In this study, an independent t- test is used since there are two different groups involved- Group Less and Group More. With the significance level of 0.05, the tvalue is 1.448 while the p-value is 0.079 . The result is not significant, and therefore the null hypothesis is failed to reject, yet there is no clear evidence that could prove the null hypothesis as accepted.

4 Discussion

The purpose of this research is figuring out how the sleeping time affects the performance of caffeine. This goal has come from the idea 'Is there a way to prevent tolerance of caffeine?'. This question led us to the decision to find an effective way to take caffeine. There are many researches about the caffeine affection to sleeping time but the sleeping time affection to caffeine is not a topic that people are commonly studying for. The null hypothesis of this research is that sleeping time won't affect the function of caffeine. To discover the interaction between sleeping time and caffeine, we did an experiment with 30 people in a specific church named Soo Jung International Ministry. Half of the participants who are called Group Less usually sleep around four to five or less hours and the other half of the participants who are called Group More usually sleep around eight to nine hours or more. Final result shows p-value of 0.079 and t-value of 1.448 ; since there is no significant difference between the performance of the two groups, there is no correlation of sleeping time with the effect of caffeine. Even in each group of results, it does not show us any general results, which means each result of a test is an individual's ability.

Before we decided to do the experiment, we planned to do a survey with ICS students who

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are aged 13 to 19 years old. We thought that this might not be accurate since the participants themselves are deciding their answers - they would not make objective thinking themselves so we would not have exact individual's difference only with the questions about average sleeping time, types of caffeine usually taken, and the time when participants take caffeine. Also, people do not know their own statement such as exactly when is the time they are well-concentrated after taking caffeine without testing.

During the experiment, we missed some points - the first point is that we failed to accept random sampling. The participants who joined our experiments were done within one specific church which was limited. Our population for the experiment was 100 people for accurate results and these populations were the most people in the church. The result will be more accurate with the larger population and various types of people. For instance, different races, different regions, and different ages can make a wider variety of population. The second point is that we failed to do random assignments because of limitations of participants. There were only 15 people who had chosen that they usually have four to five sleeping hours and also only 17 people had chosen that they usually have eight to nine or more sleeping hours. Each 15 people in a group is not enough to generalize for another large number of people. We were not capable of randomly selecting participants for each group - it shows that this study has failed in random assignment. In order to establish random sampling and random assignment, a more specific number of participants is needed. The third potential issue about SART is that the test might not be testing on the concentration level only. The results might vary depending on one's responding time or the speed. Some researchers suggest that the model formulated within the ACT-R cognitive architecture implies how the SART results might be affected by speed-accuracy trade-off rather than the sustained attention. During analyzing the experience with SART, we were not able to figure out the reaction time. According to the research by Peebles, D., & Bothell, D. (N.d.), the data analysis of results of the SART contains the correlation between errors of commission and reaction time. We cannot contain the reaction time in the analysis so the result of our experiment might not be accurate [10].

The other attentional test that can replicate SART is Wisconsin Card Sorting Test (WCST). This test is another type of an attentional test done by using cards matching the shape of Target Card in front of the tester with the other four different colors and features of Stimulus Cards [6]. We can replicate these other attentional tests such as WCST for accurate results. With using other attentional test, it could show bigger correlation between two variables.

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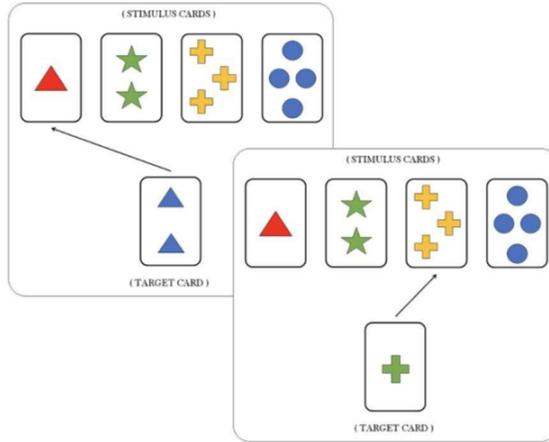
Alessandro, Marco D, et al. "A Bayesian Brain Model of Adaptive Behavior : An Application to the Wisconsin Card Sorting Task,"

Since there the null hypothesis has failed to reject, we got the information from the experiment that sleeping time does not affect the performance of caffeine. The most important thing is that we should complement our mistakes which happened during the experiment. Within our result of the experiment, we can notice that the reason why people tend to study caffeine's effects to sleeping time instead of sleeping time's effects to caffeine consumption and function.

5   Conclusion

This study's initial goal is to find a way to consume caffeine in an effective way. As more and more people are using caffeine to boost their energy level or hinder sleep, there is more misuse of caffeine- there is tolerance and withdrawal created by the frequent consumption. The participants were tested on their concentration level after an equal amount of caffeine consumption- however, each group slept for different hours of sleep the day before. This way, the effect of sleeping time on caffeine performance is detected since caffeine improves one's concentration level. As a result of the attentional test SART of all 30 participants, the t-value was bigger than the p-value, and therefore the null hypothesis has failed to reject. The t-test has proven that greater sleeping time does not advance one's concentration level and less sleeping time does not reduce concentration level. And therefore this indicates that sleeping time does not affect caffeine functioning.

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The XYY Syndrome; Physical Growth that Extra Y Chromosome can Cause

Hyunseo Kim

Abstract

All people have a pair of sex chromosomes according to their biological sex, which is determined genetically. It is known that males have XX sex chromosomes and females have XX sex chromosomes. This research had started from a question, "Is it possible for a person to have yy sex chromosome?" Insead of cases of YY chromosomes, XYY syndrome, which is having XYY sex chromosomes, had existed. There were studies done about physical growth of a person and XYY syndrome, but the majority of the studies were done in the late 20th century. This research will be able to clarify the question about the physical difference that extra Y chromosome within people diagnosed with XYY syndrome can cause, such as difference in height and weight.

Contents

1 Introduction

1.1 Background

1.1.1 Chromosome

Majority of organisms have chromosomes. Chromosomes are located inside the nucleus of a cell, and contain genetic information of an organism. Number of chromosomes is different between organisms. Humans have 46 chromosomes, which is paired to 23 pairs by two chromosomes each. Last pairs of chromosomes are the chromosomes that determine one's sex, the sex chromosomes. In most cases the last pair is either one of XX sex chromosomes for female organisms, and XY sex chromosomes for male organisms. As so, the Y chromosomes, which only exist in male, are the sex chromosomes that result in the difference between two sex. These chromosomes are inherited genetically, each one from mother and father.

1.1.2 XYY Syndrome
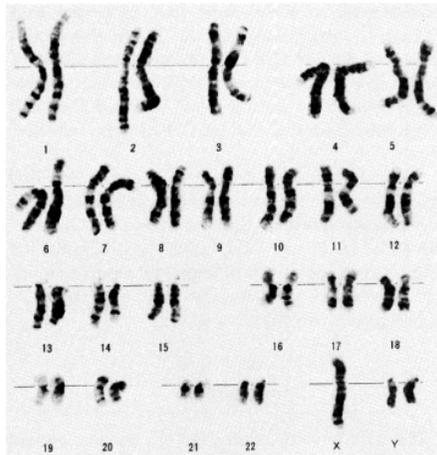
Figure 1: Chromosome analysis showed that the subject had XYY syndrome. [9]

XYY syndrome is also known as Jacob's syndrome or $47, XYY$. This syndrome is a chromosome disease that is shown to males. As the majority of the people have XX or XY sex chromosomes, XYY syndrome is a case when a male with XY sex chromosomes has 47 chromosomes in total by an extra copy of the Y chromosome. Even though XYY syndrome is the second most common chromosome disorder over males, which is found in every one male out of a thousand, this chromosome disorder is often not well known. XYY syndrome is a relatively recently found syndrome. The first case of the XYY syndrome patient was reported in 1961, which was less than a century ago. After the discovery of XYY syndrome, there were studies done about symptoms that XYY syndrome can cause such as growth rate, the correlation between XYY syndrome, violence, and crime rate.

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1.2 Hypothesis

The cause of XYY syndrome will be related from birth, since the chromosome would be decided at birth. Since "Evidence in favour of a Y chromosomal factor is that XY males are taller than XX males, that XY females are taller than XX females, and that XYY males are taller than XY males" [2, p.1], there will be a cause of y chromosome that increases growth of person, including height, weight, and other body parts.

1.3 Research Gaps

Even though XYY syndrome is a second common chromosome disease for male, it is hard to find and directly meet the patients to measure their height, weight, or other sizes of other body parts. Making new statistics for the XYY syndrome patient is an unrealistic goal for someone who is not a medical speciality. This research would have to rely on other statistics or study that has been done for the actual measure of the XYY syndrome patients. Therefore, this research might not be able to offer a perfect solution. There also might be confounding variables other than XYY syndrome that influence one to have different physical features from the norm such as genetic or environmental reasons.

2 Literature Review

2.1 Cause of the XYY Syndrome

XYY syndrome is justified by having an extra copy of y sex chromosome, so having a total of 47 chromosomes by the extra y chromosome in each nucleus. Cells are formed genetically before birth. Chromosomes, which are included within the nucleus of the cell, are not the exception. Thus, extra copy of Y sex chromosomes that indicate XYY syndrome also are caused by genetic reasons. Since extra Y chromosomes are unusual for XYY syndrome, and the Y chromosome is inherited from the father's chromosome, there should be a relation to the mutation of the father's chromosome. However, since the XYY syndrome patient does not seem to inherit the syndrome to their offspring, the cause of formation of extra copies of any kind of chromosomes still remains a mystery. Likewise, no specific reason for the extra copy of chromosomes has been revealed until now.

2.2 Physical Appearance Difference of the People Diagnosed with XYY Syndrome

2.2.1 Height

Height is a factor that often is influenced by genetic causes. However, people with y chromosomes often seem to have higher mean height overall compared to the people without y chromosomes. This indicates that there is a cause of the y chromosome on height. There are few extreme cases of heights over the average, such as the study by [6] of a teenager with height of 195 centimeters. In mean, the distribution of the height between subjects with XYY syndrome and subjects without XYY syndrome has shown a difference.

If the mean height of the XYY syndrome patients are greater than the mean height of their age, this could lead to a question about whether XYY syndrome patients are born with greater body size compared to the other newborns. However, [13] concluded that as a newborn, the status does not show differences.

Nevertheless, without difference showing from the birth for the status, as in Figure 2, the patients
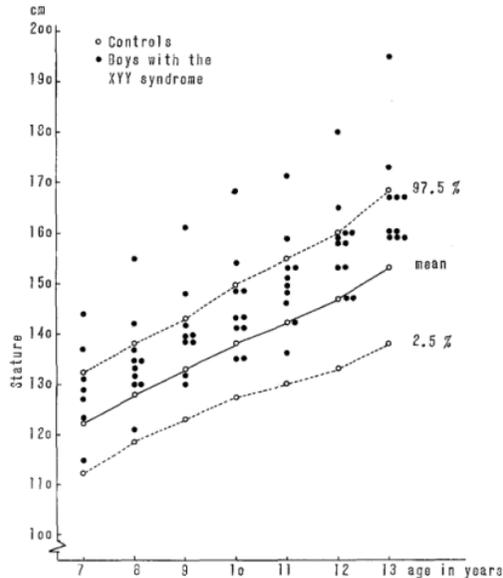
Figure 2: boys with the XYY syndrome and controls. Distribution by stature, weight and age. [11]

with the XYY syndrome seem to show a greater mean compared to the mean height indicated in the graph. According to [13] and [14], patients with XYY syndrome are more likely to show increasing velocity of the growth rate of height over time. Moreover, "The only phenotypic expression of an extra Y chromosome that can nearly always be found is an increased growth velocity from early childhood, ... XYY men are usually taller than 1.85 m...." [14, p.2]. This the increment of height velocity of XYY syndrome patients can be resulted by the extra y sex chromosome.

2.2.2   Weight

Weight is a factor that can be determined by nurture reasons. Only by not spending the energy absorbed that day could cause to have a weight over the mean. Exercising or starving can cause a person to lose weight. These confounding variables can cause differences to the data. If this part is contributed or not, the weight difference of XYY syndrome patients from the mean weight was not found, "... but they have a weight that fall within the normal distribution." [11, p.3]. Thus, neither XYY syndrome nor extra copy of y sex chromosome is involved in the weight, or even if it is, there is no great effect of these factors on weight.

2.2.3   Other Physical Changes

Tooth   Tooth size or specifically, tooth crown size shows difference between male and female. According to [2], the crown size of the tooth is larger for the male subjects compared to the female

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subjects. One of the differences between male and female is the existence of the y chromosome. Moreover, the subjects with XYY syndrome had shown larger tooth crown size than both male and female subject groups. The clear difference between three subject groups was the y chromosome. To add on, "The results of this study confirm that the extra Y chromosome does have an influence on tooth size in 47, XYY males,...?" [16, p.4]. Hence, the y chromosome has an effect on the tooth crown size to be larger than the average.

Brain
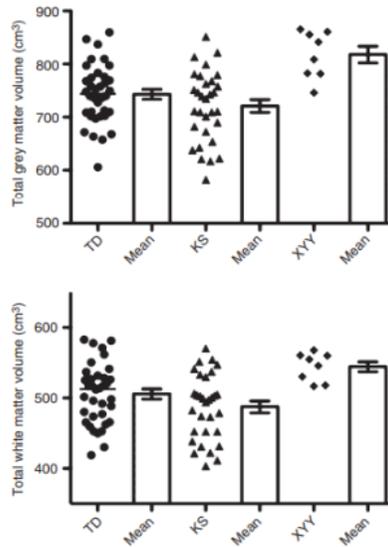
Figure 3: Total grey matter volume and total white matter volume corrected for age. For each of the three groups (TD, typically developing participants [circles]; KS, participants with Klinefelter syndrome [triangles]; XYY, participants with XYY syndrome [diamonds]), individual participant values are shown alongside the group mean with error bars indicating standard error of the mean. [3]

As in Figure 3, the volume of the grey and white matter in the brain of XYY syndrome patrons has shown a greater value compared to mean. Not only the grey and white matters, "Participants with XYY syndrome had significantly increased total tissue volume, including individually increased TGMV and TWMV, ⋯. [3, p.5] indicates that participants with XYY syndrome also have greater tissue volume for the brain. In addition, by the volume of grey and white matter, and the brain tissue increasing, the head circumference has also shown larger size compared to the mean head circumference size.

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2.3 Differed Case

Most XYY syndrome patients show few physical status above the mean. However, there are cases that show exceptions. One particular case of a patient of XYY syndrome showed height lower than the mean. According to [9], this patient's mother had height of 153 centimeters and the patient's father had height of 162 centimeters. Growing up, the subject was smaller than the mean, and showed slow growth velocity. "... but our patient was of short stature (-2.6 SD), ..." [9, p.2] was the conclusion of the study, also quoting "His height was 113.6 cm(-2.6SD) and his bone age was 6.4 years (B.A./C.A.=0.78)." [9, p.1] for subject's height and bone age. Thus, having XYY syndrome does not indicate that a patient will always have a physical status above the mean.

3 Conclusion

3.1 Summary

Overall, patients with XYY syndrome had shown physical status over the mean for several body parts such as growth velocity of height, tooth crown size, the volume of matters and tissue in brain, and head circumference. To see differences caused by the y chromosome comparing male, who have y sex chromosome, to female, who do not have y sex chromosome, occasionally, men have greater size of the status of physical parts stated compared to women. Moreover, patients with XYY syndrome showed physical status greater than the mean of other groups, which includes both male and female groups. The difference existing in these groups was the y sex chromosome.

However, weight distribution did not show any difference relating to height, also there is a case for a patient with XYY syndrome, that had a height smaller than the mean, which is unusual with the data of height distribution of the XYY syndrome patients. This indicates that weight distribution is not affected to increase or decrease by the XYY syndrome or y chromosome. For the patient with small status than mean is introduced as a rare case. In most studies, the graph distribution does not include an outlier that lies extremely under the mean of other subject groups. This fact concludes that it is a rare case that XYY syndrome patients have a height under the mean by the effect of an extra y chromosome. Thus, the y sex chromosome can affect and does affect the growth of physical status, in majority of cases to increase, of an individual.

3.2 Limitations

Yet, the findings did not consider the effect of other genetic reasons such as the influence of the parent's height of the patients to the XYY syndrome patients. Physical status is a factor that may vary by environmental factors such as food consumed. These statistics did not conduct such environmental factors in the result. The few outliers indicated the confounding variables existing to affect the physical status, and this growth might not be the pure effect caused by the extra y sex chromosome itself.

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8

The Effects Of Cleansing On Acne In Adolescents

Ji Won Wolcott, Victoria Park

Abstract

Everyone cares about their appearance, but adolescents who are going through puberty care 1more about their appearance. Usually, they put on makeup to cover their shortcomings, and they are also used to highlight their strengths. Students improve their self-esteem by putting on makeup. Acne is everyone's major problem these days. Although it occurs as an adult, students who are experiencing puberty are more likely to develop hormone secretion than adults. Hormone problems also cause acne, but the surrounding environment is also very important. For example, yellow dust is really bad these days. If dirty wastes accumulate on the skin, acne gets worse. Also, cosmetics have a lot of really bad ingredients. We only focus on putting on makeup, but we do not think it is not a big deal to remove makeup. Even if you cleanse well, you can't get rid of acne at all, but it can help relieve acne. We will study acne and how cleansing affects acne in adolescents.

Contents

1 Introduction

1.1 Propose

Our goal is to help people who are stressed out by acne, we are going to focus on adolescents. We would do research on this subject. Acne lowers a person's self-esteem and causes stress. Adolescents who wear makeup only know the importance of makeup, not the importance of cleansing. Cosmetics contain a lot of harmful ingredients. In addition to cosmetics, when you go out and do activities, your skin will accumulate nope. When they are trapped in the skin, it causes acne. Even if you're not wearing makeup, if you're doing outdoor activities, use cleansing to cleanse your face. You should prevent acne by wiping it. We can prevent acne by using cleansing. We studied the pH level of cleansing, the first step in preventing acne, to find out which pH is good for the skin and which is bad for the skin. We would like to help students suffering from acne.

1.2 Background

1.2.1 What is acne?

Acne is a common skin disease that many people have. Acne formation means that the hair follicles are blocked and inflamed. Acne is caused by inflammation of hair follicles and sebaceous glands as oil and dead skin cells block pores. The reason why acne occurs a lot in adolescence is because hormone secretion increases and sebum secretion increases at the same time. Then, many pimples are formed because a lot of sebum blocks hair follicles more easily and quickly. Most people start developing acne in adolescence and disappear as an adult, but there are cases where it remains as an adult.

1.2.2 Typical acne germs

A typical example of acne is Cutibacterium acnes. Cutibaterium acne is more famous for P.acne, an abbreviation for propionibacterium acne, which was previously called, than its current name. It was originally Bacillus acne, but it was discovered that it could produce propionic acid, so it was called Propionibacterium acnes.

This Cutibaterium acne is a benign bacterium that grows slowly and is positive bacteria that can be dyed dark blue or purple. It is characterized by symbiosis with most other bacteria and is often detected on the skin of healthy adults. Conversely, there are significantly fewer cases of this acne bacteria detected in the skin of infants. It is potentially present in the skin of most healthy adults and does not harm the skin at this time.

It is known to be the main cause of most inflammatory acne. It is often found in adolescent acne patients, and the perfect treatment is death. There are innate and acquired reasons for this acne bacteria, which are inherited by heredity for innate reasons and are often caused by a surge in acne in adolescence.

The cause of occurrence is similar to most other acne causes. When pores are clogged and oil or air can not pass through, an inflammatory reaction occurs. At this time, what is produced is Corynebacterium acnes.

1.2.3 The Principles, and Roles of Cleansing

Cleansing is a process of removing impurities such as sweat, fine dust, waste, and makeup accumulated on the skin while living all day long as a basic step for cleansing and healthy skin. Cleansing facilitates metabolism and physiological functions. It also helps with normal secretion function. If not, on the contrary, physiological function, metabolism, and normal secretion will decrease and cause acne and skin problems.

1.2.4 Types of cleansing

There are many different kinds of cleansing in cleaning products. For example, there is cleansing foam, cleansing balm, cleansing oil, cleansing gel, cleansing water and more. They all have different characteristics.

First, there is a cleansing foam. It is a soft cream type and has good cleaning power. It can be used regardless of skin type, so it is a product used by many people. It is widely used as a secondary cleanser used after using such as cleansing oil. Also, in cleansing form, it has two types. We can use it for the sensitive and acne skin type. For that, we can use it in the morning with hypoallergenic people or who have very sensitive skin. Second is we can use it for cleansing, such as removing dirty waste and makeup.

The base of cleansing water is purified water, so it is effective in removing light makeup such as eye makeup, lip makeup and if they put on thick face makeup (foundation, suncream), then we can use it for first-cleansing. There are two types of cleansing water, one with a small amount of oil and one with no oil at all. It is good to use in hot seasons and is recommended for oily skin.

Cleansing tissues are convenient to carry around like wet wipes. It is used a lot when removing or modifying makeup partially. Since it is a product that is used after wiping, it is not recommended to use it frequently or who has a very sensitive skin type because the skin is very irritated when wiping.

Cleansing oil is for deep cleansing, and cleansing oil helps to clean the blackhead in the nose and it also helps to melt the thick makeup. It prevents coloration of color makeup and is widely used in waterproof products. It's basically an oily product, so it's good for dry skin. The oil dissolves in water and enters the pores and gets pushed out, when getting pushed out it removes makeup that was inside, but since the oil could be still in the pore, it is necessary to wash a second round of cleaning.

As the name suggests, cleaning balm is a soft type of balm like Vaseline. It melts by body temperature and allows non-irritating cleansing. Since it is a balm type, it has a good moisturizing effect and is widely used for dry skin.

Cleansing lotion which is also called cleansing milk, is for the sensitive skin and if we have flushing skin, it is highly recommended. Since it is easily removed in water, it is fine to use only this product. It is not irritating, so it can be used for all skin types, but is not recommended for heavy makeup due to its weak cleaning. There are more and more diverse cleansing products, but these are the characteristics of representative cleansing.

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2 Research method

2.1 Experimental Materials

pH Index

- Red cabbage

- Beaker

- Wooden Chopsticks (to be stirred)

- Cleanser

- Pot

- Burner

- 500ml of water

Bacterial Culture

- 3 g of Agar powder

- 3 Pvc petri plates

- A Disposable aluminum container

- Plastic container

- Stirring Tool (ex)disposable wooden chopsticks)

- 100ml of water

2.2 Experimental Methods

In the experiment, the experimenters washed their face with a cleanser every night before going to bed, and used a deep cleansing product once a week. Pictures that show the difference every week, will be provided. We will check the pH concentration of the cleanser and use it to wash the face. The bacteria on the face before cleansing at night will be cultured every week to see what difference it will make.

2.2.1 Data analysis method

pH Indicator   Firstable, heat the red cabbage in a pot with water. After about 10 minutes, after the water starts to boil, turn off the heat and let it cool down for about 10 minutes. Check if the color of the water came out well. Using a sieve, remove the cabbage ingredients, and put only the water brewed with red cabbage in a beaker.

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<pH indicator: boiled red cabbage liquid>

This is boiled red cabbage and excluding the ingredients. The color of the water boiled with red cabbage came out like this.
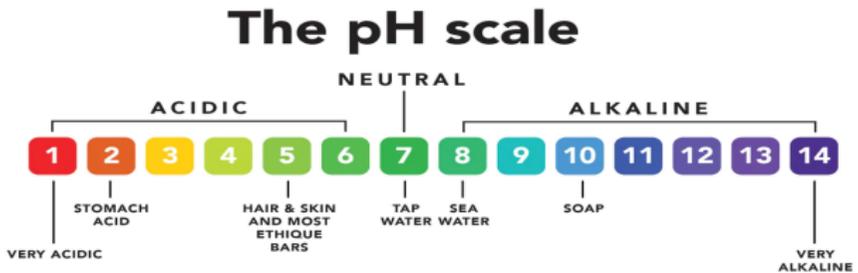
This is the pH scale, which is an average of the colors that appear when checking the index of each pH. We checked what pH index each product has by referring to this table.

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If you look at the pictures above, you can see that each product has a different pH index.

PH index of cleansing products:

Cleansing Foam	7 ∼ 8	Cleansing Balm	12
Cleansing Gel	13	Cleansing Clay Pack	11
Cleansing Oil	13	Soft Peel	2

When checking the pH concentration of products that we used often, most of the products were from pH 11 to 13. It is alkaline that the concentration of pH is 11 to 13.

Among them, cleansing balm was selected as a product for daily cleansing, and clay pack was selected as a product for deep cleansing once a week. Once a week, after deep cleansing, moisture was supplemented using peeling.

The experimenters cleansed between 11 to 12 at night. When cleansing using a cleansing balm, scoop up the amount of your index finger's fingernail and rub it well. After rubbing for about 5 seconds, the cleansing balm melted by body temperature. In that state, gently rub it on your face that is dry. For about 5 minutes, gently use a cleansing balm to remove impurities from the face. After that, wash it with water.

Bacterial Culture

Firstable, measure 100ml of water and 3g of agar powder.

Mix agar powder and water thoroughly until the floating powder is gone.

Transfer the mixed solution to a disposable aluminum container and increase the temperature of the solution by double boiling. If the solution starts to boil and small bubbles rise on the rim, stop the heat and cool for about 10 minutes.

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A boiling solution

A cooled solution

Divide the solution into three petri dishes and wait about 10 minutes for the solution to harden and create an environment in which bacteria can be cultured.

8
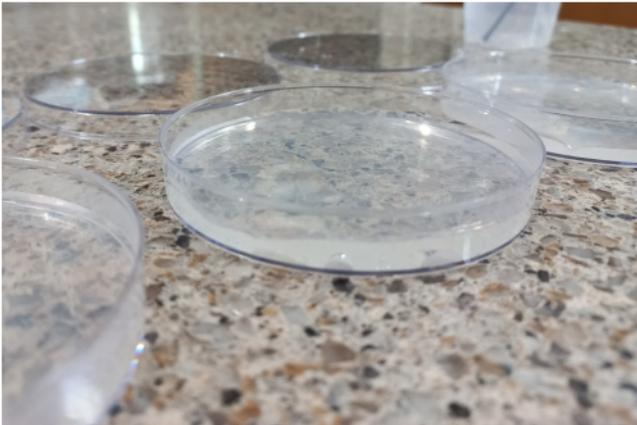
A solidified solution

Week 1

In the first week, you can see a lot of acne. It's typical oily skin. Overall, the skin is a little less elastic.

Week 2

In the second week, it was more comfortable to sleep at night when cleansed every day. Compared to the first week, acne on the forehead can be seen to improve and the complexion has improved. It can be seen that a lot of pimples are also getting better in the cheeks.

Week 3

In the third week, most of the pimples on the forehead have improved, and you can see that only a small amount is left. Although acne on the cheeks still remains, it can be seen that the skin's elasticity has improved compared to the first and second weeks. You can start seeing glow in the skin and the overall color improves.

10
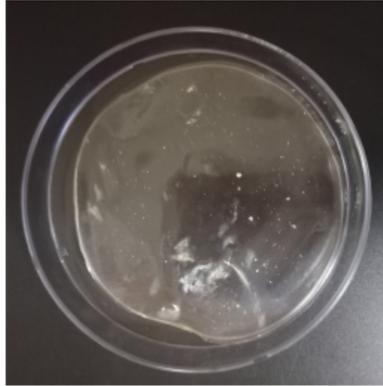
Week 1

If you look at the culture of the first week's bacteria, you can see a significant amount of white bacteria coming up.
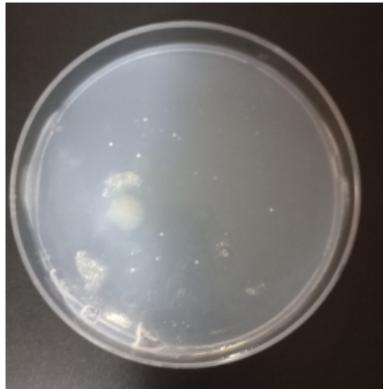
Week 2

If you look at the cultured bacteria in the second week, you can see several white spots. It can be seen that less bacteria appeared than in the first week.

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Week 3

If you look closely, you can see the white dots in the lower right. In the third week, a small amount of bacteria was cultured compared to the first and second weeks.

2.2.2 Interview With Export

Q. What could be a better way to grow germs?

A. Like a culture in a lab, sterilization can make a more reliable culture. P.acne, a typical acne bacterium, grows well in a vacuum because it is an anaerobic microorganism. It would have been better if we could create such an environment. It would be easier to create a specific environment if there was a tool to control humidity.

When making a culture kit, mix the ingredients that grow well according to the bacteria among the bacteria's food. Examples include beef blood, agar powder, etc.

Q. What kind of treatment do you usually give to acne patients?

A. First of all, skin identifies washing habits, frequency, cosmetics used, eating habits, sleep, stress intensity and factors, and consults and corrects them. Acne is usually accompanied by secondary infection, pore enlargement, scarring, and pigmentation, so first of all, pore sterilization cleaning and skin cell regeneration care are provided as manuals. There are acne-causing factors in the pores. In the case of suppurative, inflammatory cells are distributed, so using radiofrequency therapy. It kills inflammatory cells, sterilizes and cleans the pores, enters the regeneration stage, allowing skin cells to operate normally. It absorbs collagen, hyaluronic acid, amino acid, and stem cell culture ampoule needed to activate skin cells. And it balances oil and moisture, which is the best environment for skin cell activation.

Q. What is the best way to self-care?

A. Usually, when acne occurs, people often get squeezed by hand, but there is a high risk of secondary infection and scars occur. Do not squeeze it with your hands, but if it's full of yellow acne abscess, wash your hands and use a Q-tip to remove the excess (엑세스).

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Excessive extrusion causes lymphatic fluid to flow out and damage skin cells. Wash your face lightly with enough foam. There are many types of cleansing such as oils, lotions, and etc. Use one of them to keep your skin from drying out. Excessive washing of the face makes the skin dry and the skin barrier breaks down. Rather, acne can get worse. However, there is a point that contamination in the pores must be removed, so using oxygen bubbles allows sterilization and cleaning without

Q. What is the clear way to get rid of acne?

A. You need to remove acne-causing bacteria from your pore. Removal methods include extrusion, laser, and radiofrequency therapy.

Q. What is the best way to take care of your skin in daily life?

A. First, Moisture care, second, do not eat stimulating food, such as locking inflammatory factors such as delivery food with a lot of spicy food and food additives. Lastly, Stress hormones have a great effect on inflammation, so get rid of stress through mind control. It's about letting go of stress naturally and growing by stimulation. We need to change the concept of positive stress. We need a good night's sleep - helps regenerate skin cells.

3 Conclusion

3.1 How Does Cleansing Affect Adolescent Skin?

As you can see from the previous experiment, you can see the skin that changes noticeably in three weeks by cleansing every week. By removing impurities from the skin every day, it was possible to prevent many environments where pores could be clogged and acne could grow. By doing so, the condition of the pimple has improved a lot. In addition, skin color and elasticity of skin were also seen to improve.

As a result, it can be seen that if you cleanse continuously every day, not only the condition of the pimple improves, but also the overall skin improves.

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Algae As a Fertilizer For Houseplants: What Is The Most Effective Level of Algae?

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Abstract

In this experiment, we looked into the topic "Algae As a Fertilizer For Houseplants: What Is The Most Effective Level of Algae?"'. The purpose of the experiment was to show that harmful algae might be able to be used as a fertilizer for the growth of plants since algae are made by bacteria absorbing fertilizer runoff and the nutrients absorbed by algae may be used as a fertilizer for plants. The two plants used were 10 Lucky Bamboo sticks and 10 small Sweetheart Ivy. We examined the growth of each plant, grown in the same environment. The hypothesis was that 20% of algae would be the most effective level for the growth of plants. Since algae are partially made of toxic materials, more algae added to each plant can cause a decrease in the amount of growth. But the nutrients that algae consume in order to grow could act like a fertilizer for plants.

Contents

1 Introduction

1.1 Background

An algal bloom is a major issue derived from multiple factors in the environment and it causes side effects that can be dangerous to the environment and to humans. An algal bloom is a sudden increase in the population of algae in any type of water body. The most common type of algal bloom is caused by an abundance of cyanobacteria. Cyanobacteria algal blooms are caused by fertilizers and therefore, our experiment will reversely use cyanobacteria algal bloom as fertilizer. Algal blooms are also caused by the eutrophication of the water bodies. Eutrophication is the process by which a water body becomes enriched in minerals and nutrients specifically phosphorus and sulfur. The abundance of phosphorus gives the environment in which algae can rapidly increase in population causing algal bloom. Algal blooms also appear in freshwater caused by runoffs of fertilizer in nearby farmland. The environmental effects that algal blooms bring are the alternation of nearby plant communities, hypoxic conditions, changes in the color of water, and possible health risks. The abundant phosphorus that remains after the algal bloom can cause an alternation of plant communities in the acceleration of plant growth. The decomposition of algae consumes a large amount of oxygen present in the water body which causes a decline of oxygen present in the water body, and as a result, a hypoxic condition is created in the water body causing massive death of aquatic animals. Algae also have their own specific colors which contaminate the water in that color and they have main types. The possible health risks algal bloom can bring to humanity are mainly caused by freshwater algal bloom. There are also harmful types of algal bloom labeled as HAB which acts like a toxin when consumed. The economic cost to monitor, manage, and the treatment of this HAB is tremendous, and hypoxic conditions can appear all around the world causing high economic costs around the world. The world is experiencing a scarcity of natural resources, and even harmful algae that no one puts value on can be useful. Algae, even though it is responsible for harmful effects, is full of useful nutrients because they grow by absorbing nutrient runoff, and can be used for the growth of other useful plants. Therefore, we are trying to investigate a way to be able to grow plants, specifically house plants, on top of these nutritious algae.

1.2 Objectives & Significance

The goals of this experimental research are to test the efficacy of algae as a fertilizer for plants, and if the test is to be found positive, the most effective percentage of algae in water for plant growth will be studied and algae as a fertilizer will be analyzed in the paper.

Algal blooms are harmful; they can be a toxin and cause disease to people, however, algae can be beneficial when they are manipulated to be used as a fertilizer. Algae contain a lot of nutrients since they are created from either fertilizer runoff or excess phosphorus. Algae would be able to be turned into a form of fertilizer for plant growth. Algae present in freshwater can be filtered out and turned into a state of fertilizer. The presence of algal blooms raises the treatment cost of drinking water. Using algae as a fertilizer decreases the population of algal blooms, which would lower the cost of the treatment of drinking water. As it is mentioned earlier, algal blooms in water bodies cause various problems. The lack of studies and beneficial factors of algal bloom found by humans are gaps in the usage of wild algal blooms. To fill in this gap, this experiment helps show the benefits of algal blooms such as the ability to fertilize home plants.

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2 Hypothesis

Our hypothesis for this research is that a 20% level of algae will show the most effective level of growth rate in plants. The percentage of algae will be based on the amount of water in the bottle. For example, if there is 1000 mL of water, then algae 20% would be 200 mL. The percentage of algae existing in each plant causes them to be exposed to different levels of nutrients given. The cause of our experiment is to convey that harmful algae can be easily manipulated into a form where it can be beneficial to people. The reason behind our hypothesis is that even though algae can be helpful for plants, too much algae can be an overdose for plants due to the toxic material.

3 Literature Review

3.1 Concepts

3.1.1 Fertilizer

A fertilizer is an artificial material or a natural resource that people primarily use for foods or plants to improve their productivity and growth. Fertilizer provides more nitrogen, phosphate, potassium, and sulfur for agriculture which are the main nutrients for plant growth. Adding fertilizers to the soil that had enough nutrients causes some nutrients to not be used and they will end up in streams, rivers, lakes, and reservoirs. It causes various water problems, such as a reduction in the amount of oxygen in the water and a rise in the rate of growth of eutrophication. Eutrophication leads to the death of living organisms.

3.1.2 Different Levels of Algae in Water

For our experiment, a total of 20 samples of Lucky Bamboo and Sweetheart Ivy will be used to test the effects of different levels of algae on plants. This is crucial for our experiment because each can result in different outcomes of plant growth, and our goal is to find out which level of algae is ideal for home plants to grow in water. Then, people can use the resulting amount of algae for home plants, and with higher purchases of algae, the problem of algal bloom in water bodies can be partially solved.

3.1.3 Cyanobacteria Algae

Cyanobacteria is a photosynthetic microscopic organism or bacteria that is also known as blue-green algae. Cyanobacteria is a natural part of all-natural lake ecosystems. Cyanobacteria come in a variety of colors, including blue, green, brown, red, and white. Algal blooms are caused by many different factors, and one is caused by cyanobacteria in freshwaters with high nutrient concentrations, particularly in warm temperatures. Cyanobacteria algae, a common algal bloom around the world, will be the algae used in the experiment.

3.1.4 Plant Choices

Two plants will be used for this experiment, Lucky Bamboo (Dracaena Sanderiana) and Sweetheart Ivy (Hedera Helix "Sweetheart"). Lucky bamboo is known to be able to grow on water and the only supply they would need would be liquid fertilizer. They are also suitable for houseplants since they can grow in semi-shade environments and are fast-growing plants. Sweetheart ivies are also a type of well-known houseplant and an invasive species. Sweetheart ivies are also fast-growing plants and they can rapidly grow in rich soils.

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3.2 Developments

Humans consume algae as pills and medicine because "blue-green algae spirulina is a good source of protein...[and] also contain vitamins A, C, E, and several of the B vitamins, including thiamin, riboflavin, vitamin B-6, and folate" (Naveed 3). One of the main studies on algae's use as fertilizer is the *Role of blue-green algae in rice productivity*, which talks about how blue-green algae can replace nitrogen fertilizers; a positive result was found - "In all treatments inoculated with BGA with a low dose of NPK, there was [a] significant increase in all parameters of yield over the control" (Paudel 2). These provide essential information for our research that algae can replace fertilizers.

3.3 Research Gap

Algae used as fertilizer is the subject of several research studies mainly to replace nitrogen. However, they do not specify the number of algae used nor the best amount of algae for plant growth. Moreover, the effects of algae on the two plants, bamboo and ivy, have not been researched. It will be difficult to conduct an experiment with limited information on the effects of different levels of algae present on the plants. Thus, this research discovers the effects of algae on each plant and analyzes the differences.

4 Research Methods

4.1 Tools & Materials

The materials needed for the experiment were green algae, plants, plastic bottles, rulers, sunlight, a beaker, and tap water. To obtain green algae, we contacted a worker in Gyeonggi-do Hwaseong-si, as shown in the picture above, who works in a fertilizer factory and we could receive a tank with about 5 liters of algae water from him. We bought 10 Lucky Bamboo and 2 pots of Sweetheart Ivy plants in a plant shop. We obtained 20 large plastic bottles in trash bins of three different apartments and used them as a container for plants.

4.2   Methods & Procedures

The methods used in this experiment are as below:

1. Cut plastic bottles into containers (Different sizes for each plant species)

2. Separate 2 Sweetheart Ivy plant pots into different stems with roots

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3. Names for each plant species (A for Lucky Bamboo, B for Sweetheart Ivy)

4. Names for plants with different percentages of algae (1&2 - 0% of algae, 3&4 - 20%, etc)

5. Calculate and measure the percentage and amount of algae that should be added to each sample.

Lucky Bamboo	Percentage of algae (%)	Volume of algae (mL)	Volume of water (mL)	Sweetheart Ivy	Percentage of algae (%)	Volume of algae (mL)	Volume of water (mL)
A-1,2	0	0	1000	B-1,2	0	0	400
A-3,4	20	200	800	B-3,4	20	80	320
A-5,6	40	400	600	B-5,6	40	160	240
A-7,8	60	600	400	B-7,8	60	240	160
A-9,10	80	800	200	B-9,10	80	320	80

6. Pour each measured algae into their containers

7. Measuring the height of each plant daily

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8. Collecting data for analysis

	5/17	5/18	5/19	5/20	5/21	5/22	5/23	5/24
A-1	91.7	94.5	94.5	94.5	94.7	94.7	94.8	95
A-2	78.5	78.7	78.1	78	78	77.8	78.3	78.5
A-3	76.5	76.3	76.4	76.5	76.5	76.7	76.3	76.7
A-4	87.8	87.8	88.2	88.1	88.1	88.2	88.5	88.6
A-5	85	85.8	85	85.5	85	85.6	85.6	85.6
A-6	88	88.3	89	89.1	89.1	89.1	89.3	89.7
A-7	78.1	78.1	78.1	78.2	78.3	79	78.6	79
A-8	83	83.1	83.4	83.5	83.5	83.5	83.8	84	84
A-9	81.6	82	82	82	82	81.9	82	82.1
A-10	86.7	86.8	86.7	86.9	87.4	87.4	87	87
B-1	14.7	14.7	14.7	16	16.1	17.2	17.2	17.7
B-2	17.5	18	17.9	19.5	19.8	20.1	20.7	21
B-3	13.1	14.3	14.7	14.7	16.6	17	17	17
B-4	16.8	17	17	17.4	17.4	17.4	17.4	17.4
B-5	16.9	17.7	17.7	17.8	17.8	18.2	18.2	18.6
B-6	11.7	11.9	12	12	12.7	12.7	12.7	12.9
B-7	11.2	11.5	11.5	11.3	11.5	11.8	11.8	11.8
B-8	16.7	17	17.2	17	17	17	17	17.2
B-9	17.0	17.1	17.5	17.5	17.4	17.4	17.5	17.5
B-10	19.8	19.9	20.9	20.8	20.8	21.3	21.5	21.6

Height of Plants (cm)

5 Data & Results

Growth of Lucky Bamboo
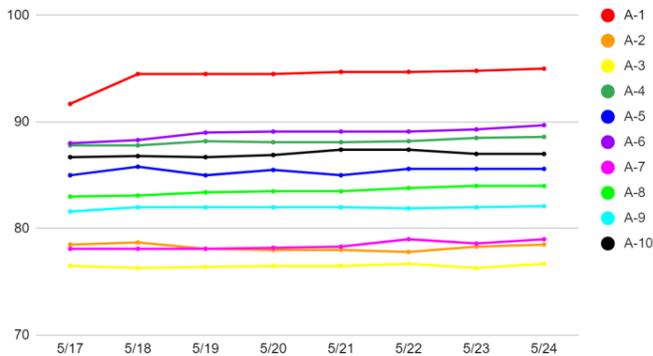
A-1 and A-10 grew at the beginning of the experiment, but each stayed constant or decreased in growth. Even though the heights did not increase constantly throughout, both plants' heights grew

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on the final day when compared to the first day.

A-4, A-6, A-8, and A-9 all grew constantly throughout the experiment even though there were minor ups and downs in height. A-4 and A-8 grew by about 1 cm when comparing the heights when measured on the first day and the last day. A- 6 grew about 2 cm from the first day to the last day, while A-9 grew 0.5 cm with the same conditions.

A-2 grew slightly, but then the height measured dropped by a lot due to a leaf falling off from the bamboo, but after the leaf was fallen off, the height seemed to start growing again. The height of A-3 remained fairly constant throughout the experiment as shown in the graph and the data table. On the other hand, A-5's height varied a lot due to some margins of error and unknown variables that we could not account for and find. For A-7, the height seemed to stay constant for some days, then it grew by about 0.7 cm on the sixth day, resulting in a total of 0.9 cm of growth when comparing day 1 and day 7.

Growth of Sweetheart Ivy
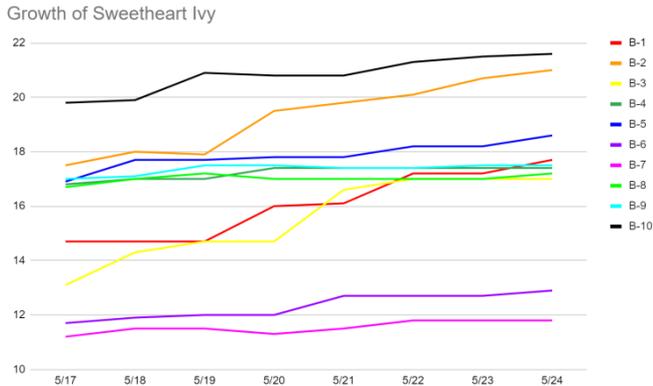
B-1, 2, 3 each showed a high increase in growth each growing over 3 cm in a week. Samples B-1,2 remained at a constant height for 3 days and after on showed a rapid increase in their height, resulting in more than 3 cm of growth.

B-4, 7, 8, 9 were the samples with the least amount of growth each not being over 1 cm of growth. B-7, 8, 9 were exposed to high levels of algae which might have been the cause of low growth compared to the other plants which had lower levels of algae.

B-5, 6,10 showed minor growth each growing by 1.7, 1.2, and 1.8 cm. B-5, 6 were exposed to the same level of algae each being contained with 40% of algae and B-10 with 80% of algae.

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6 Analysis & Discussion

6.1 Discussion

In the experiment, we found that for Lucky Bamboo A-1 and A-6 showed the highest growth among the samples. A-6 had a constant growth rate whereas A-1 grew at first but remained constant for the rest of the days. Therefore, it is concluded that Lucky Bamboo is to grow effectively in water with 40% of algae. Sweetheart ivy showed the highest growth with an algae level of 20%. The plants that were not exposed to any algae showed the next highest growth for Sweetheart Ivy. This experiment's results that have been made can give more support for how algae shouldn't be used with greater content but rather in small portions. Plants that were most exposed to algae with a higher percentage were observed to have a lower increase in growth. Samples A-1, 2, and B-1, 2 showed constant growth in their height whereas samples A-9, 10, and B-8, 9 was shown to not have as much growth. Other samples examined also have been shown to prove the same outcome. As samples A-4 6 and B-4 6 showed how either they were observed to grow less or showed decreases in their height. However, there were some exceptions in height growths for sample B-10 has shown excessive growth compared to the other sample B-9 which was also exposed to the same level of algae. From this analysis, we can also assume that algae level, the environment, and the characteristics of the plants can also give out different outcomes. For instance, we have observed that a few of the plants we bought were in the process of rotting even before we exposed them to algae which might have caused differences in their outcomes.

6.2 Limitations

The temperature of the current season was too low for algae to grow and affect the plant growth as much as it would if we did the experiment in the middle of summer. Due to the short amount of time that we were given after we had algae in our hands, we could only conduct an experiment for a week, which might not be enough to conclude a better and more exact correlation between the percentage of algae and the amount of growth that each plant had. Another limitation would be that some of the plants had a few leaves fallen out of their stem and the height of the growth measured decreased by a lot. For example, A-2 had height decreased by 0.6 cm on the second day due to a fallen leaf. We held this problem by measuring the height of another leaf for the rest of the experiment.

7 Conclusion

Our hypothesis for this research was that 20% level of algae will show the most effective growth rate for Lucky Bamboo and Sweetheart Ivy. We used five different levels of algae which were 0%, 20%, 40%, 60%, and 80%. The result of this experiment for Lucky Bamboo showed that plants with 0%, 20%, and 40% levels of algae had the most effective level of growth rate. Within these ranges, Lucky Bamboo with 40% of algae showed the most constant and high growth and we concluded that this level is the most effective for Lucky Bamboo's growth. By this result we can conclude that our hypothesis did not exactly match the result, however, it was near it. The result of this experiment for Sweetheart Ivy was that the water with 20% of algae showed the most growth so the conclusion is that 20% of algae is the most effective for Sweetheart Ivy's growth, which follows our hypothesis.

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Future Research & Improvements

Future research can be improved by conducting the experiment with other different plants and for a longer period of time because observing the growth of plants only for a week shows more effects of confounding variables and other variables. Moreover, the results of Lucky Bamboo and Sweetheart Ivy would not be the perfect representative of all houseplants. In future studies, more kinds of plant species could show a more accurate representation of the effects of algae as fertilizer, unlike our model.

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The Correlation Between Stock Market Fluctuations (NYSE) and Number of Suicides in The City of New York 2000-2019

Jihoon Choi, Sejin Tennant, Jiwoo Ma

Abstract

This research will discover the correlation between NYSE stock market fluctuations and suicides in New York from 2000-2019. Past researchers have tried to analyze this correlation, but different answers and results were given every time. Furthermore, this research is based on a Western country, whereas earlier research has focused on Asian countries, so it is thought that different results could be produced. The correlation coefficient(r-value) and p-value were calculated using google collab, with suicide data from Epi Data Brief and stock market data from Yahoo! Finance. Though basic information was shown, monthly data was not identified, creating a barrier to our research since it would reduce reliability and validity. The number of suicides were not higher than average suicide (488.8 suicides) during the great recession in 2008, showing no relationship between suicide and the stock market and economy overall in the great recession.

The result of the research was that for males, the correlation between suicide and the stock market was 0.3 with a p-value of 0.2 , implying a weak positive correlation that is not significant. For females, the correlation was 0.22 with a p-value of 0.36 , which was far from significant. For males and females, the correlation was 0.3 with a p-value of 0.21 . All results imply no significant results. This implies more data to be observed. There may be a weak correlation now, but if monthly and exact data are present, more reliable data could be shown, to get a more meaningful data.

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1 Introduction

1.1 Background

1.1.1 Stock Market

The stock market our team has defined for this topic is the NYSE, or the New York Stock Exchange, which is the world's largest stock market exchange in the world. It is owned by the ICE, or the Intercontinental Exchange which operates 12 well-known stock exchanges around the world. The NYSE was founded in 1792 and currently holds the majority of the stocks in some of the largest companies in the U.S. such as Tesla, Apple, and Google.

1.1.2 Great Recession

The Great Recession is the well-known terrible-stock market crash that occurred from around 2008 to 2012, and had many negative impacts on not only the value of the stock market that held many people's money but also people's lives. It increased inequality, and unemployment, and also declined economic activity and stock market activity. (economic commerce decreased by 60% according to stock records). It significantly decreased in June 2009, with policies that gradually helped resolve the conflict while Barack Hussein Obama was president. It created a large downfall in many of the stock markets, though suicides seemed to not have significantly decreased.

1.2 Research purpose

1.2.1 Past Research

The purpose of this research is so people can understand the correlation there is between suicide in New York and the downfall of the supposed economic commerce in the New York Stock Exchange, or the NYSE for short, to solve the resulting curiosity. Furthermore, it can be determined if suicide and NYSE stock fluctuations correlate. This will set the way for understanding the impacts of stock markets on people and their responsiveness. There were several papers discussing stock market crashes and suicide, but they were primarily focused on Asian countries, which led to less access to research on Western countries. Furthermore, the studies done had conflicting and inconsistent and contained loose results so our team could not have a strict, specific result. A study by Yin, Honglei, et al in China found no correlation between suicide and stock markets while in Taiwan, Lin, Chung-Liang found a positive correlation between suicide and stock market downfall. To further investigate the correlation between different countries, this meta-analysis is being presented.

1.2.2 Hypothesis

This research finds a correlation between suicide and the stock market, and it is hypothesized that as stock market performance declines suicide would show increase, thus showing a negative correlation. Stock markets could be related to mental health, and thus suicide, which makes way for predicting that suicides are negatively correlated with stock market performance levels. Another hypothesis is that there would be no correlation, since the results, suicide were not higher when the great recession happened, which caused a downfall in the stock market.

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2 Methodology

Data from Epi Data Brief(an American government website on health and its statistics)was used to find essential and specific suicide information in New York. The Epi website has shown annual suicide data from the year 2000 to 2019. The information was annual suicide, and not monthly, which could influence the reliability of the results since fewer data can be recovered. The information from Yahoo Finance containing the historical stock market prices for NYSE was used to see the annual percentage change of NYSE. The annual percentage was analyzed for NYSE from Yahoo! Finance by subtracting December closing price data for the previous year from the measuring year's December closing price and dividing it by the previous December price. Using Google Collaboration, the scatter plots were graphed and plotted, showing the p-value and r-value. Though there was data, only annual data could be revealed, creating a barrier to our research in terms of reliability and validity. For later research, finding sites where there are monthly suicide data would be very helpful, causing better results.

Even though the third variable can not be isolated, which could be unemployment and an ill-timed divorce, which could potentially influence the results, correlation just implies that there is a relation and even more correlation research could be done. This research purely identifies relationships and will find correlations.

3 Results

3.1 Males Data
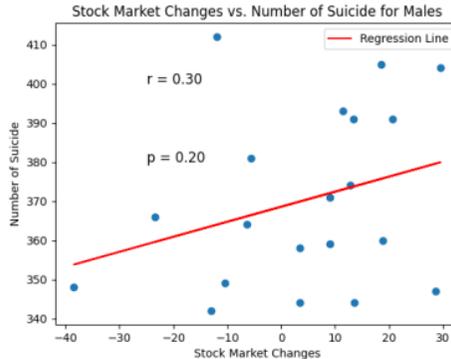
Source: Google Collaboration

Correlation	p-value
0.3	0.2

It has been founded that there is a fairly weak positive correlation between suicide and stock market changes for males living in New York. This implies that data showed suicide going up when

the stock market's percentage change went up. The P value was 0.2 , implying that the results could have happened by a percentage of around 20% and that results are not very consistent.
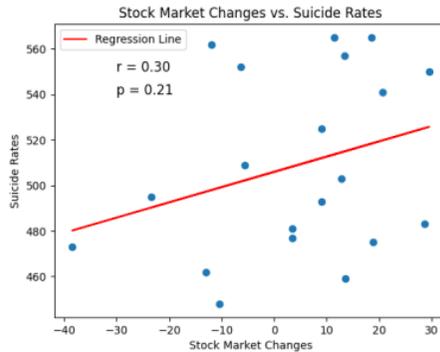
3.2 Females Data
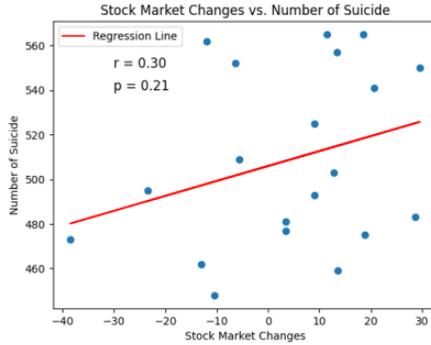
Source: Google Collaboration

Correlation	p-value
0.22	0.36

There was a weak positive correlation between the suicide and the stock market for females, similar to the results of the male's result. The p-value was 0.36 , which was close to the previous results.

3.3 Males and Females Data

Source: Google Collaboration

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Correlation	p-value
0.3	0.21

The correlation was close to being moderate, with a 0.30 correlation, and the p-value was also 0.21 , which was closer to being statistically significant than previous results.

4 Conclusion

4.1 Analyzing Results

As a result, it is concluded that in New York, from $2000-2014$, suicide and stock market performance were insignificantly weakly correlated for females and males alike, having a correlation that ranges from $0.22 \sim$ to 0.3 . This finding was unexpected since it means to say that suicide showed increase when stock market performance increased. But since the p-value was less significant than 0.05 , saying there is a correlation would be invalid and not statistically significant, since this finding may have happened due to chance. Though there is a nonsignificant weak correlation between suicide and the stock market, according to Nandi Arijit, et al, another factor, such as unemployment, can be more highly correlated with suicide. According to a study by McInerney, Melissahough, et al though, stock market crashes increased antidepressant use, but it would not have been enough to cause many to suicide. This would imply stock market would not be a direct cause of suicide.

This result signifies that more research should be done, from getting vast amounts of data and analyzing reliable data. Because this research was unable to get data on annual suicide, research was hindered from reaching data and thus more reliable results. The danger of the stock market is a mystery, but further research could help with this problem. NYC suicide should also be tracked with further data so that future research could be done with more reliability.

4.2 Conclusion

Government websites such as the Epi Data brief were found to obtain information on suicide, and a finance center for the NYSE stock market information. It was hypothesized that suicide would have a negative correlation with the NYSE. Results showed suicide weakly increasing as the major stock market in the US(NYSE) had a positive percentage in value for males and females alike. The hypothesize was disproved.

The contradicting results may be due that suicide is not directly influenced by stock markets, but rather could other factors such as unemployment and ill-timed divorce. Again, the results had a weak positive correlation of around 0.3 and an average P-value of about 0.23. Some readers may notice that the P-value is not low enough to be statistically significant, and this would have happened because the project could not obtain enough information as it was not accessible.

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Diabetic Patients' Safer Option of Covid Vaccination: A Comparison of Pfizer and Moderna

Hyoungsun (Eddie) Koh, Sieun (Shine) Lee, Esther Noh, Yeijin (Stacy) Kwon

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1 Topic Statement

1.1 Background

1.1.1 Pfizer

Pfizer is a vaccine that provides a framework for the cells in one's body to build a defense against SARS-Cov-2. This vaccine included mRNA encoded with the viral spike glycoprotein that instructs bodies to replicate a protein containing the outer layer of the coronavirus. In turn, the immune system detects them as malignant, releasing antibodies. Antibodies work by initiating self-destruction after attaching them to pathogens. Other elements of Pfizer include lipids such as ALC-0315, ALC-0159, Distearoylphosphatidylcholine(DSPC), and cholesterol. Salts such as potassium chloride, potassium phosphate, sodium chloride, phosphate dihydrate, and sucrose are added to ensure the quality of the mRNA protein.

1.1.2 Moderna

Similar to Pfizer, Moderna contains a similar version of mRNA protein with the layer of coronavirus. One key difference is that the amount of dosage in Moderna differs from that of Pfizer. Although the dosage differs, the mechanism of how the immune system releases antibodies to fight the cell is still the same. Other ingredients include lipids such as PEG2000-C-DMG, a synthetic lipid used to manufacture lipid nanoparticles that are used in mRNA, 1,2-stearoyl-sn-glycero-3-phosphocholine, BotaniCal, and SM-102. To stabilize the mRNA protein, salts, sugar, and acid stabilizers such as Tromethamine, Tromethamine hydrochloride, Acetic acid, Sodium acetate trihydrate, and sucrose are also included.

1.1.3 Diabetes

Diabetes is a disease caused by an increased glucose level that overcomes the amount of insulin produced by the pancreas. Diabetes affects many parts of the body such as nerves, bladder, and kidneys. Even though diabetes is age and gender-dependent, it poses a hazard since, regardless of age, both its incidence rate and mortality rate are rising. In a case study done by Khan Fareena and other researchers, diabetic patients who were exposed to covid vaccination saw more side effects than the initial dose. Even in the second dose, diabetic patients elicited a more frequent response to side effects than non-diabetic people.

1.1.4 Side Effects

Side effects are a response by the immune system that is beyond a treatment's effect. When a vaccine is injected, it affects the whole body, as the chemical component travels through the bloodstream. Although this process can help treat the main problem, there are other parts of the body that can react abnormally to the vaccine. As a result, the immune system produces an undesirable side effect to oppose the unexpected reaction.

1.2 Problem

In the modern world, COVID-19 is a prevalent disease that poses a threat to a lot of individuals. Diabetic patients, however, face even more risk than normal people because of the disease's properties. A study done by G. Targher, A. Mantovani, and other researchers found that having diabetes was associated with about a 4-fold increased risk of having critical COVID illness compared with

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others without diabetes; these conclusions are independent of age, sex, obesity, hypertension, and smoking. In order to counteract the effects of the coronavirus, multiple COVID vaccines have been invented, such as Pfizer and Moderna. Although these vaccines have proven efficient most of the time, unexpected health problems still occur, affecting diabetic patients in an unhealthy manner. Since Pfizer and Moderna both are effective vaccines against the coronavirus, there isn't a clear standard for which particular vaccine serves a greater purpose for diabetic patients.

1.3 Significance

The Covid-19 virus is commonly thought of as dangerous but is especially dangerous for people with diabetes. Diabetic patients are increasing as time goes by, so some resolutions should be executed. Since there are 2 major companies that are known for vaccination, we wanted to perform comparative research to find out which vaccine would better diminish the risks of diabetes. Although there is no guarantee that the vaccine is correlated with the disease, there are still side effects that result from the vaccines, negatively harming people. Our research will be consequential for diabetic patients, especially because diabetes is an elementary step that can cause life-threatening diseases such as ischemic stroke. In this paper, we need to research all side effects that result from Pfizer and Moderna and analyze them in a biological sense to determine which vaccine offers a safer outcome.

2 Research Questions

Our research question is 'What is the main difference between Pfizer and Moderna's effect on diabetic patients? and 'What vaccine provides safer outcomes for diabetic patients?'. We want to focus on how and what such factors influence the risk of diabetes. Our hypothesis for this research is that Moderna would be a safer vaccination company for diabetic patients compared to Pfizer because of its more widespread use.

3 Literature Review

3.1 Concepts

Over the past 3 years, COVID-19 has been a worldwide pandemic capable of causing a number of deaths. This outbreak serves multiple problems -affecting health cases the most. In particular, patients with diabetes display a higher percentage of death rates than those without. A study done by Hamad Ali and other researchers showed that the COVID-19 virus highlighted the impact of diabetes on the severity of the disease. In response to this epidemic, Moderna and Pfizer, the most effective vaccines against coronavirus, were invented. These mRNA vaccines have proven to be effective approximately 95% of the time. However, these boosters still show negative side effects that may pose serious harm.

3.2 Developments

Pfizer and Moderna have very similar effects on the human body, but they still have different ingredients and concentrations for each product. Although they both may be effective against COVID-19, their side effects vary from time to time. Through previous research, the severity of the side effects on diabetic patients has been proven. With this, we designed our research to analyze the side effects of both vaccines in a biological sense to provide a clearer stance as to which booster is safer than the other.

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3.3 Research Gaps

Through the research papers above, we figured out that diabetic patients who have received the COVID-19 vaccine showed an increased mortality rate. However, there are very few comparative studies done on which vaccine is safer for diabetic patients. In turn, each vaccine offers varying side effects which may negatively affect patients. Moreover, even though there are a couple of side effects listed for both Moderna and Pfizer, offering the whole perspective of risks associated with the vaccine would be optimal. Therefore, we hope to investigate the differences in side effects to show a better understanding of which vaccine has a lower severity in reactions.

4 Research Design

4.1 Objectives

In this research, we will conduct a comparative study focused on the side effects of COVID-19 vaccination relating to Moderna and Pfizer. Through this, we want to have a better understanding of the correlation between COVID vaccination and diabetes because of its worldwide impact. Researching which vaccination offers a safer approach to diabetic patients would be our key point. As the development of vaccines is not fully done, there are no approved studies that state whether the vaccination is safe and reliable for every human being. Also, we want to aim to reach a consensus on which vaccination offers a lower risk overall by analyzing the side effects of each one.

4.2 Methods and Sources

In this research, we will conduct a comparative study of the side effects of Pfizer and Moderna. Using data gathered from previous research, we will analyze what those side effects are, how they work in the body, and whether they contribute a slight or significant portion of risk for diabetic patients. Specifically, all the analysis will be done in a biological sense. When finding articles and research papers related to our topic, we would take note of keywords such as "Pfizer's side effects", "Moderna's side effects", and "diabetic patients". As these words are the topic of our research, we would prioritize analyzing them as deeply as possible. After gathering all data and information regarding the side effects of Pfizer and Moderna, we would analyze how those side effects occur by incorporating their effects on specific body parts. By determining the severity of all the side effects and their outcome on the body, we would be able to establish a point that states which vaccine is safer.

4.3 Obstacles

Despite the in-depth analysis we plan on researching, there would be a couple of obstacles. As high school students, we are not able to perform a direct experiment on the effects of the vaccine on diabetic patients. This would require the government's consent, and since we are not professionals, it would be hard to conduct this type of study. In addition, this paper would offer a choice on which vaccine is better most of the time, but not a full guarantee that the vaccine would prevent all side effects of the virus. Since there are still debates going on in the field of research about the correlation between diabetes and COVID-19 vaccination, we are only going to focus on examining the side effects of the vaccines. Due to these limitations, we have settled on a collective and comparative study where we read various articles and past research papers to get the answer to our research question.

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5 Weekly Plan

Week 1 3/19 ∼ 3/25	Background information
Week 2 3/26 ∼ 4/01	Lit review
Week 3 4/02 ∼ 4/08	Research Design
Week 4 4/09 ∼ 4/15	Results
Week 5 4/16 ∼ 4/22	Discussion
Week 6 4/23 ∼ 4/29	Conclusion
Week 7 4/30 ∼ 5/06	Bibliography
Week 8 5/07 ∼ 5/13	Go over our research paper and finalize
Week 9 5/14 ∼ 5/20	Presentation script/PPT
Week 10 5/15 ∼ D-Day	Presentation practice

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6

Comparing The Performance of Different Software Frameworks/Libraries for Game Development

Joe Chun, Woojoo Kim, Matthew Park

Abstract

Frameworks are defined as the structure that can be the structure of the building, projects, or anything else. Software Frameworks are the structure for building software. These software frameworks are associated with specific programming languages. Software libraries are collections of object files. There are two types of libraries. Static and dynamic. Static libraries are large in size but not shareable, but dynamic libraries are small in size and shareable. Love2D, Pygame, and Kaboom.js are the frameworks and libraries that will be compared. Love2D has a great physics engine, and it has flexible collision size adjustment, but its input handling is slow, and the time input to execute is long other than Pygame and Kaboom.js. Kaboom.js has advantages in input handling, the delay between input and execution is faster than other frameworks and libraries. But Kaboom.js's physics engine poses a disadvantage. Collision detection is not accurate. But it is the easiest. Pygame has a good physics engine but not as Love2D. Pygame had low FPS and bad input handling. Overall, Love2D was the best choice for game development.

Contents

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1 Introduction

1.1 Background Information

The term framework is defined as the structure. Like its definition, frameworks are the structures of a system, buildings, projects, etc. Software frameworks are structured for building software. It acts as a foundation in which we do not need to make extra logic from scratch to build software. Software frameworks can simply be defined as resources for developing software. Software framework acts as a foundation in which extra logic does not have to be created from scratch to build the software. These software frameworks are associated with specific programming languages such as javascript, python, c++, etc. For example, Microsoft's framework, .NET core is associated with a programming language called C#. In 1960, software engineering was accepted as its engineering. After software engineering got more developed and improved, software frameworks were developed for software engineers. Software frameworks supported software engineering more easily and better. A software library is a collection of programming resources often used for building software. In software libraries, there are two types. The two types are static libraries and dynamic libraries. Static libraries are collections of object programming files. As the developer links static libraries, static libraries simply take the developer to a specific object program file that the developer needs for his software which should be compiled to access the object file. At the end of linking static libraries, exporting, or running the software, the software would be very large since the software files will contain all the code and all the required library code if the software is linking static libraries. Dynamic libraries have additional features other than static libraries which is that it is shareable, but dynamic libraries have it's offer. The input of the dynamic library is similar to the static library, object files. Dynamic libraries' way to link and a way to handle is different from static libraries. In the dynamic library, it records the information of the software when programming, but does not load the recorded information when the code is executable, which results in a small size of the software. When the software is executable, the code is loaded to the shared memory which can be used by other programs. The frameworks/libraries that this essay will discuss are Pygame, Love2D, and Kaboom.js. Pygame is a library that uses a programming language called Python. Love2D is an open-source cross-platform framework that uses a programming language called Lua. Kaboom.js is a library that uses a programming language called javascript or typescript. By comparing each of these frameworks and libraries, which will find the best frameworks or libraries for game development.

1.2 Importance and Impact

The importance and impact of the study could be huge. The market of games is very large, lots of people play video games and buy video games and there are lots of big game companies like Nintendo, EA, Nexon, etc. Recently, the concept of metaverse has risen and large companies like Microsoft bought game company BIZZARE.co to invest in the multiverse. And also, in recent years people are getting interested in using frameworks and libraries. Since many people are interested and trying to start game development, this experiment can be a valuable experiment that will benefit the game development community and the game development industry. This comparison of the performance of different frameworks/libraries for game development study could be important to the game industries and game developers since choosing software frameworks or libraries is important for developing games because people tend to like good games with high quality. This study could also impact game developers who want to try and start game development since they do not know what frameworks or libraries to start for game development.

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2   Literature Review

This experiment will compare three frameworks and libraries that each use different programming languages and define what frameworks or libraries and what programming language has the most advantages for game development. To compare these three frameworks and libraries, 2D Platformer was the kind of game that has many advantages for comparing frameworks/libraries. 2D Platformer is a type of video game in which the user can control the character. For example Mario. Developing a 2D platformer can compare each framework and library's physics engine, graphic rendering, input detection, and scripting. Graphics rendering is the process of displaying characters, environment, and effects. This means it will give users more immersion. Also, there are two types of physics rendering: pre-time rendering and pre-time rendering. Real-time rendering is usually used for motion capturing. This means it will show the movement of the characters, using FPS (Frame Per Second). Pre-time rendering is usually used for motion pictures. This means pre-time rendering will show the motions that will be used for character movement. Pre-time rendering requires high-quality motion pictures. Comparing physics rendering will define which framework can show a stream of light. The physics engine is an engine that simulates physical situations. For example, if a player falls from the ground the program should demonstrate the motion of the character falling by using the physics engine. Another example is a collision. Collision is a program that can make the character stand on the ground. If there is no collision then the character will not be able to stand on the ground since there is no collider that makes the character stand from the ground. By comparing the physics engine of each framework and library it can define which libraries can benefit from collisions and by using the physics engine it can make the game more natural. User input handling is basically if the user puts the input then the program will receive the input and execute the input. For example, if a user presses the up key at the keyboard then the program will receive the input and execute then the player will jump. The method of comparing user input handling is how long it takes to receive and execute the input. Scripting is the word that is used to execute the program. The method that is used to compare the script is how many scripts it takes to make the same game, and how much time it takes to create the same game. The libraries that used fewer scripts and the libraries that finished making the game earlier are the better libraries. By doing this research we had some research gaps. First of all, by making games with Love2d, there was a problem exporting the map through the code. But the problem has been solved by importing an image in the code and dividing the code by 16 pixels, then putting the image on the map for the game. Secondly, using Kaboom JS had some problems. To compare the FPS(FramePerSecond) the most important part is animation. However, using KaboomJS there were some problems putting the animation in the game. The solution for this problem was cutting the image by pixels more specifically. Also, there was a problem with the collision. This means if the character touches the ground it automatically falls to the ground. The solution to this problem was adding the code called solid that will block the character passing through the block. Making games with Python had some problems. For example, if the character moves the character automatically gets duplicated. The solution for this problem was to erase the code that has the problem and change the background to white. If the background changes to white then however it gets duplicated the background will hide the image that is duplicated.

3   Methodology

In this experiment, a framework called Love 2d, and libraries called Pygame and Kaboom. js are used to make our own 2d Platformer game with our own assets and then compare the quality of

the physics engines, graphics, debugging speeds, input handling, and the script complexity of the game. These are the methods of how we are going to compare our projects.

3.1 Method of comparing the physics engine

Physics engine is when the real-world physics is displayed in the Game. For example, creating gravity and some forces that are in the real world. For the physics engine, their collision, gravity, and player movement are compared by comparing what frameworks and libraries used had a smoother collision, gravity, and player movement, and which had higher accuracy.

3.2 Method of comparing the graphics

Graphics displays the player, the map, sound effects, and so on. It includes animation, sound effects, FPS, and so on. It is a vital resource in game development. For graphics, player movements are compared to whether it is smooth or not. For debugging speed, we calculated how many seconds it takes to make the program run (however, we didn't have the professional instruments to calculate it, so it might be a little inaccurate).

3.3 Method of comparing the input handling and debugging speed

Input Handling is when the game receives a key or mouse input from the player. For example, when the game receives the right key, the player moves right. For input handlers, how fast it takes to make the player follow our command is compared. So for example, if the space button is pressed, the speed after the character jumped is what it is going to be compared

# 4 Method of comparing the code complexity

For the code complexity, codes for Pygame, Kaboom, and Love 2d are compared to find whose code is longer. This is to find which frameworks or libraries are simpler to use by comparing the code length. Also, what frameworks and libraries have easier simpler code? For example, in Kaboom, you only need the code 'area()' to make a collision, and PyGame and Love 2d need a lot of codes. So, in making collisions, Kaboom is easier to use.

5 Results

Making a game with Love2d, there were advantages and disadvantages. Love 2d can change the size of collisions. Which means. The user can decrease or increase the area where the player can stand on the ground safely. Love2d has a great physics engine compared to Kaboom and Python. If the player jumps and lands on the ground but if the player touches the spike even one pixel the player will get eliminated. However, Love2d has the disadvantage of user input handling. This means the Love2d program takes a long time to receive input and execute. This disadvantage of Love2d will make the player frustrated. Because if the user presses the key and it takes a long time to execute the input that is received from the player it will have a problem completing the stage. Lately, Love2d has taken advantage of Debug speed. Debug Speed is how much time it takes to execute the code. It takes 1.30 seconds to execute the code completely.

There were some advantages and disadvantages for KaboomJS. Kaboom has the advantage of user-input handling. This means it will take less time to execute the input from the user. This

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advantage will make users comfortable with completing the stage. Since it takes less time users will easily get the time to jump or run. However, Kaboom has a disadvantage with the physics engine. This means if the player didn't touch the spike but it could make the player eliminated. Also if there is a bad physics engine, it can make the player fly. Also, Kaboom can't increase or decrease the collision. Which means it will have disadvantages in making spikes. Kaboom has a disadvantage with debugging speed. It takes 7 seconds to execute the code completely. This disadvantage will lead users frustrated waiting to play the game and it will take a long time to execute and test the code. Also, Kaboom has a simple script that will make game makers understand the code easily and young students can make it too.
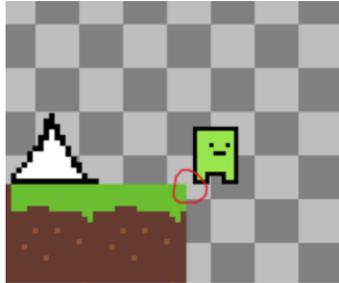
Lastly, python has some advantages and disadvantages. First of all, python has a great advantage in graphics. This means Python has great animation and movement, This advantage will make users enjoy moving the characters. It takes 2.56 seconds to execute the code completely. Which is not bad. However, the disadvantage of Python is that sometimes the screen cuts out. This disadvantage will make users miss important information or important scenes. Lastly, Python has the advantage of increasing and decreasing the collision. Which will have the advantage of making obstacles. Since it can change the collision it can make the area of spike that will hurt the character. Lastly, python has disadvantages with input handling. This means it takes some time to execute the input. This disadvantage will make users mad sometimes. Because it takes some time to move the character completely.

6 Conclusion

In this study, each framework, and library compared the physics engine, graphics, and input handling. For the physics engine, Love2D was the smoothest framework, and then Pygame, and then Kaboom. For debugging speed, Love2D had the fastest record, and then Pygame and then Kaboom. For input handling, Kaboom had the fastest delay, and then Pygame and then Love 2D. For graphics, Pygame had the best quality, and then Love 2D, and Kaboom had the worst quality. For script complexity, Kaboom was the easiest, and then Pygame and then Love 2D. For people who just started programming and who want easier-level codes, Kaboom will be a better choice. For people who are intermediate at programming and need a little high quality, Pygame will be a good choice. For people who are good at programming and need high-quality games, Love 2D will be the best choice among those three. Overall, Love 2D showed the best performance.

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Effects on the Behavior and Brain Morphology due to MOBA(LOL) and FPS Games

Alex Kim, Andrew Kim, and Daheun Lee

Abstract

As it is the 21 st century, video games have become a worldwide cultural phenomenon for all ages. This study deals with the two main genres of video games/e-sports, FPS and MOBA, and how they are capable of affecting the brain's morphology and behavior. Since this study is a literature review, the method of gathering information was by looking at studies and researches other people have conducted, and analyzing the effects of MOBA and FPS games on people's behaviors and brain morphology. This study reviews two studies, each discussing FPS or MOBA games and their effects on the brain's morphology and behavior. The first research paper that was used which was written by Qinghua He, Ofir Turel, Lei Wei, and Antoine Becharathe was about analyzing the differences in the brains' morphology of extensive video gamers who played MOBA games frequently and non-gamers who do not play MOBA games or other games at all. The second research paper that was used was written by Klaus Mathiak and Rene Weber and explained the experiment of examining the brain structures and behaviors of violent game players, who mostly play FPS games, using a type of neuroimaging called fMRI. FPS game players' amygdalas showed suppression of hemodynamic activity during the violence. Due to this result, it was hypothesized that FPS players are going to experience numbness, loss of memory, and attention difficulties more often than non-gamers. The comparison in the brain structure of MOBA players and non-players shows that MOBA gamers had less GMV in many parts of their prefrontal region, which we can hypothesize that they have a harder time functioning properly in their normal life than the non-gamers. Abnormalities in VMPFC, DLPFC, and other prefrontal regions can result in increases in problematic and aggressive behaviors, unable to control future consequences normally, and can also reduce a person's ability to adjust expectations [6].

Contents

1 Introduction

Figure 1: Share of South Koreans playing games from 2015 to 2022

After the 20th century, the 21 st century has led to a new generation of video games. This led to many young people around the world spending time in virtual reality; e.g., it was recorded in 2022 that over 74 percent of the Korean population played video games that year which was almost a 10 percent increase from 2019 [1]. While some video games might affect positive coordination and visual selective attention, some can also negatively affect things such as behavior.

1.1 Significance

By studying and analyzing the effects of MMBA and FPS games, we can see which specific part of our brain is stimulated and activated after gaming. It is important to know the effects of video games on our brains so that we can regulate and prevent ourselves from leading to the negative effects of gaming such as being addicted, having violent behavior, or losing control of ourselves. Many people around the world are still debating whether gaming has positive aspects in our lives. However, according to the 2021 systematic review and meta-analysis, 3-4 percent of gamers, which is 60 million people, are addicted to video games and have disorders associated with gaming. Studies regarding the development of the brains of gamers help people to decide whether gaming is pointless or not.

1.2 Literature Review

The studies we used examined the relationship between extensive video gaming and brain morphology. While previous research has focused on non-gamers and individuals with Internet Gaming Disorder, this study specifically sought to understand the brain structure of individuals who play MOBA games 3 hours a day. The result of the study indicates that extensive gamers have smaller

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prefrontal regions, which means those gamers have weaker inhibition abilities, and larger visuomotor regions, indicating stronger motor skills in response to visual stimuli. Another study is an article written by Klaus Mathiak and René Weber. Researchers applied fMRI to find the impact of virtual violence in first shooter games on brain function. Participants were assigned to play either violent or nonviolent games while having their brains monitored. The data gathered was then carefully examined to detect any variations in the brain activity that could be linked to virtual violence, and to compare the results between the two groups. Modern video games represent highly advanced virtual reality simulations, and many of these games contain violence. In a significant amount of young people, playing video games is a quotidian activity, making it almost natural behavior. The study aims to explore the neuronal correlates of real-life behavior through recordings of brain activation during gameplay.

However, there is a need for further research on the effects of MOBA gaming on brain morphology, as the study by Dorel Picovici, David Denieffe, and Brian Carrig had a limited sample size and only focused on one specific game, League of Legends. While the study provides valuable insights, it may not be representative of the wider population of gamers who play MOBA games, and there is a lack of information on the participants' gaming histories, which is crucial for understanding the long-term effects of gaming on the brain. Therefore, future research should aim to recruit a more diverse sample of gamers who play different types of games and gather information on their gaming histories. Similarly, the study by Klaus Mathiak and René Weber has a research gap in that it only examined the neuronal correlations of virtual violence in a small sample of gamers who played violent first-person shooter games for an average of 14 hours per week. Thus, there is a need for further research that examines the potential effects of different types of games on the brain, including non-violent games. Additionally, future studies should explore the impact of gaming behavior, such as gaming frequency and duration, on brain morphology. Such research would provide a more comprehensive understanding of the effects of gaming on the brain and inform the development of interventions to promote healthy gaming habits.

2   Background Information

2.1   MOBA and FPS

As the 21st century resembles the start of e-sports otherwise known as video games, League of Legends and FPS games are the two most resembling video games. League of Legends has been a popular game for all ages since it first came out, due to it being a second generation of MOBA or "Multiplayer Online Battle Arena" games. MOBA games put players in groups and require them to defeat the opponent team. They require players to have teamwork, tactics, and quick decision-making. On the other hand, "First-Person Shooter", or FPS, is a type of game where the player views everything from the first-person perspective. FPS games require players to have good aim and fast-paced action. Games like Valorant and Overwatch are the ones that resemble this category.

2.2   Amygdala

The amygdala is one of the most important parts of the limbic system, controlling many emotional responses such as fear, anger, happiness, sadness, etcetera. Amygdala also plays an important role in the integration of a wide range of sensory and motivationally salient stimuli [11]. It plays a major role in controlling aggression. The study done by Matthies et al shows that females with more aggressive behavior tend to have a smaller volume of amygdala than those who were less aggressive.

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Figure 2: Computer game addiction is now a diagnosis

The study done by Pardini et al shows that amygdala volumes of males tend to be smaller in those who were engaged in violence within 3 years. Due to these studies and results, we conclude that the amygdala plays a significant role in controlling aggressive behaviors.

2.3 Parietal Lobe

Located at the top of the skull, behind the frontal lobe, the parietal lobe is well known for its involvement in sensory perception. It is also known for its four components; primary somatosensory cortex, posterior parietal cortex, superior parietal lobule, and inferior parietal lobule. The primary somatosensory cortex, also known as the postcentral gyrus, processes sensory information from our body. The posterior parietal cortex is the structure that controls movement, spatial cognition, and attention. The superior parietal lobule helps us to determine our orientation in space, and of other things around us. The inferior parietal lobule involves the management of our facial expressions.

2.4 Frontal Lobe and Prefrontal Cortex

The frontal lobe is the most prominent in the cerebral cortex, located at the front of the brain, and is divided into the left and right hemispheres. It is well known for its involvement in motor functions and language and is the center of two important psychological factors: emotional control and personality. The prefrontal cortex is one of the main components in the frontal lobe, responsible for controlling cognitive functions. The prefrontal cortex can be viewed as a major component of a large-scale neurocognitive network where complex behaviors are organized at the interactive level of multifocal neural systems [5].

2.5 fMRI

Magnetic resonance imaging (MRI) is a non-invasive test doctors use to diagnose medical conditions (RSNA & ACR). fMRI is a form of neuroimaging that uses MRI to measure the changes in your

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blood flow. Doctors use fMRI to learn how a normal, diseased, or injured brain is working. They may also use it to assess the potential risks of other invasive brain treatments, brain mapping, and or monitor the growth of brain tumors (RSNA & ACR).

3 Results

3.1 Brain Morphology

A study done by Klaus Mathiak and René Weber shows the changes in our amygdala when we play a violent First Person Shooter game. The functional mapping showed signal decreases in the amygdala during virtual violence. The amygdala showed suppression of hemodynamic activity during the violence [9]. Hemodynamic activity is a homeostatic process that replenishes the nutrients used by biological tissues by adjusting blood flow to areas of focal activity (Neuroergonomics, 2019). When hemodynamic activity is suppressed, it can result in many problems such as numbness, loss of memory, and attention difficulties.

Playing MOBA games can result in several changes in the brain's structure, especially in our prefrontal cortex. The study done by Qinghua He et al. compares the structure of the brain of a non-gamer and an extensive gamer (gamers who play games about 3 hrs/day) using two main devices, which are Voxel-Based Morphometry (VBM) and Deformation Based Morphometry(DBM). VBM is a technique that uses MRI which helps us to see the complete picture of the structure of the brain. DBM is a more precise technique that helps us to detect the brain morphometry for different regions of the brain in more detail. They also used Cortical Thickness and Sulcus Depth analyzes to see extensive gamers and non-gamers brain structures.

The VBM results showed that non-gamers had significantly more volume in the gray matter volume (GMV), which is a tissue that helps us to function normally in our daily lives. They had more GMV in their bilateral ventromedial prefrontal cortex, left lateral frontal pole, and right ventromedial prefrontal cortex. The DBM results also show that extensive gamers had less GMV in their VMPFC than non-gamers. The cortical thickness analysis shows that extensive gamers had thinner cortices in their left superior parietal lobe, left VMPFC, left DMPFC, left superior parietal lobe, left DLPFC, left SFG, right VMPFC, and right SFG compared to the non-gamers. The sulcus depth analysis showed that extensive gamers had shallower sulci in the R VMPFC compared to the non-gamers. These results suggest that extensive gamers have less efficient prefrontal regions which were involved in inhibition since they had thinner VMPFC and shallower sulci depth in the VMPFC [6].

3.2 Behavior

Several regions in the prefrontal cortex such as VMPFC and the DLPFC are in control of decision-making, impulse control, integrating somatic markers, sending signals related to reward and punishment experiences, exerting self-control over temping behaviors, and more. However, irregularity and abnormal structural differences in these areas can lead a person to have increases in problematic and aggressive behaviors, unable to control future consequences normally, and can also reduce a person's ability to adjust expectations [6]. These changes in the prefrontal cortex could potentially contribute to the development of internet gaming disorder in individuals who engage in extensive gaming. The ventromedial prefrontal cortex, in particular, has been implicated in decision-making processes, such as risk assessment and evaluation of potential rewards and punishments. If this

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region is altered in extensive gamers, it could lead to impaired decision-making and difficulty in regulating impulsive behaviors [6]. On the other hand, the left superior parietal lobule, which was found to be larger in extensive gamers, is involved in visuospatial attention and motor coordination. This suggests that extensive gaming may lead to improvements in these cognitive abilities, which are important for success in video games that require quick reflexes and precise movements. It is important to note that the findings of this study are specific to Massive-Multiplayer battle arena games, and may not generalize to other types of video games. Additionally, it is unclear whether the observed brain alterations are a result of extensive gaming or if individuals with pre-existing brain differences are more likely to engage in extensive gaming. Further research is needed to address these questions.

Overall, this study highlights the potential risks and benefits of extensive gaming and suggests that brain morphology differences may serve as markers for the development of Internet Gaming Disorder. Clinicians and parents should be aware of these potential risks and monitor excessive gaming behaviors in adolescents and young adults. Interventions aimed at promoting healthy gaming habits and reducing the risk of addiction should also consider targeting these specific brain regions and cognitive processes.

First-person shooter(FPS) games have become increasingly popular over the years, with some of the most well-known titles including Call of Duty, Halo, and Counter-Strike. While these games can be exciting and entertaining, there are potential negative effects associated with playing them excessively. Studies have shown that playing FPS games can have an impact on various parts of the brain, for example, prolonged gaming can lead to changes in the prefrontal cortex, the area responsible for decision-making and impulse control. This can lead to a decrease in the ability to inhibit inappropriate behavior, and reading to an increased risk of aggression and violence. Moreover, FPS games can also lead to changes in the amygdala, a part of the brain responsible for emotional processing. This can result in an increased sensitivity to violence and aggression, leading to higher levels of anxiety and depression. Additionally, FPS games often involve fast-paced action and intense graphics, which can overstimulate the visual system and cause eye strain and headaches. Prolonged gaming can also lead to sleep disturbances, as players may have trouble falling asleep or staying asleep due to overstimulation of their brains. Furthermore, the social isolation associated with excessive gaming can lead to a lack of real-life social interactions, which can impact mental health and well-being. Players may become more withdrawn and less likely to engage in activities outside of gaming leading to a decrease in physical activity and an increased risk of obesity and other health problems. Overall, while FPS games can be entertaining and enjoyable, it is important to be aware of the potential negative effects associated with excessive gaming. To minimize the risks, players should take regular breaks, limit their playing time, and engage in other activities to promote social interaction and physical activity.

4   Conclusion

Video games have become an increasingly popular form of entertainment in recent years. Among the many types of games available, first-person shooter (FPS) games have gained particular popularity, with titles like Call of Duty, Halo, and Counter-Strike attracting millions of players around the world. While these games can be exciting and entertaining, there are also potential negative effects associated with playing them excessively.

Studies have shown that playing FPS games can have an impact on various parts of the brain.

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For example, prolonged gaming can lead to changes in the prefrontal cortex, the area responsible for decision-making and impulse control. This can lead to a decrease in the ability to inhibit inappropriate behavior, and could potentially lead to an increased risk of aggression and violence. The prefrontal cortex is also involved in regulating emotions, so changes in this region could lead to mood disturbances such as anxiety and depression.

Another brain region that can be affected by playing FPS games is the amygdala. This part of the brain is responsible for emotional processing, particularly in response to fear and aggression. Studies have shown that playing violent video games can result in increased activation of the amygdala, which can lead to an increased sensitivity to violence and aggression. This, in turn, could lead to higher levels of anxiety and depression.

In addition to affecting brain function, FPS games can also have physical effects on the body. Many of these games involve fast-paced action and intense graphics, which can overstimulate the visual system and cause eye strain and headaches. Prolonged gaming can also lead to sleep disturbances, as players may have trouble falling asleep or staying asleep due to overstimulation of their brains. This could lead to daytime fatigue and difficulty concentrating, which could in turn negatively impact school or work performance.

One study by Klaus Mathiak and René Weber examined the changes in the amygdala when playing a violent FPS game. The researchers used functional mapping to measure the signal changes in the amygdala during virtual violence. They found that the amygdala showed suppression of hemodynamic activity during virtual violence.

Another study by Qinghua He et al. compared the brain structures of non-gamers and extensive gamers using various techniques, including VBM and DBM. The study also used cortical thickness and sulcus depth analyses to compare extensive gamers and non-gamers brain structures. The VBM results showed that non-gamers had significantly more volume in the gray matter volume (GMV) in many parts of the prefrontal regions. The DBM results also showed that extensive gamers had less GMV in their VMPFC than non-gamers. The cortical thickness analysis showed that extensive gamers had thinner cortices, and the cortical thickness analysis showed that extensive gamers had thinner cortices compared to non-gamers.

This study focuses on the potential danger and negative effects of video games. However, there are also some positive aspects of playing FPS and MOBA games. Playing MOBA games shows improved attention and visuomotor skills. However, are these aspects beneficial enough to cover all the negative effects? According to this study and the results, it was concluded that playing video games has much more potential danger than positive effects. Properly knowing the bad effects MOBA and FPS games have on brains can help many humans prevent many areas of our brains from being damaged throughout their life.

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Comparing the Durability of Two Popular Brands of Fencing Foil Springs

Sia Chin

Abstract

In this research, I have investigated the topic "Comparing the Durability of Two Popular Brands of Fencing Foil Springs". The purpose of this paper is to compare the springiness of fencing foil springs from two different brands and determine which spring is more efficient to purchase and use according to the needs of different fencers. In addition to comparing the springs, the time it takes for each spring to weaken until the point both springs can not be used is researched. Before every set of the fencing game and each time the fencer changes their foil, the referee checks if their foil tip can endure the weight of 500 g and if the blade can't, it can not be used. Therefore, having an idea on when the spring will weaken will benefit the fencers a lot from unexpected difficulties. In the experiments, I found out that the Allstar spring weakened at a faster rate than compared to the Pbt spring and that both springs take about more than 30 hours to be weakened up to the point where they can not be used anymore.

Contents

1 Introduction

1.1 Background

Fencing is an organized sport that involves the use of a sword. Depending on the different shape and function of the sword, fencing is mainly divided into three events each using weapons: foil, épée, and sabre(or saber). Out of these events, this research will be about foil only. In a foil game, every fencer requires a mask, a glove, a trouser, a jacket, a white stocking, a flat-soled shoe, a body cord, a mask cord, a lamé, and a foil. Each of these equipment have strict restrictions that must be kept in most of the fencing competitions but there is a very strict restriction for the foil in particular. In foil, you can earn a point when the foil's pressure-sensitive button at its tip gets compressed with a pressure of more than 500 grams on the lamé. Before each game, the referee puts on a weight on the tip of the foil. When the point can't hold the weight, you get a yellow card and the referee keeps the weapon for the game which is a huge disadvantage. Since the fencer can not know the durability of the spring before the referee checks it, a spring with strong durability can prevent the fencer from getting disadvantages which can lead to the fencer losing the bout since he or she will have to give away a point if they get only one more yellow card.

1.2 Problem

In fencing competitions, foil fencers unexpectedly encounter a problem with their foil, especially with their point(tip). According to the particular measurements and conditions a foil must follow, stated by the International Fencing Federation also known as FIE, the point must be able to lift a 500 g weight with a margin of error of ± 2 g. Before every set of the competition and every time the fencer changes their foil, the referee checks if their foil tip can endure the weight and if the blade can't, it can not be used. The measurements of parts other than the spring usually do not have a risk to be off the standards or the particular measurements that have to be kept. However, the durability of the spring inside the point weakens as it is used and sometimes works for one game and doesn't for the other. When the fencing point can not endure the weight, the referee will give the fencer a yellow card and take the blade for the whole game which can suddenly make the fencer panic and lose focus since the fencer gets closer to losing a point. When the fencer gets another yellow card during the game, for each additional yellow card, the opponent gets a point.

1.3 Significance

Through this research paper, the time it takes for the spring to lose its "springiness" can be estimated. Experimenting how much the elasticity of the spring decreases to the extent of not fitting the particular measurements will be very advantageous for fencers. Having a sense of how long the spring can be durable in a fencing game can let them know when they should be replacing the spring inside the point(tip) before the referee gives the fencer a yellow card. According to the FIE, if a fencer gets caught in the weight test at the start of the game, they get a yellow card and they can not fix the point and use it for the particular game. For this to not happen, knowing approximately when the spring will weaken to the point it can not be used is very significant. Knowing when the spring will weaken can prevent the fencer from panicking in the middle of a fencing bout and let the fencer prevent it by replacing the spring beforehand.

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2 Literature Review

2.1 Concepts

2.1.1 Spring

A spring is an elastic object that can be deformed(loose shape) with an external force applied to it and return back to its original shape due to the restoring force(force in opposite direction) exerted by the spring. This characteristic of the spring can relate to Newton's third law of motion and Hooke's law.

2.1.2 Hooke's Law and the Spring Constant

Hooke's Law is the law discovered by Robert Hooke which shows the relationship between the force of the spring and the displacement of the spring when stretched. The equation for Hooke's Law is $F = -kx$ where F is the restoring force of the spring, x is the size of deformation of spring, and k is the spring constant which varies on which materials the spring is made of and how the spring is shaped. In this research, the weakening of the spring will be determined by the decrease in spring constant after its use in fencing. Since the equipment that calculates the force exerted when compressing the spring to its maximum displacement is present, the value of F in Hooke's law can be determined.

2.1.3 Newton's Third Law of Motion

In nature, force is always applied in pairs which means that an object can not exert force to another object without receiving an equal force in magnitude back. Newton's third law of motion which explains this concept states that for every force exerted to a certain object, there is a force applied in opposite direction with an equal magnitude. By applying Newton's third law of motion in this research, the maximum displacement when compressing the spring will be the same as the displacement when stretching the spring to its maximum so it will be more concise to find the x value in Hooke's law of motion. Using the value of F and x, the spring constant or the elasticity of the spring can be found.

3 Experimental Setup

3.1 Objectives

In this research, I will be finding the durability of fencing foil springs from two different brands: Allstar and Pbt. To determine which spring to use when fencing, each brand's spring constant will be measured for different time intervals of use and the results will be compared. When each spring's durability is found, fencers can determine which brand of spring fits with them best. Moreover in this research, my other goal is to determine how many hours it takes for the spring to lose its springiness to the point where the spring can not be used in fencing bouts. When the hours it takes for the spring to weaken is known or at least approximated, fencers can know beforehand when the spring needs to be replaced.

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3.2 Tools

Foil blade (and any other fencing material used to actually fence)

New and unused springs from Allstar and Pbt

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A tool that can measure the force needed to compress the spring

Ruler

3.3   Methodology

Two experiments will be conducted.

3.3.1   First Experiment

1. Buy springs from two different brands: Allstar and Pbt.

2. Buy equipment that can measure the force needed to compress the spring.

3. Use a ruler to measure the length of displacement when stretching an unused Allstar spring.

4. Use the equipment to measure the force needed to compress the Allstar spring.

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5. Find the spring constant using the Hooke's Law of motion.

6. Play fencing for 1 hour using an Allstar spring.

7. Using the equipment that measures the force of the spring, find the force needed to compress the Allstar spring that was used for 1 hour.

8. Find the spring constant for the Allstar spring used for 1 hour.

9. Repeat step 6 to 8 for different time intervals of the Allstar spring use (2 hours, 4 hours, 8 hours, 12 hours)

10. Repeat step 3 to 9 using a Pbt spring.

11. Record data and analyze.

3.3.2   Second Experiment

1. Use the springs from the two different brands that were used in the previous experiment.

2. Play fencing with the Allstar spring(used for 12 hours previously) for 2 hours and record the force used for each interval.

3. Repeat step 2 until the force measured by the equipment goes below 5 newtons.

4. Repeat step 2 to 3 using the Pbt spring(used for 12 hours previously).

5. Record data and analyze.

3.4   Obstacles

There are a few obstacles that can be encountered in this research. First, there can be measurement errors during the experiment since the spring itself is very small and all the values that will be measured are small. Therefore, some slight differences between the two spring's spring constants as they weaken might be so small that they are unnoticeable. Another limitation that could be present is that compressing the spring will be done by me using a foil with the spring replaced each time instead of the point(tip) being compressed constantly using a certain device. This can be a limitation since I might be compressing the spring more in one experiment but not in the other which can result in a different number of compresses when experimenting for the two different brand springs. In addition, even though the springs are from the same manufacturer and are new, there is a chance that there will be slight variations in the spring length or spring constant during the manufacturing stage. Lastly, it might be difficult to obtain fencing springs from both brands or difficult to obtain the tool that can measure the force needed to compress the spring since both items can take a long time to ship or obtain.

3.5   Hypotheses

1. The durability of the Allstar spring would weaken at a faster rate compared to the durability of the Pbt spring. By interviewing some of my coaches that have had fencing experience for at least 20 years, most of them replied that the Allstar spring weakens at a faster rate than

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the Pbt spring according to their experience.

2. Both the Allstar spring and the Pbt spring will defect until the point the springs can not be used after 40 hours of use in fencing. This also means that the force needed to compress the spring after 40 hours of use is 5 newtons.

4   Results

Hours of Use in Fencing	Allstar Spring Length	Force Needed to Compress Allstar Spring	Allstar Spring Constant	Pbt Spring Length	Force Needed to Compress Pbt Spring	Pbt Spring Constant
0 hour	0.0074 m	40.8 N	5513.5	0.0078 m	43.3 N	5551.28
1 hour	0.0074 m	40.6 N	5486.49	0.0078 m	43.3 N	5551.28
2 hours	0.0074 m	40.5 N	5472.97	0.0078 m	43.1 N	5525.64
4 hours	0.0074 m	38.0 N	5135.14	0.0078 m	42.2 N	5410.26
8 hours	0.0074 m	33.1 N	4472.97	0.0078 m	37.5 N	4807.69
12 hours	0.0074 m	27.7 N	3743.24	0.0078 m	32.6 N	4179.49

Force Needed to Compress Allstar Spring vs Force Needed to Compress Pbt Spring
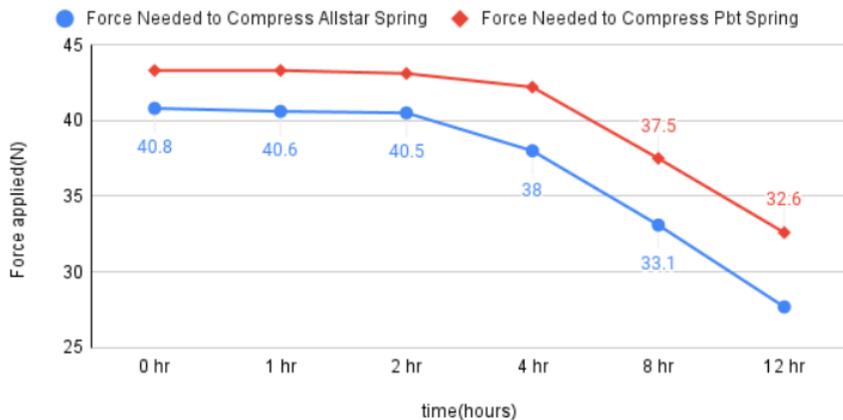
5 Discussion & Conclusion

5.1 Discussion

In the experiment, the Allstar spring was found to be more weakened over time compared to the Pbt spring. The Allstar spring constant started with a 5513.5 but ended up with a 3743.24 after 12 hours with a decrease of 1770.26 which is almost a third of the spring constant of an unused Allstar spring. However, the Pbt spring constant started with a 5551.28 but ended up with a 4179.49 after 12 hours with a decrease of 1371.79 which is about a fourth of the spring constant of an unused Pbt spring. Though both Allstar and Pbt springs' spring constants deformed at a similar rate, the Allstar spring slightly weakened at a faster rate.

There were a few limitations that were found while conducting this experiment. First of all, there was not enough time to conduct the experiment. Since there was a limit in booking fencing lessons with my teachers during the given time interval, there was not enough time to fence until both of the springs lose their springiness to the point where they can not be used. Therefore, the results of the second experiment could be only estimated with the results from the first experiment. Also with more time, data for larger time intervals like 16 hours, 20 hours, and 24 hours could have been observed which could have differentiated the results. Moreover, the tool that was used to measure the force needed to compress the spring was too weak and unreliable. The biggest problem with the tool was that it did not clearly show when the spring was fully compressed and the force measured kept increasing even though the spring was fully compressed since the spring compressor kept winding when power was acted on it. To prevent this, I had to take a video of the compressing to figure out when the spring was fully compressed but still there is a high chance of errors in the data found with an unreliable measuring tool. Lastly, there might have been more power in the compressing for an hour than another hour or there could have been larger numbers of compresses for one hour than another which can lightly impact the data. Since the workout or number of compresses I do with my fencing blade can not be exactly measured and kept constant for each hour counted in the experiment, it can definitely differentiate the results.

5.2 Conclusion

In conclusion, the data found in the first experiment supported the hypothesis that stated that the durability of the Allstar spring would weaken at a faster rate compared to the durability of the Pbt spring. Though there was not much of a difference in the weakening of the two springs, this research can at least be referred to when choosing which brand spring to purchase. If a fencer prefers to use a spring that requires a less stronger touch when scoring a point but is aware that the spring might weaken quickly and is okay with changing the spring inside the point more often, it will be better for them to buy and use Allstar springs. However, if a fencer prefers to save some money and is not aware of changing the point as often, he or she will fit with the Pbt spring. Therefore, due to which one the fencer prefers, this conclusion can help them make their decision.

Since the second experiment was not conducted, the results for the experiment were estimated according to the results from the first experiment. The estimation rejected the hypothesis that stated that the force needed to compress the spring after 40 hours of use is 5 newtons. According to the dot plot in the results above, both springs have deformed to be 5 newtons less difficult to compress every 4 hours of use. When applying this relationship into account, both springs will lose their springiness after approximately 30 hours of use. Therefore, it can be concluded that fencers should be aware of replacing their springs(doesn't matter which brand) after more than 30 hours of

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intense fencing workouts.

5.3 Future Improvements

In future research, there should be plenty of time so that the experiment can be fully conducted. Moreover, the results will be more reliable with a more expensive but professional tool that measures the force needed to compress a spring. In addition, instead of having only one fencer as the sample, randomly sampling several fencers and conducting a random block design out of a larger sample can make the results also more accurate and reliable.

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Can Gender Affect People How They Take the Depth of Emotion

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Abstract

Depending on how people lived and thought, the standard of understanding and constructing the opinion on situations becomes different. Voice acting is a subject in which you have to understand those standards and apply them well in your acting. There are many different factors such as age or strength of voice that contribute to people's understanding of the situation. This paper examines how gender contributes to people's interpreting the depth of the emotion of situations.

ICS middle and highschool students are the population of this research, and there are 2 groups of female students and male students to compare the results between two groups. Stating the null hypothesis that there is no difference between the true mean level of measured depth of emotion for male and female ($\mu_1 - \mu_2 = 0$), this paper states the alternative hypothesis that there is a difference between true mean level of measured depth of emotion for male and female ($\mu_1 - \mu_2 = 0$) by a significance level of 0.05 . The level of depth of emotion is gathered for each participant from both of two groups by 0 (totally none of emotion is contained) to 10 (full of emotion is contained). Using the two-sample difference of mean t test and 95 percent confidence interval, convincing evidence to reject the null hypothesis is collected.

In conclusion, there is convincing evidence that there is a difference for the level of measured depth of emotion between male and female. But, even though the experiment is conducted to minimize the confounding variables, there are still some limitations in the research. First, sample size is too small that sample variability might affect the result. Second, the population is limited only to the middle and high school students of ICS, and the result can not be generalized towards all other people. Lastly, some factors such as personality or personal perspective that may affect people's interpretation of depth of emotion can not be perfectly controlled.

Contents

1 Introduction

Interpreting the depth of the emotion can greatly affect how people understand the situations. For some people that do not understand the term, depth of emotion well, depth of emotion is the level of emotion in a situation. In voice acting, the depth of emotion would be the level of expressed emotion in your act. Even though you express the same emotion in different acts, the depth of emotion is different. For example, if a mom is scolding the child, it contains anger, but the depth of emotion is not that high. On the other hand, if a person is yelling at the murder who killed the person's parents, the depth of emotion for anger is much higher compared to the previous situation. This research is examining whether the gender of people who hear the act also can contribute to how people measure the level of depth of emotion.

1.1 Purpose of Research

Voice acting is not a familiar subject for many people. Compared to the other subjects, voice acting has higher difficulty on starting the subject, and takes a long period to become professional with it. This research contains the purpose of expanding the knowledge of voice acting and getting more familiar with voice acting for more people.

1.2 Research Questions

The main research question of this study is, "Can gender of audience affect how they take the depth of emotion of acts?" This research is basically examining whether gender can be contributed to people's interpretation on depth of emotion. To progress the appropriate experiment, we need to find a specific situation that does not create bias towards the quote for both of the genders. So, another research question would be, "What kind of situation can lead the same emotion toward male and females and create the fewest biases?"

1.3 Hypothesis

The main alternative hypothesis of this research is that there is a difference between true mean level of measured depth of emotion for male and female. ($\mu_1 - \mu_2 \neq 0$) Since the alternative hypothesis claims that gender contains an effect on interpreting the depth of emotion, the null hypothesis of this research would be that there is no difference between the true mean level of measured depth of emotion for males and females. ($\mu_1 - \mu_2 = 0$)

1.4 Operational Definition

In the experiment for this research, the groups of two would be divided by the gender of randomly gathered participants. In other words, the gender of participants would be the independent variable for this experiment. As a result, participants measure the level of depth of emotion for a given recorded act by the figure from 0 (could not feel any emotion from the act) to 10 (the act was full of the emotion). So, the dependent variable of this experiment would be the level of measured depth of emotion for a given act. On the other hand, some confounding variables may be included in the experiment. The given recorded act would be done by the researcher of this study. Since the participants are from ICS, there is a high chance that participants are acquaintances of the researcher. In other words, there is a high chance of occurring bias towards the act because the actor is acquainted with the participants. Furthermore, there are more variables that can affect people's measuring the depth of emotion such as their own perspectives or experiences. In other

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words, there is a difficulty of removing all other variables that can affect the measurement of depth of emotion except for the gender of participants, and some recorded results may be created from other factors.

2   Literature Review

2.1   Introduction

To support this research with more data, "Emotion and Decision Making" by Jennifer S. Lerner, "Handbook of Emotion" by Michael Lewis, "Gender and Emotion in the United States: Do Men and Women Differ in Self-Reports of Feelings and Expressive Behavior?" by Robin W. Simon, and "Effects of Age and Gender in Emotion Regulation of Children and Adolescents" by Alejandro Sanchis-Sanchis are utilized as reference for this research.

2.2   Developments & Research Gaps

Jennifer S. Lerner and her research mates examined theories and evidence from the nascent field of emotion and decision making, ranging from approximately 1970 until the present. According to their research, decisions are decided through multiple mechanisms such as content of thought, depth of thought, and content of implicit goal. Furthermore, emotions can lead to swift action, but on the other hand, some types of emotions can also lead to more systematic thoughts and decisions. People's behavior is decided by their decision. In other words, this article supports that emotion can be one factor that contributes to how people interpret the near situations and construct their own decisions.

According to the Handbook of Emotion written by Michael Lewis and others, much research has been done with gender in emotional functioning, but most cases show inconsistency across personality, social, cultural, and situational variables. This article gives a critical point towards my hypothesis by saying that other factors contribute more to people's emotion than gender of people and supports the null hypothesis of my research.

U.S. culture often shows beliefs that women are more emotional and emotionally expressive than men and that male and female contain differences of expressive emotion. This article used data from 1996 emotions module of the GSS to investigate whether male and female differ in self-reports of feelings and expressive behavior, and evaluate whether the observed results from male and female are consistent as cultural belief. The result of the research does not support that there is a difference in emotional expressiveness for male and females. In other words, this study supports that there is also a high chance of no difference in interpreting the depth of emotion for male and female, which supports the null hypothesis of this research about depth of emotion for male and females, since it showed the results which gives evidence that there is no difference in emotional expression in males and females.

Effects of Age and Gender in Emotion Regulation of Children and Adolescents is a research that examines emotion regulation with age and gender, focusing on children and adolescents. According to the article, because most of the research related to emotional regulation is still divergent with age and gender, they targeted children and adolescents as samples, and conducted a research. They analyzed the difference in emotional regulation in two age groups of 9 to 12 years old and 13 to 16 years old. The results showed that male showed lower emotional regulation ability on specific emotions such as anger, but Age, not gender, showed a major effect on emotional regulations.

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This article supports the null hypothesis, since the result showed that age showed a major effect on emotion regulation rather than gender. On the other hand, there may be support for the alternative hypothesis, since the result also showed that boys showed lower ability on emotional regulation on specific emotions such as anger.

3   Methodology

3.1   Objectives

This research is about how gender affects people's interpretation of depth of emotion. This study primarily includes the goal of expanding the knowledge of voice acting and getting more familiar with voice acting for more people.

3.2   Methods and Sources

The population of this study is all middle and high school students of ICS. Sample size of 4 male students and 4 female students are randomly chosen as sample of this study, and all the subjects are volunteered to be the sample of this research. Additionally, sample size is smaller than the 10% of total population to progress the appropriate test for the research.

In the experiment, there are two groups: group A containing 4 of male students and group B containing 4 of female students. Recorded act will be given to each of the samples in each group To minimize the confounding variable that can affect participants' interpretation, the quote would be conducted to contain only one emotion and not create bias for any of the groups. If the mother is scolding the kid that has lied, the depth of emotion might not be so deep. But if someone is yelling at the murder who killed his or her family, the depth of emotion would be very large. To minimize these kinds of bias occurring, the given quote to the participants would include the scripts that most people can feel the same emotion from. The selected emotion that would be included in the act is anger, because anger is one of the emotions that can lead to empathy easily from people. Also, the act will be recorded with the most comfortable language of the recorder to create the most natural act, and may contain abusive language to express the anger in the act easily. The script of the act would be, "나쁜 ㅅㄲ.. 개ㅅㄲ..! 니가 뭔데 씨ㅂ..!! 짜증나.. 진짜 짜증나.. 왜 아픈척도 안하는건데..? 난 너한테 맞느라 얼마나 아팠는데..? 넌 왜 그걸 익숙하다는 듯이 처 맞고 있어..? 아픈척이라도 좀 하라고!! 전혀 복수한다는 기분이 안 들잖아!!", which contains the content of a bullied boy revenging to the student who bullied the boy. The background of the content will be explained to the participants before they hear the act to help them understand the situation.

Each participant will score the level of depth of the emotion of a given recorded act by 0 (no emotion felt) to 10 (full of emotion). There will be two methods to find convincing evidence for the hypothesis. First, 95% confidence intervals will be conducted with the observed results. Second, two-sample differences of mean t test will be applied for this research. All the conditions for the t test are met. First, the population standard deviation of level of depth of emotion is unknown. Second, this experiment contains random sampling, sample size less than 30 and 10% of the total population.

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4 Results

The following data is summarization of observed data:

	Mean	Median	Standard Deviation
Male	7.75	7.5	0.75
Female	9.18	9.36	0.86

The five number summary of observed results are following:

	Minimum	Q1	Median	Q3	Maximum
Male	7	7.25	7.5	8.25	9
Female	8	8.36	9.36	10	10

The 95% confidence interval that we can construct with observed data can be calculated by the equation of confidence interval $= (\overline{x_1} - \overline{x_1}) \pm t-\text{critical} \sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_1^2}{n_2}}$. Using the equation, the 95% confidence interval with the df (degree of freedom) of 5.891 would be $(0.0276, 2.8324)$.

On the other hand, $t-$value should be calculated to conduct the appropriate conclusion. Using the equation for t-value, $\dfrac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$, the observed value for $t-$value is $\dfrac{9.18 - 7.75}{\sqrt{\frac{0.86^2}{4} + \frac{0.75^2}{4}}} = 2.506$. Using calculator, accurate observed data of $t-$value, p-value, and degree of freedom, $n - 2$ are following below:

- $t-$value: -2.506

- $p-$value: 0.0469

- degree of freedom: $6 = 8 - 2$

Since the $p-$value is less than the significance level of $\alpha = 0.05$, the null hypothesis, there is no difference between the true mean level of measured depth of emotion for males and females, is rejected.

5 Conclusion & Discussion

According to the result of the experiment, there are two convincing pieces of evidence to conclude that there is a difference between the true meal level of measured depth of emotion for male and female.

First, 0 can not be included in the 95% confidence interval. The confidence interval of $(0.0276, 2.8324)$ shows that there is a 95 percent confidence that the true difference of mean level of measured depth of emotion would be captured between 0.0276 and 2.8324. In other words, 0 is not included in the interval, and there will be a high chance that difference between male and female for depth of emotion will occur.

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Second, p−value is less than the significance level of $\alpha = 0.05$, which means that the null hypothesis is rejected. The null hypothesis of this research was that there is no difference for true mean level of measured depth of emotion for male and female. In other words, the alternative hypothesis of the research can be accepted.

With the following evidence, the appropriate conclusion for the study would be that there is convincing evidence of a difference for true mean level of depth of emotion between male and female.

The key information that the study could find is that there is a difference for true mean level of depth of emotion between male and female.

But on the other hand, more studies should be conducted further to confirm this result. The sample size was too small to prevent the sample variability, and there is a high possibility that the result of the experiment would be affected by the other confounding variables. Furthermore, the population is only limited to the students of ICS, so we can not generalize the result to the larger population.

For the future replication, larger sample size for minimizing the sample variability, greater population, gathering participants that are not aware of the researcher, and better acting skill for the given recorded act would be needed to conduct the more appropriate conclusion.

6   Limitation

Even though the appropriate experiment is progressed for this research, there are still some remain of limitations in the study.

First, the result of this study can not be generalized towards all middle and high school students. The sampling of this research has been done only with ICS middle and high students. In other words, the result of this study can be only generalized towards ICS middle and high school students.

Second, the sample size is too small to generalize the results to all middle and high school students. Compared to the whole number of middle and high school students, the sample size of 8 students is too small, which contains too large sample variability. In other words, there is a high chance of other factors occurring that may affect the result of the research.

Lastly, other factors that may contribute to people's interpretation of depth of emotion could not be eliminated perfectly. There are several other factors such as personal perspective or personality that can affect people's interpretation. Unfortunately, it is impossible to remove all other factors that may affect people's interpretation. In other words, there can still be a remaining confounding variable that can affect the gathered result, level of depth of emotion.

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Equal Pay in U.S. Soccer Federation: An Analysis of the Economic Equality Between Male and Female Soccer

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Abstract

This paper shows the truth of the recent agreement to achieve equal pay between men and women soccer in the United States National Teams. The paper can definitely improve by a huge margin when more information is out for the public in the future but as of this point the information below is the best available. The paper uses evidence from court documents, news articles, and other secondary sources to analyze equal pay to its fullest extent.

Contents

1

1 Introduction

Recently, it was reported that the USWNT (United States Women's National Team) have received $6.5 m after the USMNT (United States Men's National Team) reached the round of 16 in the 2022 FIFA World Cup due to the recent CBA (Collective Bargaining Agreement) made by the USMNT, USWNT, and the USSF (United States Soccer Federation) where the earnings will be distributed among both parties equally. The news about this new agreement has sparked discussions among many people with one side claiming that equal pay in sports has reached and other side claiming that this is actually unfair to the male. A reason for the difference in pay can be most directly connected to the different contracts both parties have signed. The USMNT has signed a contract that will only give them money and nothing else, meanwhile the USWNT signed a contract with benefits and guaranteed money. This has been a factor in the past as a reason for the court to side against USSF instead of USWNT during previous cases. But the new CBA saw that the USWNT will follow the structure of USMNT with no guaranteed money but a salary based on games played. Due to this fact, the results of this research will be divided into two parts; Part I will be based on the previous CBA, and Part II will be based on the new CBA.

2 Background

2.1 Purpose

The purpose of this study is to find out whether the pay for both the USWNT and USMNT is truly equal. Recently, it was announced that the USWNT's payment has increased in order to equalize the salary with the USMNT. The USWNT will now receive equal compensation with the USMNT in various competitions such as friendly matches and the FIFA World Cup in 2022. However, as the term 'equal' is not defined fairly with everyone in terms of payments and benefits, there were numerous disputes online. Some people made statements that it would be unfair for the USMNT as they have to deduct their compensation and spread it to the USWNT. Due to these issues, the purpose of this research is to identify whether the payment for the US national team is equalized.

2.2 Hypothesis

The equality between USMNT and USWNT in soccer is likely influenced by different contract systems. These contracts lead to differences in pay. Also making their pay and benefits different. But despite this, we believe that the USWNT is getting discriminated against and is treated unequally.

3 Methodology

3.1 Preparation

We started our research by looking at the performance of the USWNT and the USMNT. One of the biggest differences in performance was their performances at the FIFA World Cup. The USWNT were 4 time champions, the USMNT's highest ranking was to reach the round of 16. We investigated if the USWNT has a lower salary than the USMNT even when they have more achievements.

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3.2 Research Gaps

The specific financial aspects for the USMNT and USWNT are not publicly available which will cause challenges for the research to be done. The USSF only provides the revenue generated by both national teams as a whole but does not tell what each national team generated that money from and how it was generated. This causes us to forcibly rely on court documents only due to the lack of information available to properly analyze the situation.

3.3 Gathering Information

Most of our information will be gathered from the USSF site, news articles, and official court documents. Due to the lack of resources available to determine the revenue of USWNT, the information provided from these sources will have the highest reliability, therefore allowing us to estimate the difference in the payments to both national teams.

4 Results

4.1 Results: Part I

Based on the claims made by the USSF and also accepted by the court; the results show that the overall money paid to the USWNT was approximately $24,000,000 and USMNT was approximately $18,000,000. So from this chart it is clear that the USWNT have gotten paid a higher amount of salary than the USMNT. But the results may be skewed due to the time period of the data gathered ranging from 2015-2019, where the USWNT played in two FIFA World Cups while the USMNT played only once. But even when it is broken down to money received per game, the results come out as $220,747 per game for the former, and $212,639 per game for the latter. To emphasize again, the court's claims are heavily skewed due to the presence of the FIFA World Cup. It is-in our opinion-quite mind boggling that the court did not take that factor into account and even more mind boggling that the plaintiff (USWNT) did not protest this by bringing up the FIFA World Cup, instead, they claimed: "*that all compensation, including bonuses and benefits, should be considered in determining whether a rate of pay differential exists.*" The court however, rejected this and even if benefits were taken into account, it would most likely only weaken the Plaintiff's argument and not the Defendant's since the USWNT receives benefits such as guaranteed money and paid pregnancy leave meanwhile USMNT receives no benefits whatsoever. Another aspect that should not be overlooked is the fact that the USWNT had originally declined a contract that-just like the USMNT-had no guaranteed money or benefits but only a pay-to-play type of deal, which eventually became the main reason for the court siding with the Defendant (USSF) and dismissing the case as a whole. (Morgan V. USSF, 16-19) From the information laid above, it is plausible to conclude that the members of the USWNT were not discriminated against at all but the USMNT could have been the real victim.

4.2 Results: Part II

The recent CBA saw the USWNT agreeing to a pay-to-play contract structure just as the USMNT. USSF has also provided clear guidelines to show how equal pay will be received. The money gained from the Men's FIFA World Cup and Women's FIFA World Cup will be all collected into a prize pool. From this prize pool the USMNT and USWNT will get 45% each in 2022 and 2023, and 40% each in 2026 and 2027. Other competitions that are not FIFA World Cup will be given to USMNT at 35% and USWNT at 35%. The bonuses based on the results of the matches are also the same

for both men and women. All of this shows the equal pay idea that is in the new CBA. But, in the benefits section there are three benefits: parental leave, insurance, and short-term disability that are only given out to the USWNT. Up until this point, all the prize money and performance-based bonuses were equal, but it is the USWNT the only one who gets these special benefits. Also, the fact that the prize money from the FIFA World Cup will be collected into one pool and then be redistributed equally to both parties even when Men's FIFA World Cup generates a significantly higher amount of prize money than the Women's FIFA World Cup is also unequal. Even with the new CBA, it is seen here that the USMNT are the one who is not receiving equality that the USWNT had desperately tried to achieve.

5 Conclusion

5.1 Limitations

As mentioned, there is no specific data on the revenue generated by the USWNT that is available to the general public. One's best way to approximate the revenue will be from secondary sources such as news articles and other analysis made by financial institutions. This also directly leads to our analysis being totally worthless when those data are possibly released in the future. But as for now, our hypothesis was wrong and the USMNT are the actual ones who are getting paid less. It is them that are getting inequality.

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Comparing Microchips and Canine Nose Patterns for Identification of Dogs: A Cost and Safety Analysis

Seongjoo Kim, Sioh Park, Yeneul Seong

Abstract

These days, people tend to identify their dogs for medical support, and there are mainly two ways microchips and canine nose patterns. To use microchips, vets inject a grain-sized microchip inside the dogs' skin using a needle. On the other hand, identifying dogs with canine nose patterns use the procedure of biometric authentication that scans the whole nose. To gather these information for comparison of advantages and disadvantages between microchips and canine nose patterns, the research questions 'What are some benefits of having early pet identity for dogs?', 'Are there other ways to establish identity? If there is, why the dog's nose?', and 'How do the safety and cost profiles of microchips compare to using canine nose patterns for establishing identity?' - are explained by researching the cost, procedures, and side-effects, along with potential usages. By analyzing the pros and cons of each method, dog owners are able to identify their dogs, and in the future, they are able to medically support their dogs in a more appropriate way.

Contents

1 Introduction

1.1 Purpose

As people age, they prepare themselves to prevent events where they need medical care, such as future accidents or being injured or ill. This behavior applies similarly to their pets, too. Between 2016 and 2022, US households that own dogs have increased from 38.4% to 44.5% (Megna). With the fact that the number of dog owners has been recently increasing, more people are looking for ways to support their dogs. So, as their dogs age, pet owners look for ways to enhance their dogs' life medically. Eventually, they would have to first consider identifying their dogs. Dog owners would want to provide their pets the best care and treatment possible.

For people who are new in the search for getting pet identity, comparison of two ways that are mostly used in making identity (microchips and using canine nose patterns) will be helpful in choosing the appropriate way for their pets. It is useful to be knowledgeable about the establishments of identity as they prepare for getting the identity for their dogs. Based on their environment, suitability, and affordability, they can provide the proper and moderate conditions for their dogs.

1.2 Significance

The most important reason why people register identities for their pets, especially dogs, is to make it easier for pet owners to reunite with their pets when they get lost. When pet owners register identities for their pets, pet owners include information about their pets, such as their breed, sex, and size. Other personal information of the pet owners, such as their home addresses and names, are also included.

2 Background Information

2.1 Humans' Fingerprints

Identification of fingerprints is known as one of the most common ways to forensicate criminals or possible suspects. Fingerprint identification is a simple way to distinguish people due to their rareness of overlapping fingerprints. According to Frances Galton, an anthropologist, fingerprints are useful when identifying individuals because the probability of identical fingerprints is 1 in 64 millions (Kaushal), and due to the fact that fingerprints do not change after an individual is three months old.

Similar to the method of identification of human fingerprints, canine nose patterns are used to distinguish specific dogs among many. A group of Korean researchers conducted a study where they collected images of canine nose patterns from a total of 130 dogs to see if there are any identical nose wrinkles present (Byun). The researchers concluded that every dog has a unique nose pattern, and similar to humans, canine nose patterns are fully formed in the second month since the dogs' birth.

2.2 Procedures & Side-Effects

Microchips are inserted in dogs to serve its purpose as an identification. Implantation of microchips is carried out with the method of radio-frequency identification (RFID), a way of identifying or tracking things using electromagnetic fields. Dogs can be microchipped at any age, and the

microchips are about the size of a grain of rice. Many dogs will not be able to feel the microchips inside them since the time of inserting microchips is very short, and due to modern medical technology. Before actually inserting the microchips, the microchips are scanned and confirmed to see if the identification code of the microchip is accurate (Hunter). The microchip is placed in the needle of the syringe and is inserted into the dog's skin. The dog is microchipped into the subcutaneous tissue along the dorsal midline of the spine.

When microchipping dogs, there may be side-effects. Common side-effects include swelling in the place that got microchipped and the misplacement of microchips. Migration of microchip happens when the inserted microchip is not placed in where it was implanted. The possibility of microchips migrating around the dog's body is quite high. Although the microchip itself is harmless, it is dangerous that the microchip can end up anywhere in the dog's body. Minor problems from this include infections and hair loss. Also, infections can occur during the process of inserting microchips. Infections can be caused by needles, and it can be treated with antibiotics. Hair loss can occur around the dog's injected area. It is more prone to dogs that have sensitive skin.

Using canine nose patterns as an identification method, on the other hand, is an easier way to identify and track dogs. If you use the application, 'Petnow,' by simply taking a picture of the dog's face, the three layers of AI will be able to identify specific dogs by scanning. It is recommended to register for canine nose patterns after the age of six months to make sure that the nose print does not change afterwards.

2.3 Cost

On average, microchipping dogs generally cost around $45, regardless of their size. Depending on the type of dog, the procedure can range from around $25 to $75. This procedure includes inserting actual chips, the vet procedure, and the online registration process (Burgos). Adopting a dog could be more beneficial to a new owner since the dog might already have been microchipped from the previous owner. Without inserting other kinds of chips or reinserting the chip inside the dog's body, it is able to only change the information based on a current owner of the dog, address, and other information.

There is also another way to identify a dog's features, characteristics, or information, called the biometric program. They are based on biological features, such as face recognition or fingerprints. 'Petnow' is a representative example of a biometric program. 'Petnow' scans dogs' noses and registers the information about both the dog and the dogs' owner for free. Even though it is a free application, it gives almost every function on making identity for the dogs. It allows dog owners to register their phone numbers, information of the dogs such as their sex, age, and other physical characteristics.

3   Methodology

We have formed three research questions:

1. What are some benefits of having early pet identity for dogs?

2. Are there other ways to establish identity? If there is, why the dog's nose?

3. How do the safety and cost profiles of microchips compare to using canine nose patterns for

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establishing identity?

As we finalized the third research question, we were able to explore the topic, along with the recognition of the need for some information. Comparing these two methods was hard to put into action in our real lives without a dog. Even with a dog, finding out the side-effects or potential advantages and disadvantages in a short period of time would have been challenging. To figure this out, we only used the research method. However, unlike injecting a microchip, trying the application physically helped identify advantages and disadvantages of using 'Petnow.'

4   Results

4.1   Potential Usage

With the procedures mentioned previously, microchips may help many owners in diverse ways. Injecting a microchip can benefit the owner by serving its role as an identification for dogs. Microchips remain permanently in the dog's body after injection. Therefore, when the dogs get lost or when the owners lose track of their dogs, other people can check the information and identification of the dogs and help their reunion with their owners. According to AKC Reunite, an organization that stores the database of microchipped pets and lost pets, microchipped pets are 20 times more likely to be reunited with their owners (Reisen).

By comparison, canine nose patterns are more widely used in scientific formal occasions due to its microscopic differences, similar to human fingerprints. The method of using canine nose patterns as an identification is beneficial for dog owners as it costs no money. As a modern example, by downloading an application and taking a picture of the dog's face, dog owners can easily register their dogs' identification. Using canine nose patterns also provide assurance for the owners that the information of the dog is more accurate.

4.2   Potential Drawbacks

Although injecting microchips into dogs benefits the owners, there are several drawbacks that can occur as the technology of microchips is not 100% accurate. Side-effects of dogs after being microchipped is a common problem that occurs in many dogs. Dogs might get infected with diseases, and some dogs' microchips might end up in dangerous places. In the year of 2002, a surgery of removing a microchip from a Tibetan Terrier's spinal canal took place. Due to the migration of the microchip, methods such as leisoning occurred in the Tibetan Terrier's spinal cord segments (Fitzpatrick).

Canine nose patterns are used as a biometric way of identification for dogs. Applications are being developed, and the technology of identifying dogs by their canine nose patterns are also being studied currently. As a modern example, 'Petnow' is one of the first applications to apply this method of identification. There are several minor problems that might occur when using this technology. Although 'Petnow' is currently free, there is a possibility that the application will cost money to the users as the program is getting popularized. The users might have to pay for future services that connect the identification with insurances or pet products. There are also chances of the application inaccurately identifying the dogs. As the number of application users increases, the technology of canine nose pattern identification will develop and be studied more. However, there are risks of inaccuracy when identifying canine nose patterns. Researchers and application developers will try to make the application identify canine nose patterns effectively and during the

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process, inaccurate scans can cause confusion among users.

5   Conclusion

Injecting a microchip has no significant disadvantages, but there are few things that the dog owner should be aware of about the procedure. There could be very small risks to the dog since there may be side-effects. There are some reports of inflammation that have been linked to the development of cancer (Madison). Also, microchips may travel around the dog's internal body system, and if that happens, the pet owner should scan the entirety of the dog's shoulder to find it. However, dogs that go through this procedure have significant advantages that can help the identification of dogs. Microchip is a painless procedure that only takes a few seconds. By investing a short period of time, it is able to make dogs live in a safe place with their owners. Also, microchips never need replacement. They do not have working parts and are inactive until the connection of the scanner, which is completely safe to dogs. In addition, changing information in the chip does not mean that the dog owner should take out the chip again and code new information. It means they can register new information in the chip with the chip's number and by changing the account. The price is cheap considering the big advantage of life long protection and identification of pets.

Biometric program, on the other hand, is a free application that has every technology which a microchip contains. It generally scans canine nose wrinkles, and updates the information, which helps organize the identity of dogs. Biometric programs improve the security system by using passwords, pins, and security codes. This security system makes people feel relieved on protecting their dog's personal information or identity. As simple as the microchip procedure, a new owner of the dog can register new information and identify themselves and their dog by taking a new picture of canine nose wrinkles. Compared to changing the information of the microchip, biometric programs are much easier and have simpler procedures to step on to change the information of each dog and owner since they only need to take a picture once more Also, the dog does not have to undergo medical intervention. However, there are also several things to be concerned about. Since it is a biometric "authentication," it relies on partial information to prove the user's identity; this might be inaccurate. For example, a mobile biometric device will scan the entire canine nose wrinkle during the enrollment phase and convert it into data. However, future biometric authentication of the canine nose wrinkle will only use parts of the prints to verify identity, and therefore, it is quicker.

Cost wise, using biometric technology or the canine nose pattern will benefit the dogs and their owners with its free application and lack of medical intervention help the owners to make cheaper insurance. On the other hand, microchips do take money. However, after a few years, compared to paid biometric programs that might offer payment as it develops, it might get cheaper. Biometric authentication is certainly ahead of microchips in their safety. For example, the 'Petnow' application only offers dog owners to scan the dog's nose and fill in simple information about the dog's age, sex, or name. They do not use any surgical procedure that does not affect dogs' bodies. On the other hand, injection of microchips can cause several side-effects in dogs. Side-effects include skin swelling, infection of diseases, and migration of the microchip. To conclude, using biometric technology or the canine nose pattern will benefit the dogs and their owners with its free application and lack of medical intervention.

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Exploring the Genetic and Epigenetic Mechanisms in Acute Myeloid Leukemia and Their Implications for Treatment

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Abstract

Treatment methods for Acute Myeloid Leukemia (AML) have improved constantly over the last few years, increasing the mortality rate and life expectancy for patients. However, one drawback of a prominent treatment method, drugs called anthracyclines, has the side effect of promoting the production of Reactive Oxygen Species (ROS) formed through biomolecular mitochondrial cellular processes such as the Electron Transport Chain (ETC). These ROS eventually cause negative effects including but not limited to lipid peroxidation, cellular membrane disruption, damage to the DNA/RNA of the cell, and most importantly - heart failure. To mitigate the side effects of the use of anthracyclines, there are hypothetical solutions that work but are not being implemented due to a variety of reasons. One of which is the study of the epigenetic aspect of the AML. This research paper aims to cover the hypothetical solutions and actual solutions that are being implemented to mitigate the drug itself or to mitigate the effects of the drug.

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1   Introduction

Acute Myeloid Leukemia (AML) is a disorder (cancer) that starts in blood-forming tissue and causes an excess amount of white blood cells to enter the bloodstream. It is classified as a hematological malignancy, characterized by an uncontrollable proliferation of myeloid progenitor cells. The cause and progression of AML are characterized by several factors including but not limited to age, general health status, heredity, peculiar clinical conditions, and other factors. Based on cancer statistics from Surveillance, Epidemiology, and End Results, AML has a fatal survival rate of approximately 27% over a span of 5 years if left untreated. AML can ultimately lead up to multiple heart diseases, especially heart failure, as a primary problem.

One specific aspect of multiple bone marrow diseases is its mitochondrial function and its effect on the individual. The mitochondria, a membrane-bound organelle, generate chemical energy, Adenosine Triphosphate (ATP), which is used as a reactant in many essential cellular processes. This organelle contains its DNA crucial to many mechanisms, the mtDNA. Therefore, analyzing mitochondrial DNA (mtDNA), which is only inherited from the mother, could show a potential breakthrough in curing multiple diseases in relation to cellular aspects. Mitochondrial DNA plays an important role in contributing essential protein subunits to the enzyme complexes of oxidative phosphorylation. Additionally, mitochondrial DNA is susceptible to mutations, making it a valuable resource for researchers to consider when looking into specific biological processes.

As a medication for AML, drugs called anthracyclines are used. However, as a side effect, the use of these drugs eventually leads to a greater probability of heart failure. The reported risk of heart failure is around $2-4\%$ in low dosages, while high dosages report numbers as high as 35%. The general correlation between anthracycline and heart failure seems to be age, as the older the patients are, the probability and association seem to be stronger. The reason behind this result is mostly suggested to be the effects of reactive oxygen species and the inhibition of topoisomerase II beta, leading to cardiomyocyte death. As anthracycline-induced cardiotoxicity is involved in cellular pathways including the mitochondria, it is possible that there is a correlation or relationship between the function of anthracyclines and the risk of heart failure with mitochondria.

As mentioned, the most accepted theory in the scientific community regarding the likelihood of heart failure occurrence based on anthracycline-induced cardiotoxicity is the generation of excessive reactive oxygen species (ROS). This occurs by electron exchanges between O2 particles and cellular electron donors, one of which is anthracycline quinone moiety. The sudden imbalance in oxidative products results in biomolecular processes such as lipid peroxidation, cellular membrane disruption, and damage to the DNA/RNA of the cell; eventually leading to apoptosis and fibrous tissue formation. The exact mechanism will later be expanded more in the "Discussion" section.

2   Background

2.1   Epigenetics

Epigenetics is the field of study of how cells control gene activity without the change in DNA sequence. Epigenetic changes are DNA modifications that regulate the activation and activity of genes. The modifications are attached to DNA and they do not affect the sequence of building blocks of DNA. Within the genome, every modification that regulates the expression of the gene is known as the epigenome. Epigenetic changes influence the production of proteins as they help

determine whether the genes are turned on or off. This helps ensure that the cell produces the necessary proteins for its function and use. These epigenetic modifications vary among individuals, like different tissues and cells due to environmental influences, like diet and pollutants, differing for each individual. Epigenetic modifications can be maintained through cell division and inheritance. This involves the nuclear DNA, alongside the mitochondrial DNA which will be mentioned later.

Additionally, one specific aspect of multiple bone marrow diseases is its mitochondrial function and effect on the individual. The membrane-bound organelle's mitochondria generate chemical energy, Adenosine Triphosphate (ATP), which is used as a reactant in many essential cellular processes. This organelle contains its DNA crucial to many mechanisms, the mtDNA. Therefore, analyzing mitochondrial DNA (mtDNA), which is only inherited from the mother, could show a potential breakthrough in curing multiple diseases in relation to cellular aspects. Mitochondrial DNA plays an important role in contributing essential protein subunits to the enzyme complexes of oxidative phosphorylation. Additionally, mitochondrial DNA is susceptible to mutations, making it a valuable resource for researchers to consider when looking into specific biological processes.

2.2 Reactive Oxygen Species (ROS)

Reactive Oxygen Species (ROS) is an array of derivative molecular oxygen that occurs as a normal attribute of aerobic metabolism. ROS can form through biomolecular mitochondrial cellular processes such as Electron Transport Chain (ETC). High levels of multiple ROS can possibly lead to molecular damage, called oxidative distress.

ROS has been shown to be in elevated levels in a wide range of cancers, including AML. Additionally, as mentioned before, ROS can damage the DNA/RNA of the cell, promoting genomic instability, which causes chemotherapy resistance. Additionally, elevated levels of ROS are shown to be responsible for pathologic conditions, including tumor promotion and progression.

2.3 Mitochondrial DNA

Mitochondrial DNA (mtDNA) is the circular chromosome found inside mitochondria, hence separate from the main nuclear genome of the eukaryotic cell. MtDNA codes for 13 respiratory chain subunits. Additionally, it is more vulnerable to damage than nuclear DNA due to its lack of histone protection and lacking repair capabilities. It is indicated that mtDNA alterations occur in human cancer, but their roles in oncogenesis (healthy cells transforming into cancer cells) and chemosensitivity are unclear. However, mtDNA mutations are shown to have associations with increased ROS production levels.

2.4 Oxidative Phosphorylation

Oxidative phosphorylation, also known as transport-linked phosphorylation, is the final step of cellular respiration. It comprises two components: the Electron Transport Chain (ETC) and chemiosmosis. The role of oxidative phosphorylation is to provide mass amounts of ATP (Adenosine Triphosphate) for living organisms. During oxidative phosphorylation, ADP (Adenosine Diphosphate) is converted to ATP in a process called chemiosmosis, where ions cross the membrane. Since the membrane is impermeable to ions due to its bilipid function, membrane proteins aid in the movement of the ions. The oxidative phosphorylation procedure works like this: NADH, a coenzyme that contains high transfer electrical potential, is created inside eukaryotes during certain metabolisms, such as glycolysis or the citric cycle.

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Additionally, the main regulator of the mitochondrial oxidative phosphorylation pathway in AML cells is suggested to be the ERR α nuclear receptor. The receptor is a key transcriptional regulator of energy metabolism and is encoded by the ESRR α (Estrogen Related Receptor α) gene.

3 Methodology

The research methods were mainly through literature reviews and potential suggestions of a solution that would fit the issue hypothetically. As experiments would take a long time and resources given the circumstances, research was the main conducting method for information gathering. Although there was sufficient information to support the initial research, a hypothetical solution to the issue was also made.

Data on AML patients and the effects of the medications would be collected from other case studies and research papers on similar topics. These case studies and research papers provide information about the patient, medication, and mechanisms that would be elaborated on and used to create a hypothetical solution. Most of these studies contain information on the biological processes and mechanisms of how the disease functions or how the drug's effects are shown on a molecular level. This study would utilize data from one case study or research paper, and bring out a conclusion and a hypothetical solution with evidence and support.

4 Literature Review

One study on mtDNA mutations in the hematopoietic system, the system of organs and tissues involved in the production of cellular blood components, revealed that mtDNA from leukemic cells represented somatic mutations instead of inherited polymorphisms by comparing leukemic cells with buccal mucosal cells from one individual. These possibilities suggested a potential correlation and relationship with physiological mechanisms such as aging and degenerative diseases, especially symptoms of AML. Moreover, the findings supported previously known knowledge that age-related accumulation of somatic mDNA arrangements has been found in multiple tissues around the human body.

However, one drawback was that unlike nuclear DNA mutations, which are visible immediately, mtDNA mutations are not set for immediate notice. The research specified the unstableness of mtDNA mutations, as they are constantly threatened by external factors such as mitochondrial turnovers or an abundance of intact alleles. One question that this research raised was "If mtDNA mutations contribute to age-related heart diseases, why isn't age-related bone marrow correlated with death?", suggesting there may be something more to this issue.

Another research was about mtDNA mutations in primary leukemia cells after the patient has undergone chemotherapy. Because mtDNA is more vulnerable to damage due to its lack of histone protection and weak repair mechanisms, there was a possibility that it was linked to leukemic conditions. The research also showed a correlation between mtDNA mutations and patients' response to chemotherapy through a series of correlation tests between mtDNA mutations and alkylating agents. The findings, patients who were clinically refractory to alkylators showed higher rates of mtDNA mutations along with amino-acid alterations while patients with no to little changes in amino acid sequence and low mutation rates were responsive to the clinical treatment, showed a correlation between the two factors (W $=$ 22, P $=$ 0.02697). The study further explored the possibility of association that was potentially shown in the previously mentioned correlation by

comparing before-and-after blood samples of a patient who had undergone chemotherapy with the drugs fludarabine and cyclophosphamide. Following the results, sequence analysis was performed, which revealed the discovery of a new heteroplasmic mutation. These findings on primary leukemia could be used to find other similar correlations for similar diseases such as AML, especially on mitochondrial components.

Patient	Mut. freq., (10^{-4})	Amino-acid alteration	O_2^- content	Clinical Status	
				Alkylators	Fludarabine
T1	0	0	22.57	Not refractory	No Rx
T2	38.5	10	53.91	Refractory	Refractory
T3	10.5	2	56.29	No Rx	Not refractory
T4	10.5	3	32.23	Refractory	Refractory
T5	21	5	53.26	Refractory	Not refractory
T6	14	3	37.84	Not refractory	Not refractory
T7	3.5	0	54.56	Not refractory	Not refractory
T8	14	3	31.32	Refractory	Not refractory
T9	14	2	11.54	Refractory	Not refractory
T10	10.5	1	46.08	Not refractory	Not refractory
Mean[a]	13.65 ± 10.49	2.90 ± 2.92	39.96 ± 15.41		
UT1	3.5	1	7.54	No Rx	No Rx
UT2	3.5	1	5.83	No Rx	No Rx
UT3	7	0	6.7	No Rx	No Rx
UT4	3.5	0	13.0	No Rx	No Rx
UT5	7	1	21.49	No Rx	No Rx
UT6	3.5	1	18.23	No Rx	No Rx
UT7	3.5	0	9.29	No Rx	No Rx
UT8	7	1	5.74	No Rx	No Rx
UT9	3.5	1	41.87	No Rx	No Rx
UT10	7	1	33.1	No Rx	No Rx
Mean [a]	4.90 ± 1.81	0.60 ± 0.52			

Abbreviations: T=treated, UT=untreated, Mut. freq.=mutation frequency and includes both heteroplasmic and homoplasmic mutations, Rx = treatment.
[a]Mean values are presented with s.d.

Table 1: Correlation of mtDNA mutation frequency with O2 generation and clinical treatment status in CLL patients.[25]

The last research study on mitochondria was about the characterization of mutations in the mitochondrial encoded Electron Transport Chain (ETC). The study had several implications depending on whether the subjects had been clinically affected. The results first started off with the frequency of ETC complex gene mutations, in which 8% of patients had a mutation in one or more of the mitochondrial ETC complex genes. The majority of the mutations were missense mutations, various in numbers, and the gene is targeted. The research then looked at the association of ETC complex gene mutations with molecular characteristics. Through the results, the study claimed that mutations in mtDNA of any ETC genes had a strong association with age (p-value: 0.001). Next, an analysis was performed to see if the mutations in specific complexes were associated with

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the patient's clinical features. The results for this sector were that in Complex IV of the ETC alone, there was a significant association between mtDNA mutations and age (p-value 0.009). The last sector was the association of mtDNA ETC gene mutations with clinical outcomes. The study revealed that patients with mtDNA gene mutations had shorter median overall survival than others without mtDNA ETC mutations (median of 9.3 vs 20.1 months; p-value: 0.007).
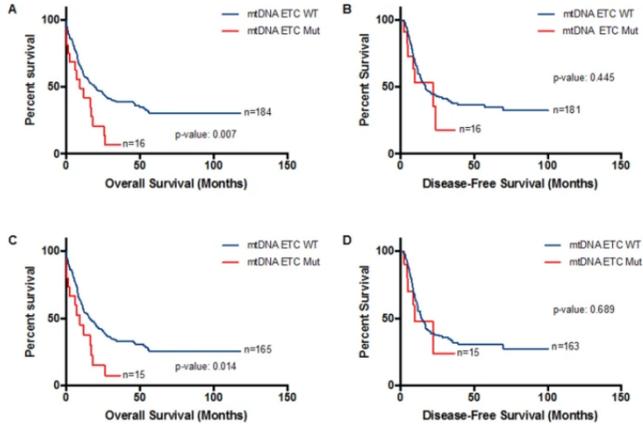

Figure 1: Association of ETC complex genes with clinical outcome.[10]

Buccal mucosa1: Epithelium lining the inner surface of the cheeks and lips from the line of contact of the opposing lips to the line of attachment between the alveolar ridge (upper and lower) and the pterygomandibular raphe.

A study on the effect of ROS with the potential of mitochondrial involvement revealed that the ETC was a major producer of ROS due to electron leaks in complexes I and III. Anthracyclines stimulate ROS production in mitochondria, which ironically harms the mitochondrial particulates. Their special chemical structure makes it easier for them to be reduced, which is catalyzed by Nicotinamide Adenine Dinucleotide Phosphate (NADPH), a major component of mitochondrial cellular function. Moreover, anthracyclines have a high affinity toward cardiolipins, substances localized at inner mitochondrial membranes. This characteristic of anthracyclines allows their accumulation in the mitochondria, ultimately producing excess ROS. Furthermore, as the heart has relatively low levels of antioxidant enzymes, it leaves it more susceptible to anthracycline-induced ROS production. Anthracyclines interfere with NADPH oxidase, nitric oxide synthases (NOS), and the ETC within the mitochondria.
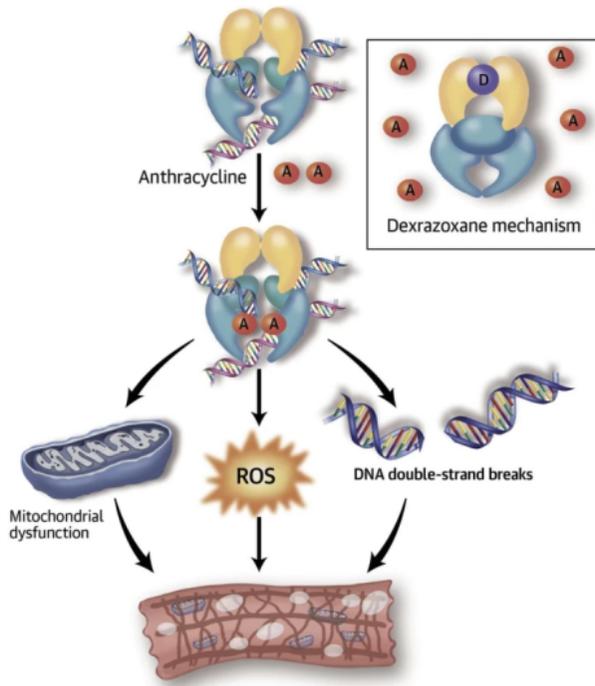
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Figure 2: Disruption of the normal catalytic cycle of topoisomerase 2β. [6]

5 Results and Discussion

5.1 Epigenetic Aspects

For AML, epigenetic alterations, like DNA methylation and histone modifications, have been shown to be a part of critical roles, in which, both methods are shown to have an important role in initiating and progressing AML. The mutational burden in AML genomes is sometimes a result of random mutations that accumulate as a result of healthy progenitor cell aging, which is a process called clonal hematopoiesis of indeterminate potential (CHIP). However, AML genomes tend to be less mutated compared to those of other cancers with similar mutational distributions in both pre-relapse and post-relapse. Additionally, these mutations tend to occur in genes that have an association with DNA methylation and epigenetic regulation. These findings suggest that there is an independence between the progression of AML and the genetic landscape of the disease.

DNA methylation has been proven to be an effective therapeutic target to restore normal DNA methylation patterns in leukemic symptoms. Moreover, compounds that inhibit DNA methylation such as azacitidine and decitabine are useful in targeting myeloid malignancies.

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Histone methylation is the modification of certain amino acids in a histone protein. It is part of almost every biological process, such as DNA repairing, cell cycle, stress response, transcription to development, differentiation, and aging. Histone methylation can result in either transcriptional activation or transcriptional repression. For cancer, histone methylation may be the cause of the disease by causing the cell cycle to dysregulate and result in uncontrolled cell proliferation. Using the epigenetic approach and controlling histone methylation could be a hypothetical treatment of AML with minimal side effects.

5.2 Mitochondrial DNA and ROS

The problem with this phenomenon is that AML medication drugs, anthracylines, enhance ROS production in mitochondria leading to an increase in heart failure. As the ETC is known to be one of the main sources of ROS due to its electron leaks, anthracyclines, for example, doxorubicin, stimulates the production in mainly cardiac and skeletal muscles. It is assumed that anthracyclines cause skeletal muscle fatigation or catabolism because of the ROS production, leading to an up-regulation of redox-sensitive E3 ubiquitin ligases [atrogin-1/muscle atrophy F-box (MAFbx) and MuRF1] and the activation of proteases (caspase-3). Therefore, in order to mitigate heart failure, skeletal muscle fatigation, and catabolism must be prevented or eased or eliminate the root of the problem: the production of ROS in mitochondrial ETCs.
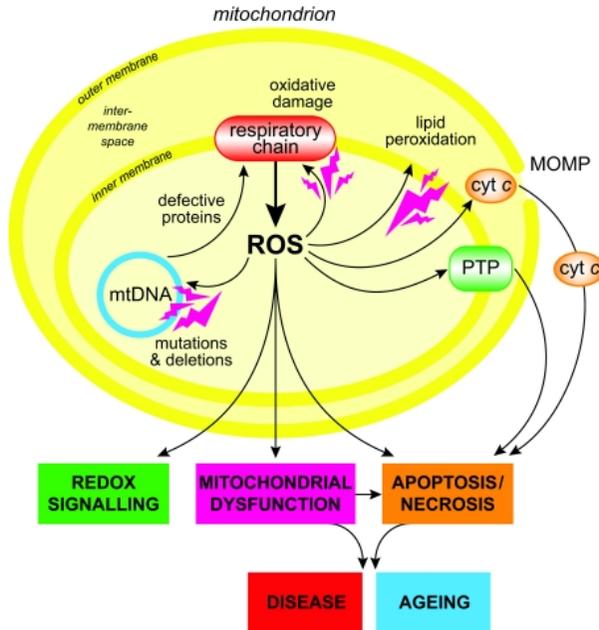

Figure 3: An overview of ROS production in mitochondria. [20]

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ROS production in mitochondria (focused on the mitochondrial matrix) has several steps. Within the organelle, O_2^- is produced by the addition of one electron - a reduction. This step is favored thermodynamically and takes place when mitochondrial electron carriers are bound to proteins or are especially at redox-active prosthetic groups within proteins.

An important factor that determines ROS production is the proportion of the electron carrier that reacts with O_2 to form O_2^-. As each respective electron carrier's E_m (concentration of the enzyme or protein) is different, the rate at which the redox reaction occurs will differ as well - affecting the various changes in mitochondrial ATP synthesis, especially the ETC.

To hypothetically mitigate the side-effect of anthracyclines, which is the stimulation of the production of ROS in mitochondrial cellular processes, there are some methods that could be processed. The most basic way would be to eliminate the ROS produced - through the addition of other molecules containing substances such as Vitamin C, Vitamin E, or ascorbic water. These molecules have the potential to reduce and mitigate the effects of ROS due to their capability of detoxification. Moreover, other cellular defense against ROS includes a variety of particles - Superoxide dismutase (SOD), Hydrogen Peroxide (H_2O_2), and oxygen (O_2). These particles detoxify the ROS in the peroxisomes of eukaryotic cells. Moreover, non-enzymatic antioxidants are one way to defend against the effects of ROS. Their exposed additional group; for example, an exposed sulfhydryl group for glutathione, makes it effective to defend against ROS species. Therefore, if there is some biomolecular method that combines the effects of anthracyclines with any compatible or suitable compound, there could hypothetically be a potential solution to decrease the likelihood of heart failure during chemotherapy treatment of AML.

However, if the solution does not exist in the drugs themselves, a mitigation of heart failures would have to be undergone. Some of the prominent treatments include beta-blockers, as they block the neurohormonal cascade that worsens the disease over time. Its characteristic of antioxidant activity has made it usable for the primary prevention of anthracycline cardiotoxicity. However, there could be different variabilities and confounding factors that might affect the process of beta-blockers against anthracycline cardiotoxicity.

Another prominent treatment is dexrazoxane, the only FDA-approved drug for anthracycline-induced cardiotoxicity. Although there has been some speculation and reports that the drug may cause secondary malignant neoplasms, recent developments allowed the drug to be imposed on all children. The drug binds with iron before it centers cardiomyocytes, preventing the formation of the iron-anthracycline complex, and eventually preventing cardiac damage. It also prevents cardiomyocyte death, mitochondrial dysfunction, and the suppression of antioxidant gene expression. The results are proven to be beneficial as a study between children who received doxorubicin with dexrazoxane as an experimental variable showed greater myocardial wall stress and dysfunction as measured by mean (SD) B-type natriuretic peptide (BNP) concentrations (18.3 [14.7] pg/mL versus 11.3[10.6]pg/mL; $P = 0.02$) and N-terminal B-type natriuretic peptide (NT-proBNP) concentrations (64.8 [55.5] versus 44.5[39.0]pg/mL; $P = 0.06$).

In summary, there are hypothetical methods to solve anthracycline-caused heart failure through ROS production in mitochondrial ROS in the treatment of AML. However, these are only hypothetical situations that seem to work based on mechanisms, but there is no guarantee or factual evidence that there is a cause-and-effect relationship, but rather a correlation between the two factors.

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Evaluating the Economic Implications of Territorial Integrity on Dokdo

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Abstract

The main goal of this capstone project is to evaluate the economic, geological, social, biological, and territorial values of Dokdo by assessing the resources and various organisms that are set in place in Dokdo and its other potential purposes such as defending the country and agriculture. We will also analyze and organize the historical events between Korea and Japan, and the various conflicts and evidence/treaties residing on the ownership of Dokdo by the two countries. The evaluated results of Dokdo's worth will be divided into different categories best fit what values they account for. For example; x number of Endangered animals in Dokdo - Biological worth. The relationship between Dokdo and Japan, meaning how Japan considers Dokdo "Takeshima" as if it were a land of their territory or not, and unofficially but who effectively has control of the island Dokdo, will also be included.

Contents

1   Introduction

From 512 to 1904 , Dokdo was taken for granted as a Korean territory. However, in 1905, as the Russo-Japanese War broke out, Japan forcibly incorporated Dokdo into its territory for military facilities. After Japan won the war, the Eulsa Treaty was signed and the Republic of Korea was deprived of diplomatic rights. After Korea's liberation in 1945, Dokdo was regained [6]. However, in 1994, the United Nations amended the International Maritime Law to allow it to be moved as an Exclusive Economic Zone(EEZ) up to 200 nautical miles from the starting point of its coast [8]. Japan discovered that Dokdo was within 200 nautical miles and continued to claim sovereignty over Dokdo.

Dokdo's Sea is a prosperous fishing ground where the North Korean cold current meets the Tsushima warm current and is full of natural resources such as methane hydrate and guano. It is also located between Russia, South Korea, and Japan, so its military value is also very high. Japan recognized this value early, and as soon as the EEZ (Exclusive Economic Zone) was declared, it unilaterally terminated the existing Korea-Japan fisheries agreement and signed a new Korea-Japan fisheries agreement related to the EEZ [5]. Since then, Japan has asserted sovereignty over Dokdo by presenting data with unclear grounds and uncertain sources, and since 2005, February 22 has been designated by Japan as Takeshima Day to pray for the return of Dokdo [7]. The reason why they insisted on such actions is because of the economic benefits of Dokdo's natural resources worth 300 trillion won and the political benefits gained by annexing Dokdo [10].

2   Literature Review

There are various reasons for Japan's claim to sovereignty over Dokdo, but from an economic point of view, Japan can get benefits from natural resources, the trade of fish, or additional benefits from special purposes such as military facilities, and tourist destinations. Research on the benefits of possessing Dokdo's sovereignty from economic points exists "Study on the Development of Dokdo Industry" by Yu Shin Lee, This study focuses on the Dokdo industry and its development direction to find ways to maintain the public's interest in protecting Dokdo in a long-term, comprehensive, and rational way. Using historical research methods, literature research, internet research, and technical analysis, the status of Dokdo's industry was examined in various fields such as legislation, industrial structure, and profit structure. Through this research, we were able to come up with several plans for the development of the Dokdo industry, such as enacting the Dokdo industry law and establishing an association, expanding interest in and raising the value of Dokdo products, providing jobs and branding the Dokdo industry. Through this, the revitalization of the Dokdo industry will fundamentally serve as the basis for the effective domination of Dokdo, and the sovereignty of Dokdo will naturally be strengthened.

"Assessment of the Economic Value of Dokdo" by Seung-Hoon Yoo, he first calculated the market value of marine life, mineral resources, and tourism around Dokdo. According to Ulleung County, North Gyeongsangbuk-do, fishery production in the waters around Dokdo was worth 94.92 million won in 2007 . The annual tourism value, calculated from 136,877 visitors to Dokdo in 2008, was 51.4 billion won. The largest part of the market value is mineral resources. It was estimated that about 600 million tons of methane hydrate, or about 150 trillion won, were deposited on the seabed near Dokdo. There are also many phosphate minerals around Dokdo, which are currently entirely imported, and these phosphate minerals also contain uranium, which is a raw material for nuclear power, and vanadium, which is a special steel material, so their economic value is expected to

increase. Professor Yoo estimated non-market values such as historical, symbolic, military security, and ecological, environmental, and geomorphological values, and surveyed the public using the 'conditional value measurement method' that converts surveys into numbers. In August 2008, 760 households in 16 local governments nationwide were surveyed, and the non-market value of Dokdo was estimated to be 1.1724 trillion won per year as of 2008. Prof. Yoo said, "Most of the respondents placed a high value on Dokdo even though they had never visited the island. This shows that they attach great importance to preserving Dokdo for future generations."

3   Results

Many Koreans know Japan wants Dokdo, and there is still some conflict between Korea and Japan because of Dokdo although it has become a bit less frequent. Also, there is the value of Dokdo. Why does Japan want Dokdo, and What is good for Japan if Japan has Dokdo?

According to the Ministry of Foreign Affairs of the Republic of Korea, 121 species of birds, 95 species of insects, 151 species of plants, and unique microorganisms such as bacteria, which are future biological resources, are distributed in the land area of Dokdo [1]. Among the valuable species inhabiting Dokdo are hawks (class I endangered), crested honey buzzards, black kites, Japanese murrelets, ospreys, swans, and hooded cranes (Class II), and more than 10,000 birds, including hoe gulls, terns (600), and waterfowl (50), have been identified. The biological resources in the waters include mammals such as sea lions, seals, harbor porpoises, and four dolphins, as well as 68 species of fish, 337 species of invertebrates, and plants, including 130 species of algae and 272 species of plankton. In addition, a plant called Bunhaengcho [2], which was not found on Ulleungdo, was found on Dokdo, suggesting that the settlement of artifacts on Dokdo was separate from Ulleungdo. Furthermore, the sea space of Dokdo has become an abundant fishing ground for squid because no one is fishing there, and according to the Ministry of Agriculture, Food and Rural Affairs, local fishermen caught a total of 6049 tons of squid worth 9.4 billion won, including 5914 tons of squid, around Ulleungdo and Dokdo last year. Dokdo's squid production accounts for about 60 percent of South Korea's total squid production.

The geological and geographical value of Dokdo can be divided into two categories: land resources and military purposes. Dokdo's land resources are mostly composed of materials buried underground or on the seabed, the largest part of which are mineral resources. Dokdo is buried with about 600 million tons of methane hydrate, which is estimated to be worth more than 150 trillion won, and it is estimated that it can be used for 30 years of South Korea's gas consumption, amounting to 11.182 trillion won every year. In addition, it has been confirmed that there are deposits of phosphate, uranium, and vanadium, a special steel material, around Dokdo, which have been reliant on imports [1]. It has also been reported that submarine activities conducted by Japan and Russia in the 1970 s found the island to be rich in mineral resources buried under the sea.

For military activities, Dokdo is very important to the South Korean government because it is in a position to monitor the military movements of Russia, Japan, and North Korea if military communications are installed, which could be very important and give them an advantage, especially in a situation where South Korea and North Korea are still at war, although there is a ceasefire.

Aside from all of this, the island Dokdo itself is declared the 336th natural monument by the South Korean Cultural Heritage Administration, so the price is immeasurable just by money.

Currently, Dokdo has no official international ownership by South Korea or Japan, but with about 280 thousand tourists visiting Dokdo last year (2022) who are mostly South Korean, and 51 Korean Civilians/Security currently residing in Dokdo, there is no real aggressive conflict living Dokdo anymore. And Dokdo is closer to Korea's Ulleungdo (87.4km) than Japan's Oki islands (157.5km). Dokdo is under South Korea's effective control.

4 Discussion

Why Japan wants Dokdo, The first reason Japan wants Dokdo is because of its abundant underground resources, which include many underground resources called methane hydrate. And securing this underground resource could be a source of income to strengthen the country's economy.

The second reason why Japan wants Dokdo is because of the expansion of its territory, which is why Japan wants Dokdo because if Japan takes it, its territorial waters will expand.

The third reason Japan wants Dokdo is that it has a military advantage, because it is located in the center of Russia, South Korea, North Korea, and Japan, so it has a military advantage and an advantage in defending other countries. And there's the Russo-Japanese War. During the Russo-Japanese War, Japan claimed to be an uninhabited land (where no one lives) and occupied it. It was 1904 at the time, and it was our land. But because of illegal occupation, Japan won the Russo-Japanese War. They forced us to take our diplomatic rights, made various unequal treaties, and started colonial rule. In the end, if we lose Dokdo, this history may be repeated, and that's why Japan wants Dokdo, and that's why Korea desperately protects it from being taken away.

The value of Dokdo (In Korean), which has a bad and painful history because of Japan, symbolizes independence. Dokdo plays an important role in national security as it is a stronghold in the East Sea, and Dokdo expresses our territorial waters and airspace and is valued as a territorial sovereignty in securing exclusive economic zones.

There were a lot of limitations when writing this paper because when we were researching for the paper we got a lot of different answers, For example, some of the papers said that Dokdo (Takeshima) is a group of islands that belongs to the Republic of Korea but some others said that Dokdo (Takeshima) is Japan's territory, also it was hard because we couldn't ask other people about this topic, and we couldn't visit Dokdo (Takeshima) ourselves.

5 Conclusion

Dokdo is a group of islands in the East Sea, Still in dispute. It consists of two large islands, Dongdo and Seodo, along with 89 smaller islands. The administrative name "Dokdo" was established in 1906 and officially incorporated into Gyeongsangbuk-do in 1914. Historically, Dokdo has been recognized as an undisputed part of Korean territory, and it was considered Korean land from 512 to 1904. And during the Russia-Japan war in 1905 , Japan stole the Dokdo forcibly for military purposes. After Japan won the Russo-Japanese War, the Treaty of Eulsa was signed and the diplomatic rights of the Republic of Korea were revoked. In 1945, Korea was liberated from Japan and Dokdo recovered. However, the United States allowed the Exclusive Economic Zone (EEZ) in 1994, and Japan, which saw it, claimed sovereignty over Dokdo.

Dokdo is rich in many natural resources such as methane hydrate and guano. Also, because

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it is located between Japan, Russia, and Korea, its military value is very high. As soon as the Exclusive Economic Zone (EEZ) was allowed, Japan broke the Korea-Japan Fisheries Agreement and voted for a new Korea-Japan Fisheries Agreement related to the EEZ. Since then, Japan has claimed sovereignty over Dokdo with unclear data and designated it as Takeshima Day on February 22, 2005. The reason why Japan is doing this is because of Dokdo's 300 trillion won worth of natural resources, its military value, and the political benefits of merging Dokdo, and the expansion of its territory. To Korea, Dokdo is more valuable than Japan. This is because Dokdo symbolizes independence for Korea. And it plays an important role in national security because securing Dokdo is securing the base of the East Sea. Furthermore, Dokdo plays a big role in expressing Korea's territorial waters and airspace and securing economic zones. And Dokdo has a lot of endangered animals and plants. And there are many islands beside Dokdo. According to the Korean Ministry of Foreign Affairs, Dokdo has at least 60 species of plants, 130 species of insects, and 175 species of birds. In the case of marine life, there are at least nine species of fish, three species of shellfish, and four species of marine algae. In particular, eight endangered species such as hawks (1-class), beehives, pine dogs, hornbills, owls, water eagles, swans, and hooded cranes (1-class) were identified, with more than 10,000 birds identified as hoe gulls, and sea swallows (600 maras) and wet birds (50). Apart from all of these, Dokdo is designated as the 336th natural monument in Korea, so money cannot even estimate its price.

There are many studies on the types of Dokdo disputes between Korea and Japan, but there is only one clear indication of how the integrity of Dokdo's sovereignty creates profitable businesses. Lee Yu-shin's Study on the Development of the Tokdo Industry focused on the Dokdo industry and its development direction to maintain public interest in protecting Dokdo in a long-term and reasonable way. The Dokdo Industrial Development Association has developed several ways to develop Dokdo's industries, including using historical research methods, literature research, Internet research, and technical analysis; the status of Dokdo's industry was analyzed in variable fields. This will naturally strengthen Korea's sovereignty over Dokdo.

Currently, Dokdo is not officially the land of Korea or Japan, but it is under the effective control of Korea because 280,000 tourists, almost all Korean, visited Dokdo last year (2022), and 51 Korean civilians/security office.

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Analyzing the Trend of Art Work in 21st Century

Heidi Jang

Contents

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1 Topic Statement

1.1 Background

Art coexists around people from the past till now. As we evolve as humans from homo-sapiens, the shape of art keeps changing. People draw on different materials too, such as drawing on the ceiling, paper, or cloth. And not only have the types of materials changed, but our drawing style is also changing since the centuries change. (There are expressionism, surrealism, pop-art, minimalism, etc) But this study will only use the three main, in personal opinion, drawing styles. It is realism, semi-realism, and animation style. And, in my opinion, these types of drawing are very close or maybe it is to a pop-art.

Nowaday it is easier to share their art work. It might have been difficult in the past to share their artwork, maybe sell the artwork, because the people in the past did not have a social networking service. But nowaday, people in society have many different social networking services to share their work, to not only people who already know but also people that are not around. Also get feedback from each other to improve.

1.2 Problem

Nowadays, It is very easy to find artwork from around the world. Not only the artwork like in the art or history museum, but can find those art work through animation, website cartoons, or selling the illustration. People these days use a lot of social media like 'TikTok' or 'Instagram.' And artists also post their drawings on social media too. However this actually gives bad influences to find their own drawing style. People, who just start drawing, easily get confused and just start to follow others' drawing style. Even though it is not fit for them, they think that by following the famous artwork style that others already like, they also want to get attention from others. So by this study, they can increase their population by finding the most popular drawing style for the ages that they want to get influence for. There are many types of drawing styles. The artwork that this study is focused on is illustration and analyzes the drawing types that people like. And in my personal opinion, in social networking services those artwork have three of the most popular uses of drawing skill. They are realism, semi-realism, and animation.

1.3 Significance

This research is important for the people who get drawing slump. The slump is known as the period that makes artists feel that their artwork is not enough and maybe think that they do not want to draw like the way they did before. But in my opinion, slump is also a period that increases their skill and finds their drawing style. Also, the drawing slump is not only coming to the professional artist. The slump period also comes to amateur or people who only draw for fun. And by analyzing the popularity of drawing style, the people who do not know which types of drawing to use, find it easier to choose their drawing style.

2 Research Question

1. What are the most popular drawing styles in the 21st century?

2. What are the characteristics of drawing types?

3   Literature Review

3.1   Concepts

3.1.1   Realism

Realism is a type of drawing that was popularized from the 19th century to nowadays. Realism is accurate, detailed, unembellished depiction of nature or of contemporary life. The famous example of a realist artist, that most people will know, is Johannes Vermeer's *Girl with a Pearl Earring*. As the picture shows, he drew the girl very detailed and realistically. Realism's popularity was good for a long time, and it is still very popular today.

3.1.2   Semi-realism

Semi-realism is the second most popular drawing style that most of the nowadays illustrators use. These types of drawings are like a mixture of realism and animation. The characteristic of semi realistic drawings is that they have similar human body proportions but by the animation style, that they might look like a doll. The example picture shown is the cover of Cookie Run Angel Flavor Cookie from an illustrator named Cox.

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3.1.3 Animation

Following figure is one of the most famous shapes when people generally recall 'drawing' because of the effect of website cartoons and animation, most people start drawing with this type of drawing style. The characteristics of this style are very different from realism.

The character's body is divided into three types. SD, LD and MD. SD stands for super deformed; a character's head is bigger than their body. Eyes and ears are very big and sometimes they do not draw nose and mouth too. LD is most likely to the human body and it is an acronym of light deformed. Lastly MD is the acronym of medium Deformed. Iis the mixture of the LD character and SD character. Usually it has a SD head, big head, and LD body, usual body.

The faces of the animation characters are not all the same, but they have some similarities. Firstly, they have big eyes. Not all the animation styles of the characters have big eyes, but most of them have bigger eyes than the human does. Secondly, thay have small and sharp noses. They draw a dot or short line, instead of a realistic nose, to show that they have a cute small nose. Lastly, they have very thin necks. Most people have a neck that is starting from one side of their ear to another side of their ear. However, in animation style, they draw a neck as almost half of their face. The face of the animation is very unrealistic but not too creepy.

3.2 Developments

This experiment could help the designer, who sells the goods, for which drawing style is effective to the age that they are trying to sell.

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3.3   Research Gaps

Drawing realism was challenging since the style of realism differs a lot with casual illustration. Also while researching the reference artworks, the style of drawing was all different so it was hard to find characteristics of each style. Also this study separates the ages into four groups so choosing a mount of people to survey and where to survey was difficult.

4   Research Design

4.1   Objectives

The goal of this research is to try the three main types of drawing style, and by randomly choosing people to survey the population of those drawing styles.(realism, semi-realism, animation).

4.2   Methods and Sources

This research is doing surveys to randomly selected people. The materials that I needed in this experience were the followings; big sketchbooks, stickers, 3 types of drawing (realism, semi-realism, and animation).

4.3   Obstacles

There were some obstacles that influenced the results of the research. I am doing a survey only at Cheongna, so the result could not be referenced for the world.

5   Weekly Plan

Date	Plan	Needed Accomplishments
Week 1	SKETCHING	To compare each other, we need to know the drawing style of each of them, so make sure you know how to draw those drawing styles and finish sketching the drawing.
Week 2	DRAWING	Now start to color the drawing that is done with the sketching. Need to decide to draw three papers with all different styles, or use all three techniques on one paper separately.
Week 3	FINISH DRAWING	Finish the drawing.
Week 4	GET VOTE	Make a big dashboard to take a vote from people at the lake park.
Week 5	MATERIALS	Find a better research paper that is useful.
Week 6	PPT	Make a PPT slides.
Week 7	PPT	Make a PPT slides.
Week 8	PRACTICE	Practicing the capstone presentation.
Week 9	PRACTICE	Practicing the capstone presentation.

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Locked up in the Land of the Free: Police Perspective, Ineffective Policing, and Racial Differences in Crime

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Abstract

The United States of America possesses and executes laws that pursue equal citizens' freedom. However, the effectiveness and purpose of such laws have faced severe limits attributed to the need for a unified conceptual framework integrating legal, social, and anthropogenic fields. Our research focuses on the efficacy of the current intervention without a conceptual direction, the resulting barriers to racial profiling, and the importance of freedom and equality for all. Racial profiling has become the stem of discrimination and stereotypes in the United States of America. There needs to be an overarching conceptual framework that adequately integrates government-level intervention, apart from mere imprisonment of those who "might" be guilty in ways that decrease ineffective trends of racially profiled mass incarceration. In this framework, there will be an analysis of case studies of what has been effective and what has not in terms of policing, comparisons of potential racial differences in past offenses, and findings that show if there is a measurable difference for ethnicity in crime. With this, our research will be able to provide a cumulative suggestion to the problem we identify in the current status quo. A conceptual framework that embraces the role of a fellow citizen in bridging the gap between government policy and realizing its effects will integrate policies in the legal, social, and anthropogenic fields of the United States.

Contents

1 Introduction

1.1 Background

Racial profiling and mass incarceration are of particular concern in the United States. It has been shown that the number of people incarcerated in the United States is much higher than in other countries. Mass incarceration, or the widespread incapacitation of people in prisons and jails, does not affect all populations equally. Instead, mass incarceration intentionally targets specific populations - especially black people. Statistics on how many people are incarcerated, under criminal justice supervision, arrested, or stopped by the police do not accurately reflect how different encounters with the criminal justice system are broken down by race or ethnicity. Therefore, an essential axis of inequality is not accurately reflected, which proposes that there is no apparent justification for keeping people behind bars - many are held captive merely because of their race.

Three notable policies, namely the "Three Strike Laws" from the 1990s, the "War on Drugs" initiated in the 1980 s, and the implementation of "Broken Window Policing and Zero Tolerance Policies" in the early 2000 s, have played pivotal roles in shaping this increase. While these approaches were initially intended to target violent repeat offenders and combat drug-related issues, their unintended consequences have disproportionately impacted non-violent offenders and minority communities.

The "Three Strike Laws" were initially designed to impose harsher punishments on repeat violent offenders. However, their application resulted in the incarceration of numerous non-violent offenders, particularly from minority communities. This policy created an unjust system where individuals were sentenced to lengthy prison terms for minor offenses, perpetuating the overrepresentation of minorities in the criminal justice system.

The "War on Drugs," which gained momentum in the 1980 s, led to implementation of policies such as mandatory minimum sentences through the Anti-Drug Abuse Act. Unfortunately, these measures disproportionately affected minority communities, perpetuating racial profiling and contributing to mass incarceration. Techniques like stop-and-frisk, driven by racial prejudices, further exacerbated this issue, intensifying the disparities in law enforcement practices.

In the early 2000s, the adoption of "Broken Window Policing and Zero Tolerance Policies" heavily emphasized strict punishment for minor offenses. These policies significantly increased the number of arrests and convictions, impacting communities of color, particularly black communities. Concerns were also raised regarding racial profiling due to the growing use of methods like facial recognition.

The consequences of these evolving crime control techniques have been staggering. Between 1970 and 2000, every state in the United States experienced an incarceration rate increase of at least 150 percent, with the median state witnessing a staggering 390 percent rise. Despite the population doubling since the 1970 s, the number of incarcerated individuals has soared, with approximately 7 million people behind bars, or roughly one in every 31 adults. Disturbingly, statistics reveal that one in three black men and one in six Hispanic men born recently are projected to experience incarceration during their lifetimes. Thus, it will be infeasible for the government to intervene intensively in decreasing incarceration as citizens' approval would be crucial yet highly inaccessible.

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1.2 Research Questions

1. Why is contemporary policing ineffective? Does this type of policing imply unjustness?

2. Are there critical racial differences in past offenses among samples of serious offenders?

3. What accounts for racial and ethnic differences in crime? Can a focus on the police perspective bridge the gap between communities and law enforcement?

1.3 Purpose

According to research done by criminologists, white people have higher levels of trust and confidence in the police than black and Hispanic people. These perceptions are partly a result of the difficulties that members of racial and ethnic minorities face throughout the legal system and the unfair treatment they may have encountered when dealing with the police. It is generally accepted that minority officers are better suited to handle issues and foster better relationships with locals in communities where a higher minority population is present. So, it can be concluded that the presence of minority officers can reduce the tensions that white officers cause among minority populations. The key to successful law enforcement is the competent relationship between police officers and the community. A cordial relationship will lead to a development of the reliability of citizens towards police officers. Gaining trust is significant because policing will not be as effective without it.

1.4 Problems

In the late 18th century, the United States of America had a watch and ward system that looked over necessary control for citizens. So, when discussing police history, it never really goes as far as the 1700 s. At the beginning of the 19th century, policing started to become modern and funded, and citizens publicly supported it. By the 1890 s, most major states had police forces. However, the establishment of police forces is rooted in structural racism: a fundamental problem that our research gap touches on. The creation of police forces began during an era when many black people were enslaved. Because of this, white people were scared of any potential slave uprising there might be, so police forces were created to have a particular focus on patrolling black people. The trend of racial profiling in policing was not an accident, and racial profiling in policing is still not illegal.

Law enforcement must overcome several obstacles to solve racial profiling and mass incarceration. The unconscious biases and stereotypes police officers carry present the first substantial challenge. Personal experiences, cultural influences, and media depictions create these prejudices and stereotypes, and racial profiling may be enhanced through negative opinions of particular ethnic or racial groups that police have. Biases and stereotypes have also been shaped by historical oppression and racism. Communities of color that have traditionally experienced discrimination or marginalization frequently experience increased levels of policing.

A thorough strategy that educates law enforcement officers is necessary to address these prejudices and stereotypes. Second, there is a lack of training. In order to address biases and stereotypes and help law enforcement officers to identify and combat them, adequate training is necessary; however, there are frequently not enough thorough training courses devoted to comprehending implicit biases and how they affect policing techniques. The historical background of structural racism, the impact of biases on judgment, and practical techniques to prevent racial profiling should all be covered in

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training. It should also promote cultural competence, empathy, and practical communication skills when working with various ethnic groups. Another challenge lies in implementing effective policing methods, which require balancing public safety and protecting individual rights. Developing and implementing unbiased policing strategies can be complex due to various factors. Some approaches include community-oriented policing, which fosters partnerships between law enforcement agencies and communities, emphasizing trust, problem-solving, and crime prevention at their core rather than solely relying on enforcement. Implementing accountability measures, such as independent oversight mechanisms, can also help reduce incidents of racial profiling and increase transparency. However, this requires ongoing evaluation, feedback mechanisms, and a will to adapt and improve practices based on the needs and expectations of the community. Addressing these challenges demands an intricate approach involving collaboration between law enforcement agencies, community organizations, policymakers, and advocacy groups.

Nowadays, there have been notable cases where it has been shown that there is an impact of officer race on tangible outcomes. Recent research suggests empirical regularity and a consequent impact on crime: as minority police increased, the number of arrests of white people increased, and vice versa. It can be said that this is due to the many diverse communities that exist within the United States of America. Predominantly white and bourgeoisie communities engender crimes in predominantly black and poor communities, so the latter community inevitably became victims of under-policing when it came to emergency services. Despite the contrary, they were overpoliced in surveillance and social control. Furthermore, implementing a national force is nearly impossible as there is no uniform set of national standards due to local differences (such as demographics and class dynamics).

The weaknesses mentioned above in policing are reflected by the positive correlation between skepticism of police expressed by minority citizens and racial profiling. Racial profiling includes but is not limited to, documents of racial disparities in police behavior. Our research aims to reduce the primary problems identified in our research gap.

1.5   Objectives

The primary goal of this research work is to deeply emphasize the necessity of police-citizen engagement and the responsibility to protect human rights. There has been a decline in citizen trust in policing and government policies. Finding a way to press the police to halt racial profiling would bring in political liberties and social rights to provide agency for people, hopefully making it institutionalized.

2   Literature Review

2.1   Key Concepts

We continue to see racial profiling in records of police offenses. What has policing been doing to fight such injustices, and how can we describe the actions taken by the government to prevent violations of human rights? One definite answer to this question is that not enough has been done to ensure that racial profiling will not occur.

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2.1.1   Contemporary Policing

Contemporary policing emphasizes a positive working relationship between the police and the public, data- and technology-based analysis, treating every citizen fairly, and upholding the rule of law. With these various strategies, contemporary policing demonstrates inefficiency and irrelevance, particularly in the interaction between the citizens and the police. According to the police, the ineffectiveness of this policing strategy is brought on by components like prejudice, racism, the use of force on citizens, and a concentration on punishing people rather than preventing crime. However, from the citizens' perspective, there may not be any trust in the police as they might only have limited information and resources, receive inadequate training, and take a reactive instead of a proactive approach to crime. Contemporary policing is highly ineffective without a structured organization and training, which makes citizens wonder if this policing approach is genuinely just.

2.1.2   Structural Racism

Structural racism is a form of racism encouraged through "mutually reinforcing systems of housing, education, employment, earnings, benefits, credit, media, health care, and criminal justice (Bailey et al., 2017)." Structural racism significantly impacts U.S. society as they lead to health inequities, mainly among black Americans. Bailey., et al. (2017) argue that focusing on structural racism offers a more promising approach to health equity and overall health. Structural racism may lead to health inequities, creating unequal access to resources and healthcare services. Some potential solutions for health inequalities caused by structural racism include "place-based multi-sector initiatives, disruption of leverage points within a sector that might have ripple effects in the system, and divorcing institutions from the racial discrimination system." According to Braveman., et al. (2022), the first critical step in dismantling systemic and structural racism is acknowledging its existence. Then there are several ways to dismantle these types of racism. For example, enforcing anti-discriminatory laws, affirmative action and diversity, equity, and inclusion in all sectors of law, or truth and reconciliation interventions such as those pioneered in post-apartheid South Africa. The influence of structural racism can also be experienced in STEM education, as researched by McGee in 2020. This paper utilizes a historical structure analysis to explore the role of structural racism in STEM programs. The status quo of education in STEM and employment strengthens racism; White people gain an advantage, whereas URM (underrepresented and racially minoritized) groups suffer from adverse outcomes. The consequence of structural racism is a lack of diversity in leadership in STEM companies. This paper suggests that to address structural racism in STEM leadership styles employed by faculty members and administrators at historically black colleges and universities (HBCUs) should be studied.

2.1.3   Racial Profiling

Racial profiling involves suspecting someone of committing an offense based on their race or ethnicity. Traffic stops are more likely to target people of color. Compared to white individuals, police are more likely to search for people of color. Police were more likely to stop black people on the street just out of suspicion. Even though it is the same offense, there is a higher possibility that black people will get arrested than white people. Black people were eight times more likely than white people to be arrested for marijuana possession, another aspect of the drug problem.

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2.2   Developments

Recently, police have established a new strategy called smart policing. This strategy is based on science and technology, which involves analyzing data and collecting evidence. It brings significant advantages to police officers and society. It heightens the quality of policing and the life of the citizens by offering fast police service through devices and improving their responses to severe crimes or incidents. Despite these benefits, smart policing requires costly procedures and a requisite skill set to investigate technology: analysis of data, researching documents, cautious handling of data, and more. Following expectations of increasing technology infrastructure and engaging with society will require the police to become highly adaptive. Additionally, to retain trust with the community and exhibit effective services to the public, the police need to form a strong partnership with the community. Thus, the future of policing presents challenges and opportunities as technological advances continue to influence how we interact as a society.

2.3   Methodology

Our research stems from case studies and literature reviews that address our research gap because we needed to gather data from earlier research publications and go deeply into a subtopic such as racial profiling and government intervention. Case studies allow in-depth analysis of specific cases or examples of mass incarceration. It also offers detailed insights into the causes, effects, and possible solutions related to the issue. A literature review allows us to see existing research done by scholars, allowing us to identify different perspectives. We read recent research papers on mass incarceration to get a sense of how much effect mass incarceration has in the United States. In order to understand why mass incarceration continues to be a significant issue, we examined previous police strategies and read articles published by different university professors. To answer our research questions, we specifically reviewed academic research examining the effectiveness of contemporary policing. We had to look at studies that analyzed other policing methods and compared them to contemporary policing. Further, we analyzed crime data and statistics to find any racial differences in past offenses by reading recent literature on racial and ethnic differences in crime.

3   Discussion

3.1   Significance

Our research gap focuses on an approach that prioritizes officer race and perspective rather than the citizens. All past research focuses on the citizens' perspective and statistics regarding the citizen perspective. However, a one-sided view of a multi-faceted issue has yet to be able to make any noticeable change for the community. In approaching research in ways that will consider the officer's mechanics and potential implications, our research brings a more practical yet modern approach to bringing justice. Focusing on officers' perspectives rather than citizens is a newer, sophisticated approach that can provide valuable insights into the causes of racial profiling; problems within law enforcement, such as biases and stereotypes that officers have, can be more directly observed. Practical strategies and interventions can be more easily created when focusing on this side. We have identified a significant impact that policing trends gain from citizen perception of policing methods (such as community policing or police stops). The correlation between increased minority officers and citizen-officer relations further supports this assertion. With the acknowledgment that citizen-officer relations stem from the problems identified, we intend to apply our research to bridging the gap between communities of color and law enforcement and apply our research in ways that

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perpetuate less unjust and discriminatory criminal justice systems. Our research will contribute to the existing body of literature through a modernist perspective of policies and practices.

3.2 Research Gaps

Knowing that mass incarceration and racial profiling are a problem, our research primarily focused on the lack of government intervention. Nonetheless, even if intervention took place, there are no policing and policies that can help support such methods to be effectively implemented. Police are a substantial source of power in the state, influencing how citizens interact with the government. In other words, the police are a force that contributes significantly to oppression and social control in the United States of America. On this note, our research gap regards analyzing what has worked and has not worked in policing.

We came across a correlation showing a significant increase in white arrests when there is an increase in minority police officers - however, being aware of racial inequality in arrest numbers, our research questions if this correlation is beneficial for restoring equality in unlawful racial conduct. To answer this question, we plan to investigate further the race and ethnic-specific relations between offenses and arrest frequencies. In order to do so, we plan to set a standard as to what is considered an ethnic difference in crime by studying linkages between immigration and crime, which would broaden our research gap in a way that does not limit the focus to "minority versus white." On top of that, we can explore the prominence of officers and race and its impact on citizen perception and evaluation of the police.

3.3 Open Questions

Communities face some challenges in addressing racial profiling and mass incarceration. One of the most prominent reasons is the loss of trust. Individuals belonging to minority groups may experience this lack of trust due to past instances of discrimination and mistreatment. The loss of trust can be directly tied to the decrease in cooperation between communities and police making it hard to prevent and respond to crimes.

Our research is heavily dependent on theorizing with reasoning. We use a historical analysis structure to study incarceration and racial profiling; thus, no empirical data is used in our research. Second, information is limited as we are studying these issues from Korea. Access to research papers about incarceration written in the United States can be challenging for us to access if there is another separate database. Lastly, it can be challenging for us to gain connections to scholars or authors who specialize in mass incarceration and racial profiling in the U.S.

3.4 Future Directions for Research

There are, however, some existing solutions, and they all have their benefits while having a disadvantage. First, there is community policing. Community policing tries to overcome the challenges communities face in addressing racial profiling and mass incarceration by building positive relationships between law enforcement and the community. However, they reduce the reliance on racial profiling and focus more intensely on community engagement. Second, training programs exist, although they are less abundant (as mentioned in the number of challenges law enforcement faces when addressing racial profiling and mass incarceration). These training programs focus on two main things: cultural sensitivity and unconscious bias awareness. Cultural sensitivity allows the officers to develop an appreciation for minorities by learning about their culture, which promotes

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fair and respectful treatment. Unconscious bias awareness allows the officers to be aware of the biases that influence their decision-making, which can help them improve when interacting with other communities. Third, police reforms can be used to solve the problem of racial profiling. This includes mandating stricter guidelines and oversight mechanisms to prevent discriminatory practices. Oversight mechanisms are necessary because they ensure accountability and adherence to policies that depress racial profiling by providing clear guidelines and protocols. There will be an ongoing monitoring and evaluation of officers' conduct.

4   Conclusion

Contemporary policing is supported by the beneficial relationship with the citizens, data analysis, reliance on law, and equality. However, with the presence of emotion, policing generally fails to bring positive outcomes and maintain relevance. Systemic improvements, greater transparency, involvement with the community, and a comprehensive approach to crime prevention are required to enhance contemporary policing and gain the public's trust. These adjustments are necessary for citizens to question whether this strategy is truly just.

The past offenses highlight the serious issue of racial profiling and its impact on the criminal justice system. The significant differences in incarceration rates, traffic stops, searches, and arrests clearly show the unequal treatment of people of color, particularly Black people. These problems tell the urgent need for equitable policing, reducing bias, and a more equal society.

Racial differences in crime literature are not evident in samples of severe offenders, but racial and ethnic differences in crime can be attributed to structural racism. Structural racism is deeply embedded into systems, laws, and policies and may often be invisible and can occur naturally; this can lead to health inequities and differences in levels of education between communities of color and white Americans, as is further mentioned in the key concepts. These health inequalities and lack of education can further act as a motive for crimes caused by minority communities, leading to a positive feedback loop, as law enforcers may strengthen their law enforcement methods. Focusing on the police perspective can bridge the gap between communities and law enforcement as problem-solving of racial profiling due to biases and stereotypes can be more directly approached.

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10

Evolution of Scientific Elements of Science Fiction and Their Factors

Yeseong Lee

Abstract

Science fiction is a genre of literature using creative concepts using science and technology. The genre has been developing for many years since it started. People reviewed it in different fields but have yet to study its scientific elements. It is what makes the genre. This research provides the evolution of scientific elements in science fiction in different periods and the factors that influenced the change. Frankenstein is known as the "first true science fiction." It used simple scientific elements like the reanimation of dead bodies using electricity. In the 19th century, people had a limited understanding of biology and other science. Mary Shelly, the author of Frankenstein, first wrote the novel after hearing about Galvanism. She heard about the experiment in that electricity touched the dead frog's leg and switched its position. People, including the author, thought it would be the key to reanimation. For modern science fiction, I reviewed *The Three-Body Problem*, which is hard science fiction. It had many complicated scientific elements such as quantum mechanics, astrophysics, game theory, etc. There are many scientific elements organized in the story. The development of modern science can explain its change. Even the author, Liu Cixin, was an engineer. The name is one of the science concepts. Also, many old works influenced it. Hard science fiction was developed in the golden age of science fiction when the genre got huge attention.

Contents

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1   Introduction

Science fiction, also known as sci-fi and SF, is a genre of literature that is hard to determine and define. Debates about their definition are still going on. Science can be defined in many different ways: by the content of the text, the theme, etc. It is too complicated if we get into deeply. In this research, science fiction refers to fiction that has scientific elements using creative concepts from science and technology. The scientific elements mean the science concepts, themes, theories, etc. It does not have to be existing science concepts in real life. It is a scientific element if it is a scientific concept in the world of fiction or shows technology and science-like characteristics even though it does not exist in real life.

1.1   Background

Because it is hard to define the genre, it is hard to determine the first science fiction. Many people argue that Frankenstein is the first science fiction. English writer Brian W. Aldiss first proposed this idea [1]. He pointed out that *Frankenstein* first had modern experiments based on existing concepts and decision-making about science. His claim spreads out. Also, there are many ideas about it. The time is usually the 18 th to 19 th century. There was a fiction that have scientific elements before them. However, the focus was on something other than the scientific elements. Even though there are debates about the first science fiction, everyone would agree that it has an important place in the science fiction field and influenced many other works. *Frankenstein* is a story that happens around a mad scientist with advanced technology.

After the 19th century, the "Golden Age of Science Fiction" opened in the 1940 s to 1950 s and ended in the 1960s [4]. It was when the genre got attention, and high-rated works were published. Authors like Isaac Asimov and Robert A. Heinlein started the period with their unique work. At the end of the period, Arthur C. Clarke, Philip K. Dick, and many other authors finished it. In this period, one of the categories of science fiction, hard sci-fi, raised up. Hard science fiction is a category of science fiction that focuses on its scientific accuracy, therefore, more scientific elements. The works in this period of science fiction greatly influenced the work after it.

Nowadays, science fiction is still a popular genre of literature that many people love. Modern science fiction is hard to say something now because we do not know the big picture of history while living inside of it. Many works influence by other old science fiction in different periods.

1.2   Research Questions & Hypothesis

This research finds how the scientific elements and their details changed and evolved from the 19th century to today. Also, it finds the factors that influenced the scientific elements and changes in the scientific elements of science fiction. As mentioned before, scientific elements are any scientific concepts, themes, quotes, or theories related to science and technology mentioned in science fiction. It can be the existing concepts but does not have to be. It just needs to be related to science and technology and work as concepts in fiction. Because the scientific elements are the key to science fiction that makes the genre itself, the research makes us discuss and think about the genre itself. It finds how science and technology influence and affect the literature. It is helpful and good for the human knowledge of work of both science and literature. Also, we can see how the author used scientific elements in their works and how they evolved.

Many factors influenced the scientific elements of science fiction, and they evolved multiple times.

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Science fiction in the 19th century, such as *Frankenstein*, used simple scientific elements with low accuracy. As time passed, science fiction nowadays has evolved, and the scientific aspects of science fiction have changed a lot. Even though many science fictions were published, and they are all different, their scientific elements are evolved and been used in many ways with high accuracy in science and technology.

2   Literature Review

The two science fiction I reviewed takes the place of significant roles in science fiction. As mentioned before, *Frankenstein* sometimes gets pointed out as the first science fiction. Even though debates are going on about it, many critics agree that it influenced many later works of science fiction [4]. One of the reasons is the way it used scientific elements. English writer Brian W. Aldiss first said that Frankenstein had modern experiments in the laboratory. Also, *The Three-Body Problem* is a hard science fiction focused on the accuracy and logic of science and technology and received favorable reviews because of that. It is the best science fiction that tells how the scientific elements improved from the 19th century.

One of the reasons that I chose this topic is the lack of studies focused on the evolution of scientific elements of science fiction. Scientific elements are not directly researched until now. Because the books that I will review are significant and famous in science fiction, there were some research or literary criticisms related to the scientific elements [2, 6], but it was not enough. Most of them are saying other things.

3   Methodology

In this research, I used Frankenstein for 19th-century science fiction and The Three-Body Problem for modern science fiction to determine the scientific elements in two different periods. I read through the books again, found the scientific elements in the books, and researched more about them. Once again, scientific elements mean any science concepts, themes, theories, etc., in science fiction. When reading science fiction, scientific elements can be found in the books. I see how they changed and got advanced. By researching the events or changes in science and literature during those periods, I can determine the factors that influenced the evolution and change in scientific elements of science fiction.

4   Results & Discussion

Frankenstein is a novel often referred to as the first science fiction. It was first published as a name, *Frankenstein; or, The Modern Prometheus* in 1818 without showing the author's real name. In 1931, the author published the novel without subtitles with different details using her name. In the research, the modern publication of the book (penguin books) will be used.
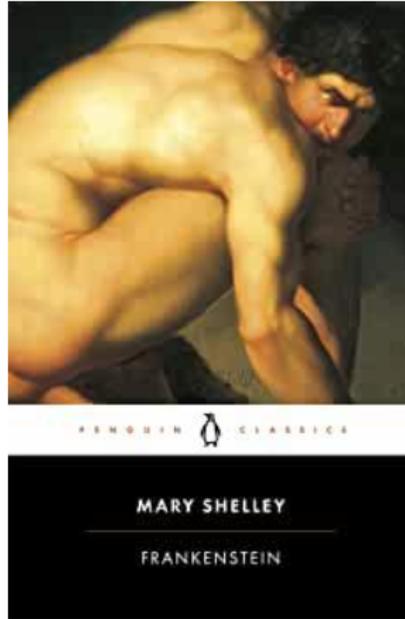
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Figure 1: Frankenstein

The scientific element it had was simple compared to modern science fiction. It mainly has only one scientific element. It is the reanimation of dead bodies using electricity. In chapter five, Victor Frankenstein, who is a university student in the story and often referred to as the first mad scientist character, creates the creature after years of studying. He used electricity to get the dead bodies' life back. It does not sound very scientific from the modern point of view. However, it was an existing scientific concept.

Mary Shelley, who is the author of Frankenstein, talked about galvanism with Percy Bysshe Shelley. Galvanism is a concept invented by Luigi Aloisio Galvani. He found out that if a frog leg comes into contact with an electrical current, it changes its position. People thought it is the key to reviving life. From it, the author came out of the idea of the story of Frankenstein (xxiii). So, Galvanism influenced the scientific elements of Frankenstein. It sounds weird from the modern point of view, but it is one of the reasons why Frankenstein is called the first science fiction. It used existing scientific concepts at that time.

The Three-Body Problem is a hard science fiction written by Liu Cixin. Hard science fiction is a genre of science fiction that focuses on the accuracy of science. So, it can show close to the maximum of the modern scientific elements of science fiction. That is why this book is used in the research.
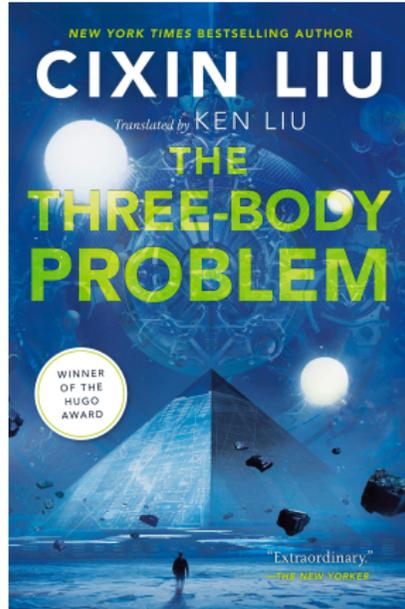
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Figure 2: The Three-Body Problem

The Three-Body Problem is full of scientific elements. The title itself is also one of the important scientific elements in the novel, that exists in real life. The three-body problem is a problem in physics and classical mechanics that predicts the three bodies' movement, like the sun. It gives the reason for the contact with aliens in the story. Not only this, there are many scientific elements. The development of science and technology can explain this. Many years passed from the nineteenth century, and so much technology and science developed. Authors have many scientific elements to use. Also, other science fiction influenced it. For example, hard science fiction developed with great attention in the golden age of science fiction. Many things with science fiction developed. So, the novel is also influenced by many other works.

There are some limitations aspects this research. Firstly, the chosen books cannot represent all the science fiction of the period even though both books are very famous for their scientific elements. Many books have been published since the genre started. One cannot replace every book in any period. Also, the books are reliant on my personal reading experience. Additionally, some factors in the evolution of scientific elements of science fiction might be missing.

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6

Development of an Automated Economic Graph Generator using Python for Various Market Forms

Roy Kwon, Thomas Jin

Abstract

This research paper focuses on developing an automated economic graph generator using Python to visualize various market forms and analyze the input economic data collected displayed in the graph. The objective is to create an efficient and user-friendly tool for not only economists, researchers, and policymakers to study and compare market structures such as perfect competition, monopolistic competition, oligopoly, and monopoly but also for just normal students, and people who are interested in economics. By leveraging and applying Python libraries like Pandas and Matplotlib, users will be able to input economic data and generate graphs such as demand and supply curves, market equilibrium, cost curves, and profit maximization. We would have to first gain the knowledge of drawing a curve line, straight line, line crossing along the other, such detail variables that will be shown in the graph through the website called Matplotlib. Then operate a program that displays the different types of market structure. We will lastly edit the program code to form the economic visual graph, the economic analysis, output, based on the input that has been coded. The automation feature and program will eliminate manual, handly-operated graph creation and calculations, saving time and effort while enhancing the accuracy of economic analysis. This Capstone project's final goal and what it aims is to contribute to the field of economics by providing informative, accessible tools to help you understand current economic market conditions and aid your decision-making process.

Contents

1   Introduction

Economics is a branch of social science that studies how every individual, businesses, governments, and companies allocate scarce resources, production of goods and services, growth of production and welfare for the satisfaction of human's unlimited wants. The field of economics relies on making the analysis of all economic information as graphical representations, which would make it easier to recognize and which are most commonly used. Economic graphs provide visual understandings into various market forms, illustrating concepts such as demand and supply, price determination, and the behavior of firms and consumers. The automation feature and program will eliminate manual, handly-operated graph creation and calculations, saving time and effort while enhancing the accuracy of economic analysis.

Using matplotlib, a computer code designing website creating static, visualizations, and etc; we looked for, searched for, and studied the Python codes we had to apply and write, and turned the code to a website where files to open all programs are already set called Google Collaboration with Python code. We have chosen Google Collaboration as our main Python code runner because in order for us to run a Python code program in other different Python libraries, we have to pay and download every single file that has to be needed for the library to run the Python code flawlessly. We would operate a program that displays the different types of market structure. We will lastly edit the program code to form the economic visual graph, the economic analysis, output, based on the input that has been coded. The key advantage of building an automated graph generation process is the flexibility it offers. Users can quickly generate, design graphs for different market forms without the need for manual calculations or drawing by hand. However, there are unavoidable factors that might affect the program that we have planned to build: Insufficient Python knowledge, or the lack of the ability for a free Python code runner, could greatly affect the automatic graph generator we were trying to build.

2   Topic Statement

2.1   Background

Automating the graph generation process for various market forms brings several advantages. It significantly reduces the time and effort that has been manually required to create graphs, enabling economists, researchers, and students to explore and work more efficiently. Second, an automatic graph generator would eliminate the potential for manual errors in calculations and graph construction, ensuring accuracy and reliability. We set our final goal for this project is to take advantage of this program and provide informative, accessible tools to help you understand current economic market conditions and aid your decision-making process.

2.2   Significance

Development of an Automated Economic Graph Generator using Python for Various Market Forms holds a very huge key advantage and value in the field of economy. Because we wanted to support making a really accurate and convenient automatic graphing program without mistakes, we are trying this project as an opportunity. We, as students, know that students, economists and researchers are manually constructing graphs to show the detailed information in economics and are tired of creating the graph handley. We wanted a convenient program for students to study and construct the graph efficiently and accurately.

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3 Methodology

There are various types of market forms such as Oligopoly, Monopoly, Perfect competition, Monopolistic competition, Supply and demand, and etc. We would have to define and identify the type of market structure to be included in the automated graph generator as typed in python. Initially, our team explored the possibility of using the "turtle" function, an inherent feature of Python programming. The turtle function appeared promising, as it provided the ability to draw various shapes and objects. Consequently, we assumed that leveraging the turtle function would allow us to generate graphs effortlessly. However, we soon encountered challenges that impeded our progress.
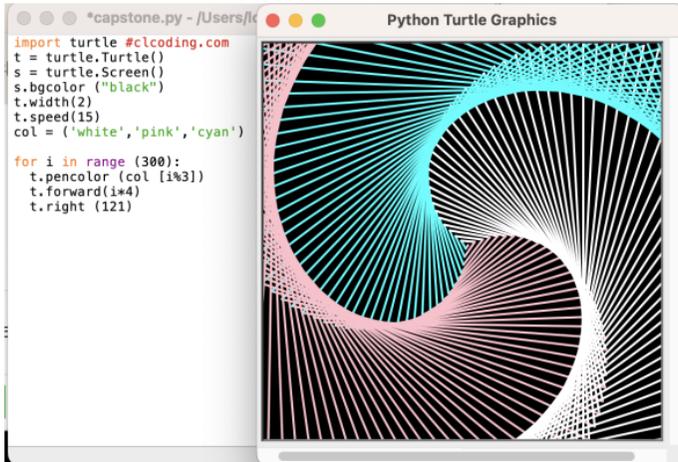
Despite its versatility, the turtle function proved inadequate for our graph generation needs. The resulting graphs lacked the desired level of precision. Our quest led us to discover a python visualizer platform called matplotlib, a powerful plug-in function tailored for Python. Although building up the program using matplotlib required downloading the library, we recognized that this approach was not ideal for potential users of our program. Requiring individuals to download additional libraries or files may not only prevent them from using the automated graph generator, but may also discourage them from using it. Consequently, we sought an alternative solution and turned to Google Colab for assistance.

Google Colab, a cloud-based platform, presented an ideal and perfect environment for our project. It seamlessly integrated various external libraries, including matplotlib, eliminating the need for users to undergo additional downloads. By leveraging the capabilities of Google Colab, we aimed to simplify the user experience and make our automated graph generator readily accessible to a broader audience.

Nonetheless, switching to matplotlib had its own challenges. We acknowledged that in order to utilize matplotlib to its fullest effect, we needed to gain a comprehensive understanding of its capabilities. As a result, our team has put considerable effort into researching and assimilating

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tutorials available on numerous platforms. This tutorial has served as an invaluable resource to help you get proficient with matplotlib and learn its intricacies.

Utilizing the capabilities of matplotlib, we aimed to use features we hadn't faced and overcome in the turtle function. Our goal was to create visually appealing and accurate graphs that accurately represent different market structures. We recognized the importance of mastering matplotlib's features and committed ourselves to mastering its use.

In summary, our journey involved switching from tortoise function to matplotlib in line with our ambition to create a more sophisticated and user-friendly automatic graph generator. Exploration sought to achieve a higher level of accuracy and aesthetic appeal in graph creation while ensuring ease of use for potential users. Also, the platform that executes the graph through Python code uses Google Collab as mentioned.

4 Limitations

While developing an automated economic graph generator using Python for various market forms, there are several limitations to consider. During this Capstone Research, we had some of the difficulties in mastering the concept of Microeconomics and Python Codes and its uses. To excel in our Capstone research, it is crucial to possess a strong understanding of both AP Microeconomics and Python programming. Developing a proficient program using Python code can indeed be challenging with limited knowledge that we have. For example, we had to draw the ATC, Average Total Cost that lies on below, above or right on the Price market line with a curve. However, with our Python skills and even with the help of research, it was very difficult to make a curve line overlap one another.

One of the limitations we had on taking this Capstone research was that economic models and market forms that our program displays use simplified assumptions to make the analysis manageable. However, these assumptions may not fully capture the complexities and intricacies of real-world markets. As a result, the graphs generated may not accurately depict all aspects of how markets behave. Next, in the program we created, the economic graph is an analytical tool that must be understood in the context of a particular economic theory. Our program doesn't provide the necessary context to understand the graphs, and produces graphs that require a knowledge of economics to be understood without any explanation, making it difficult for users without sufficient understanding of economics to interpret the results correctly.

Lastly, we also had limitations on the sensitivity of input variables, in which economic models frequently rely on input variables that determine the appearance and characteristics of the graphs that are generated. The graphical results can change significantly when these parameters are even slightly altered. The proper selection of these parameters may not be suggested by auto-generators, which could result in inaccurate or deceptive results if not done carefully.
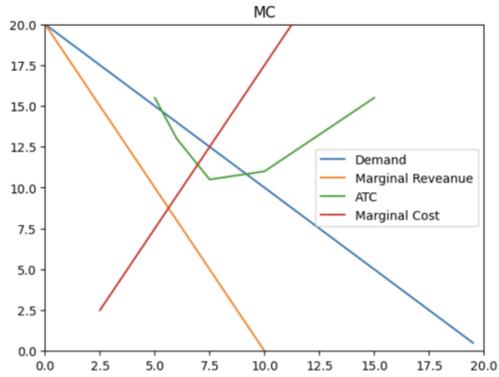
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5   Result

what is market form?PC
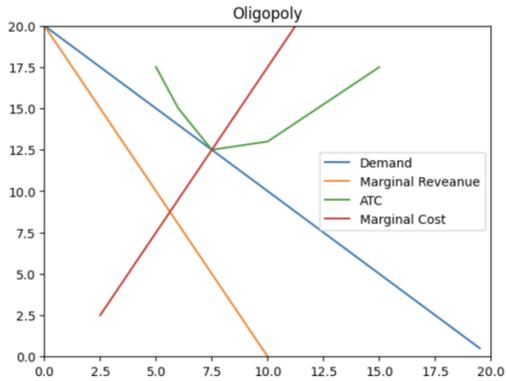what is economic profit?1
what perspective?firm
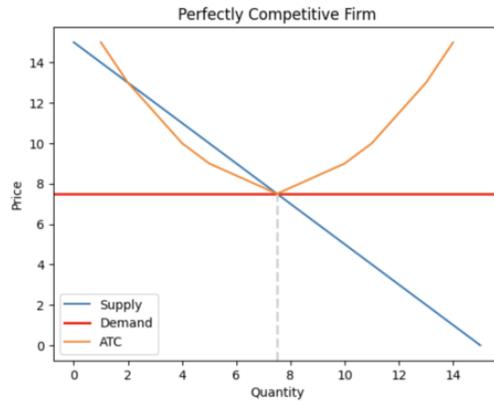
Perfectly Competitive Firm

what is market form?PC
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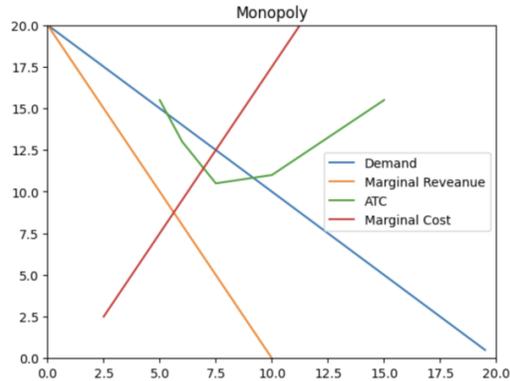### Perfectly Competitive Market

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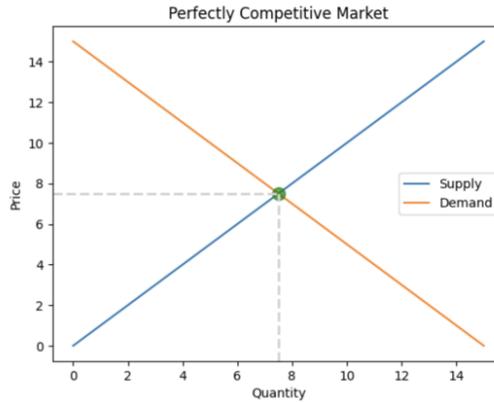
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what is market form?MC
what is economic profit?-2
what perspective?market
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MC

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what is market form?Oligopoly
what is economic profit?0
what perspective?firm
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Oligopoly

6

6   Discussion

We created this program to make studying economics more efficient. Graphs are essential for understanding economic concepts, but dealing with the numerous market forms and situations in economics can be time-consuming and inconvenient. That's why we developed this program to provide quick access to graphs for specific economic scenarios.

Another reason for undertaking this project was to improve our Python programming skills. We understand the importance of computer science in today's Fourth Industrial Revolution Era, and we believe that acquiring knowledge in this field will benefit us in the future. By working on this program, we have gained valuable insights into computer science, particularly in using external plug-in functions. This understanding has made our programming more efficient and clear, giving us an advantage when creating future programs.

To begin, we wrote Python code that generates economic graphs. We focused on four main market forms: Perfectly Competitive, Monopolistic Competitive, Oligopoly, and Monopoly. Since three of these forms share similarities, it was relatively straightforward to handle them.

Next, we added an input function to gather user information. We ask users to provide details like the market form, perspective, and product name. Based on their responses, the program generates and displays the corresponding graph.

In summary, this program aims to simplify the study of economics by providing easy access to relevant graphs for different market forms. Additionally, it has allowed us to improve our understanding of computer science, especially in utilizing external plug-in functions. This knowledge will be advantageous as we continue to create new programs in the future.

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7   Conclusion

Our capstone research of an automated economic graph generator using Python for different market forms is a significant achievement in the fields of economics and computer science. This program provides a valuable solution to improve the efficiency of studying economics by making it easier to access relevant graphs for various market scenarios.

By automating the process of generating graphs, the program saves users time and effort that would otherwise be spent searching for or manually creating the graphs. This streamlines the analysis of economic concepts and allows users to focus more on interpreting the graphs and gaining insights.

Additionally, the program serves as a practical tool for students and professionals in economics. It enables users to visualize and explore the dynamics of different market forms, such as Perfectly Competitive, Monopolistic Competitive, Oligopoly, and Monopoly. This broad coverage ensures that a wide range of economic situations can be studied and understood.

Beyond its usefulness in economics, the development of this program also promotes the acquisition of computer science skills. By utilizing Python programming, users gain practical experience in coding and learn about external plug-in functions, which enhances their proficiency in this important field.

However, it is important to acknowledge the limitations of the automated economic graph generator. Simplifying assumptions in economic models may restrict the accuracy and representation of real-world market complexities. Users should approach the generated graphs with caution and possess a solid understanding of economic theories to interpret them effectively.

In conclusion, the automated economic graph generator using Python contributes to improving accessibility and efficiency in the study of economics. It empowers users to quickly generate and analyze graphs for different market forms, facilitating the comprehension of economic concepts and fostering computer science skills. While recognizing its limitations, this program serves as a valuable tool for researchers, students, and professionals in the economics field.

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