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The Dark Truth Behind The Magazine Industry by Dory Vaughan

When flipping through the latest issue of Vogue or skimming the recipes in Bon Appetit magazine to find an exciting dinner to make, discrimination does not cross our minds. However, skin tone representation is a much bigger issue than we assume, with racial bias and discrimination commonly being present behind the scenes of media production.

Colorism is prejudice and discrimination against people with deeper skin tones. In our unit of looking at images from magazines, our goal was to analyze and pay closer attention to skin tone representation. By analyzing the skin tone representation in the *British Chees Magazine*, it helped me think more about colorism, racism and bias. Overall, the British Chees Magazine really lacked diversity.

We started this process by going through the magazine and collecting images to base our data on. When doing so, we noticed an overpowering majority of people with lighter skin tones. However, these different graphs and plots show more diversity than was actually present. The reason for this would be because we selected 3 different spots from each person's skin tone to include in the data. We collected data points where lighting, shadows, or any other factors were impacting the skin tone.

First off, in order to understand the scatter plot below, we have to understand the term RGB. RGB is a color model where red, green and blue light are combined to form any color imaginable. All 3 colors go up to 255. For example when there is 255 red, 225 green and 255 blue, the color formed is white. When there is 0 red, 0 green and 0 blue, the color formed is black. This is why the lightest dots are closer to the "200's" and the deeper colored dots are closer to where the "100's" or "0's" are.

ADS AND ARTICLES COMBINED SCATTER PLOT
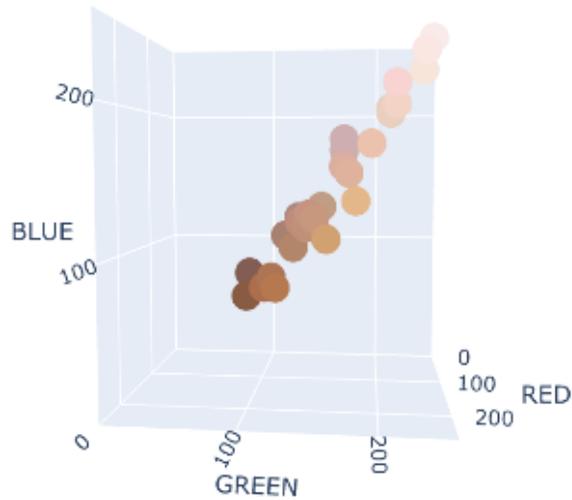
Ads and articles in British Chess Magazine, Created by author

ADS AND ARTICLES COMBINED BAR GRAPH
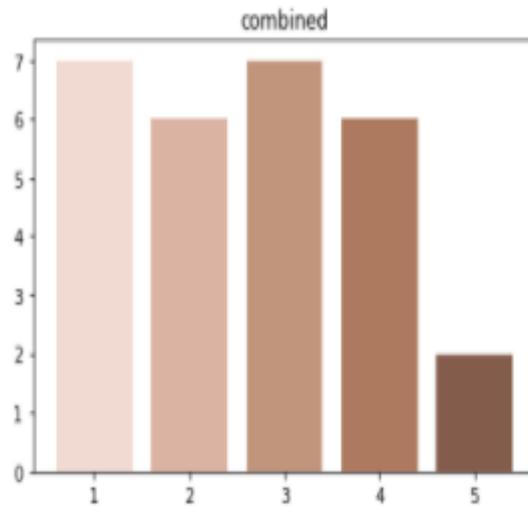
Ads and articles in British Chess Magazine, Created by author

These bar graphs were created by using the clustering technique where we used the RGB numerical values. 5 clusters were created and each of these bars depicts the color of the middle of the cluster. In other words, the average of the cluster is the color that is shown in the graph. Based on this, both the 1st lightest cluster and the 3rd lightest cluster were the most represented. The deepest skin tone was dramatically the least represented in the magazine meaning it had the fewest dots in the cluster .

While this in-depth study of skin tone representation did give me a lot more insight on issues of racial biases and discrimination, it did have its flaws. First of all, as a class, we only analyzed 6 magazines total. We were able to pick whichever magazine we wanted to closely study and also the photos that we included in our data. This definitely impacted our results and the noticings we made because every magazine and photo we chose was very intentional. Another thing that we had to consider was lighting. When collecting the dots of data we had to think about the real skin tone in comparison to how it looked when the light was hitting the skin, making it appear lighter or when no light was present, making it appear darker.

If I was to keep researching this issue of skin tone representation in magazines, I would accumulate much more data by looking at more magazines and potentially more types of media such as movies or books. I would look more into the reasoning for discrimination or why the most common skin tone in the magazine is the most common. This research was only a very small piece of a potentially huge research project that could bring change within media discrimination.

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"Beautiful": What Does This Mean? By Yarden Montia

Have you ever walked down the aisle of a makeup store and seen more white models than black or tan models? Well if you open a magazine you will find that white males are more frequently used. To the younger generation this can be extremely harmful, because it initiates a certain beauty standard, which may never be physically achievable.

Colorism is the discrimination against individuals with a dark skin tone, typically among people of the same ethnic or racial group. In our food article, we noticed that there is a significant difference in the skin tone representation between ads and articles, because of how there was more diversity in adverts. This may be because of advertisers using darker skin toned models who present more progressive body images and facial features, because of other features considered to be too idealistic such as a white woman with straight hair. This is shown by the 4 models of brown skin tone and two people of deep skin tones in the ads column, compared to either brown or deep skin tone models in the articles, this is shown in the left image below. Concluding that in the food Magazine there is more darker skin tone representation in Ads than there is articles. Food magazine is trying to strive away from these "idealistic" features, and move towards more inclusive and diverse representation of ethnicity and Skin tones.

food article	# in Articles	# in Ads	Total	food article	# in Articles	# in Ads
pale	10	5	15	pale	35.71%	15.63%
light	12	11	23	light	42.86%	34.38%
golden	5	9	14	golden	17.86%	28.13%
tan	1	1	2	tan	3.57%	3.13%
brown		4	4	brown	0.00%	12.50%
deep		2	2	deep	0.00%	6.25%
Total	28	32	60	**Total**	100.00%	100.00%

(Magazine data from the author data from food article, created by author)

We still do see the apparent stigma around beauty standards in Foods magazine, which shows that still most models for food magazines are white and lighter toned. In the table above to the left it shows that there were zero brown and deep articles, while there were 12 light people. This shows the crazy difference between skin town representation in articles. A question I have is, what is the reasoning for the food article not wanting to include deep and brown skin colored people in their articles? What we also noticed is, In the data there was even less tan representation in food magazines in both ads and articles, it appears that tan and golden models

are used less frequently to model.As someone who has middle-easern heritage, seeing little to no tan representation in magazines is quite disappointing.

Some things that make our data less reliable is that the colors for our bar graph got messed up, it shows gray and red skin tones which is not accurate. This is shown in the bar graphs below. The reason for this was probably we were not precise enough with where we plotted each individual point. Also, most of the photos we collected to use for our data, we photos of hands. Hands are only a small area of your body, and do not fully represent a model's skin. With that being said, certain parts of our body do interact with the sun more and some skin tones can be affected by the sun more. Taking that into account helps our data be more reliable, but also logical. In the future, I would like to explore more with all of the articles combined and not only the food magazine that only my group did. I think this would be more effective if every group got a couple of samples from multiple magazines, I think that way there will be more variability.
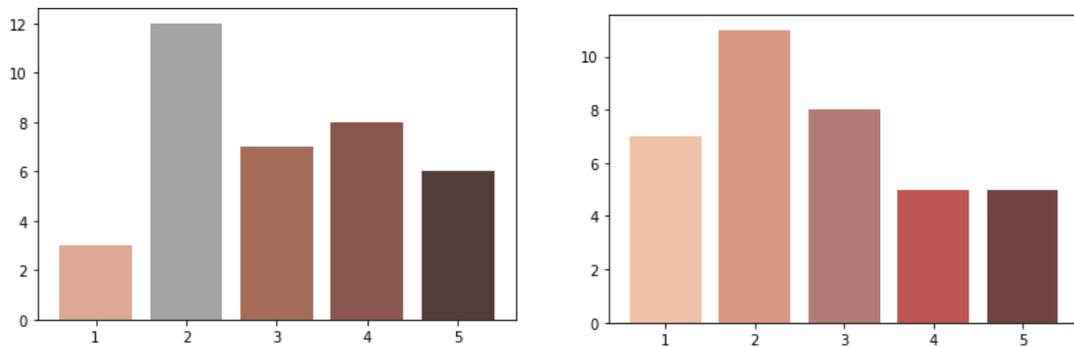
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Economic Disparity: China's Reaction and Policies by Andy Yuan, Edward Zhang, Gordon Li, Hugh Chen

This paper adopts cost-benefit analysis on evaluating both economic globalism and nationalism perspectives through exploring the definitions, benefits, drawbacks, and feasibility based on the status quo in China in order to develop solutions for global economic disparity. Our suggestion for China is to have win-win cooperation with developing countries and to build long-lasting trade partner relationships.

Introduction to Economic Disparity

Economic Disparity refers to the uneven distribution of civil incomes and opportunities between different countries in the world. As the graph attached below shows, some developed countries enjoy some financial surpluses, while other countries are still unable to deal with their civil issues: they suffer from famine, corruption and wars which have been caused by such a disparity and further worsening their poverty.

To start with famine: the current situation is that 38 million Africans are suffering from starvation (Harsch). The four regions (south-east Asia, Caribbean, Latin America and Africa) where poor countries centralize encounters either severe climate conditions or over population. Both factors have led to lack of food needed to satisfy local demand when a great portion of food is either exported for higher prices or just fell in the endless pocket of corrupted politicians. Frustrating civil health conditions and productivity, scarce food furthermore intensified poverty. Polarized politics, as a result of poverty, is another problem. Because of low incomes for the politicians as a result of poor federal governments, elites could easily bribe the politicians to do a favor for the ethnic, religious and ideological beliefs of the rich (Callahan). In other words, policies were driven by benefits, and politics are hence vulnerable to polarization as benefits separate(Carothers). When centralized power further gathered capitals, the poor were less likely to gain money and escape from poverty.

Wars are also nothing to sneeze at as a byproduct of poverty in the countries. As Bruce Riedel, a US senior fellow in Center for Middle East Policy, shared, 1990.8.12 when Iraqi invaded Kuwait marked an initial for infinite wars in the Middle East for the later decades (Iraqi). Political revolutions, disputes over territories and compete for resources quite common

and usually violent. These events meant far beneath simple benefits: motivated by strong eager for surviving in the harsh deserts, people had to violently achieve their own appeals when others were unwilling to concede as themselves. Furthermore, consuming weapons, labor and established prosperity, the wars have already been expensive enough, and thus further deteriorate their economic circumstances.

Now that the circumstance of China is quite unique: it has just accumulated wealth to satisfy civil demand with merely a little surplus. As a result, opinions are divided over whether China should actively start projects with foreign nations to improve together or to stay rather isolated to focus on domestic development. This paper may shed some light on some advice for proper Chinese policies on foreign trades based on its current situation.

Different Perspectives toward Economic Disparity: Economic Nationalism

Economic nationalism is the philosophy that instruct the national government to create a set of policies to bolster and protect the local economies in the context of world markets. Approaches attempting to define the term "economic nationalism" has been made throughout history from a political action aim to deal with the uneven development of capitalism, a central idea that economic activities are and should be subordinate to the goal of state building and the interests of the state to a national tool, rather than a state policy instrument. Nowadays, the term is more historically confined. "Economic nationalism should be considered as a set of practices designed to create, bolster and protect national economies in the context of world markets." The practices, including adding tariffs and quota, creating domestic monopolies, investing national companies, aim to pursuit national self-efficiency and avoid infringement of foreign businesses (Pryke).

Economic nationalism can also protect the national markets and currencies from worldwide crisis. Since globalization connects the economies of countries together, the impact of world trade collapse would be more dramatic if it comprises a large part of most countries' economies. In 2009, as a result of the banking collapse triggered by the collapse of the US subprime mortgage market in 2007, the volume of trade plunged by 12.2%, the largest contraction since the 1930s (WTO). Economic nationalism, by boost the growth of domestic economies and prevent international trade infringement on national economy, avoids such crisis from happening. Tariffs and quotas restrict the international trade from comprising the most part

of the national economy. Therefore, once worldwide crisis happens, the impact on national economy would be smaller. In the 1930s, after the Great Depression that affected the world, most of the economies of Latin America and the developed colonies of the European empire, those dependent on agricultural and raw material exports, suspended currency conversions and tried to stimulate domestic markets instead of external ones. Countries such as Argentina, Brazil, Chile, Colombia had an average of 20% increase in domestic consumption in 1938 compared with that in 1929 (Diaz).

However, economic nationalism can also cause reduction in domestic GDP due to people who lower their expectations for the country's growth due to less international trade and isolation from the world markets. According to The Costs of Economic Nationalism, since the impact of the British economy breaking up from Europe is not clear, people tend to give up economic activities in the UK, such as consumption, investment, etc. Britain's vote to leave the European Union was already affecting economic activity long before any policy took place. Data show that by the end of 2018, the BREXIT vote had reduced GDP by 1.7-2.5%. Indeed, raising tariff levels and retaliate international trade would be a huge loss in economy. In 2021, global exports of goods and services averaged 60% of GDP (OECD, 2021)

Economic Globalism

Another stance concerning the economic disparity is the economic globalism, promoting the extensive flow in international scope of consumer goods, services, labor, capital as well as technology and information. Through this flow, a merged economies comprising of diversified entities occur with worldwide interdependence. Some of the merits and drawbacks of this perspective are discussed below.

Firstly, specialization in general renders countries in international trade better-off. The efficiency for different countries to produce different goods is different, because of factors of land, labor, capital, and technology. Since nations can import goods from other countries that specialized in, they can specialize in manufacture that they are suitable for. To be specific, this gives countries comparative advantage, that is, to producing with a relatively less opportunity cost. When countries sell their specialized products on the international market, they would probably end up consuming outside of their Production Possibility Curves (PPC). Thus, more consumer goods are enjoyed by the citizens in each country at a lower price, improving living

standards worldwide.

Secondly, access to market overseas provides new opportunities for producers. Specific procedures of the production can be addressed where the cost of production is lower, generating more profit for producers. Nike's assembly lines, for example, are put in Vietnam and Indonesia where labor is cheaper. Moreover, groundbreaking technology tend to spread via the trade route and contribute to local productivity. The flows of knowledge with technology leaders led to, on average, 0.7 percentage points of growth in labor productivity per year for a country-sector over 2004-2014, accounting for nearly 40 percent of observed increase in average productivity overt that period(Aslam). Additionally, producers now have a chance of exporting their unexpected overproduction to avoid falling price domestically.

Finally, a low tariff favorable to global trade is considered as an essential part of government revenue for most poor countries. For example, Bangladesh's tariff accounted for nearly 25 percent of the fiscal revenue in 2017 (Bown).However, a global point of view also arouses problems. Specialization discussed before sometimes turns out to interpret a step in a vertical production carried out by a series of countries. If a country is used to take a similar step in these productions, its factors of production will be overconcentrated on a single industry, rendering the economic structure thin and pale and hence more vulnerable to crisis.

The Status Quo of China

In recent centuries, China is actively seeking cooperation with other countries for more development opportunities by trading and sharing its infrastructure technologies, which eventually yield positive win-win outcomes.

It should be emphasized that the Chinese government upholds the basic principle of extensive consultation, joining contribution, and sharing benefits, and it advocates multilateralism. Bearing this basic principle, China had developed rapidly in the last 40 years, with an economic growth rate of increasing 9.5% a year (WTO, 2010). Specifically, it led to a greater decrease in poverty, an increase in average incomes, which shortened the gap between China and developed countries.

Furthermore, infrastructure developed rapidly in China. The export-orientated economy supported by infrastructure development such as roads, railways, electricity, and infrastructures contribute largely to the economic growth. For example, China has constantly worked on

improving the domestic transportation networks. The passenger transport and freights through road are increased up to 26 % and 29.2% respectively, transporting more passengers and commodities. By the end of 2005, the running railways' length was 75,000km, reaching a turnover of 606.2 billion (Liang). Having 40 years of constructing experience, China has enough experience to invest infrastructure in other developing countries.

Upholding the belief that roads and integration are the keys to wealth and success, the People's Republic of China, seeking to connect Asia with Africa and Europe, initiated a strategy, China's belt, and Road Initiative (BRI), which connect land and maritime networks with the purpose of regional integration improvement, trade, and economic growth stimulations. When talking about its range, the BRI comprises a Silk Road Economic Belt, a belt that links China with Southeast Asia, South Asia, Central Asia, Russia, and Europe by land, and a 21st century Maritime Silk Road, a sea route that connects china's coastal regions with southeast and south Asia, South Pacific, the Middle East, and Eastern Africa, that end in Europe. BRI includes a lot of investment programs, such as development for ports, roads, railways, airports, power plants, and telecommunications networks. As of March 2020, china's bilateral trade with BRI partners' prosperity was reflected by the number of 138 countries that sigh the Memorandum of Understanding (MoU) to join the BRI (EBRD).

The BRL is a win-win cooperation, in which China provides African countries with capital goods and cheap consumer goods that gives choices for African consumer such as empowered mobile phones. In exchange, African countries offer China with materials that are required to fuel China's economic expansion. To be specific, South Africa, China's biggest African trading partner, is the top destination for Chinese investment, having 13.8% percent of Chinese Foreign Direct Investment in Africa, total stock 6.1 in USD billion. Other China's big trade partners in Africa are followed by DRC, Angola, and Zambia. All these countries are rich in raw materials. Even though Ethiopia was considered to be rich in raw materials, it is still potentially rich in geothermal energy and hydropower developed recently. Chinese business in Ethiopia is mostly infrastructure and light manufacturing; around 30% of Foreign Direct Investment from China channeled in Africa is to infrastructure and construction. Among these constructions, 25% were channeled to mining and extraction of raw materials. Though Chinese Foreign Direct Investment might not seem as large as expected, Chinese contract revenues in

Africa are abundant. John Hopkins University provided data that approximately 30 % of Chinese overseas construction contract revenue comes from the African market (Peter).

Proposed Policies-A Global Perspective

As a country of considerable population with rising influence in the international society, China may take a global and intolerant stance and propose a Community of Shared Destiny to solve international economic disparity. This powerful solution would not only show China's humanistic recognition of its responsibility of practice the experience of the remarkable success in domestic poverty alleviation to deal with poverty in developing countries, but also paves a path for a win-win relationship, facilitating development on both sides.

The first policy is continuing investing infrastructure programs. Because of low average income and limited budget for government, thorough infrastructure has been difficult for plenty of developing countries, hindering desirable environment for business with insufficient power supply, inconvenient transportation and poor working condition. On the other hand, with its advantage in outstanding ability of basic construction gained from its abundant experience of building facilities on diversified landscapes, it is easier for China to assist local construction of power station, high-speed railroads and advanced factories. Improved capital would aim local economy to overcome those difficulties and grow.

Another aid of relatively long-run benefit is to impart agricultural techniques. With the accumulation of understanding of multitudinous crops in the long history as an agricultural society, China has summarized a series of efficient techniques of growing, managing and harvesting farm crops. As a result, it is very likely for a thriving primary industry, widely recognized as a fundamental tool to save the starving and a necessary step of preparation for industrialization, to occur with particular skills of this kind according to local situation if China send scientists and technicians to teach those skills to extremely impecunious countries. In the long run, this helps to optimize the utilization of factors for agricultural production there and assist residents to get rid of famine and overall poverty. Sharp disparity due to poverty of starving kind would be relieved with boosting harvest some time.

However, no policy is without limitations. Economic Nationalism and Patriotism would stand in the way of China's investments. For one thing, there will be native people viewing China's investments as "imperialism actions", hindering China's infrastructure programs.

Kazakhstan people once organized a parade appealing to resist Chinese planting 55 factories in Kazakhstan as they felt to be colonized (Qiao). Iceland shut down cooperation with China in order to prevent being penetrated by Chi Chinese has once made an attempt named The Belt and The Road as just mentioned (VOAChinese). As a result, a total of programs that worth approximately 30 billion dollars were expired (Chen). For another, the credibility of the needy countries seriously blocked benefits of China. According to Liberty Times Net, their debts owing to China have exceeded 10% of their GDP, and China has already loaned for about 1.5% of Chinese GDP (German). Worsen by the pandemic, it is quite a tough task for the countries' economies to immediately compensate for the debts, and it is likely that China would lose a lot in the investments. Also, economic nationalists in China think that China should focus on domestic investment to recover its economy instead of helping other countries. Due to the trade war and the Covid-19, China is currently suffering a low economic growth. According to data from the world bank, China's percent rate of GDP growth dropped from 6.8% in 2016 to 2.3% in 2020 (GDP). Also, according to Boston University's Global Development Policy Center, China's oversea investment dropped from 75.0 billion dollars in 2016 to 3.9 Billion dollars in 2019 (Boston), indicating that China's continued economic slowdown made it less likely to support oversea financial projects.

Conclusion

After a comprehensive assessment of the relative advantages and disadvantages of economic nationalism and globalization, China's current policies toward global cooperation and their benefits, we strongly advocate China to take a global perspective toward economic disparity. Our research shows that by investing abroad, China can establish long-term partnerships with poorer developing countries, maintain trade and create a win-win situation. However, the plan would be opposed by economic nationalists both in China and those developing countries – they prefer to deny foreign investment and ensure a healthy domestic economy. Also, Facing the threat of declining economic growth, Chinese government would have to balance foreign investment and domestic economic development.

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Things Fall Apart by Mikhael Fentahun

   Okonkwo: a two-faced Umofian man. One face is peak masculinity and pride, the other a mask of unending rage. In *Things Fall Apart* by Chinua Achebe, Okonkwo is a wealthy and respected man throughout Umuofia, as well as famed across all nine villages, holding two titles. However, despite being a renowned hero and legend, Okonkwo is a despicable and inhumane man. In addition, Okonkwo constantly commits unethical acts on numerous occasions that leave the reader awestruck. In society, people with power and prestige exist, such as Okonkwo, yet a great number of these people are two-faced. Ultimately, those powerful and influential-people in the world, perceived as angels, are not benevolent, but ghastly devils.

   During Okonkwo's exile, he was consumed by great pique--- despite being spoiled by his uncle, Uchendu. For instance, when Okonkwo arrives vexed in Mbanta, regardless of his relatives treating him fittingly, Uchendu says, "' You think you are the greatest sufferer in the world?... Do you know how many children I have buried?… Twenty-two. I did not hang myself, and I am still alive '" (Achebe PDF 57). Achebe features a scene where Uchendu calls Okonkwo out for being an ungrateful brat when Uchendu has endured far worse. However, Uchendu still stands like a robust palm tree and picks himself up off the ground, no matter how much he has fallen. Conversely, Okonkwo seems to have tripped into a shallow lake to sulk, choosing to swim farther away from land to deal with the stigma of being exiled; when one suffers, there is always someone else that suffers greater. In brief, Okonkwo is a prosperous elite who should know when to be grateful and humble, because he is oblivious to what common folk like Uchendu have suffered.

   Okonkwo is also known for his triumphs in Umuofia; at home, he is notorious for his sadistic behavior, particularly when he beat his wife, Ojiugo, for plaiting her hair. The beating is revealed to have taken place during the Week of Peace, a divine week where violence is not allowed. As shown in this quote, "He walked back to his obi to await Ojiugo's return. And when she returned he beat her very heavily" (Achebe PDF 13). Achebe illustrates that Okonkwo becomes enraged very easily; the shrewdest action will set him off like a volcanic eruption. In addition to Okonkwo's rage and impetuous behavior, the author demonstrates the brutality of Ojiugo's beating by using phrases such as "very heavily"; this helps paint a picture that Okonkwo was not just striking Ojiugo, but viciously thrashing her. Thus, Okonkwo can display

his wealth like being able to hold three wives, but the horrors Okonkwo unleashes upon his wives are truly frightening.

At home, Okonkwo's sons succumb to his influence, which is often hazardous. This is especially true when Okonkwo shares his reaction to Nwoye's departure; Okonkwo says, "'You have all seen the great abomination of your brother. Now he is no longer my son or your brother… let him follow Nwoye now while I am alive so that I can curse him'" (Achebe PDF 71). This depicts Okonkwo's force, acting as a hammer smashing down upon the boys when he is obligated to serve as a rope that elevates his sons and propels them upward. Subsequently, Okonkwo has conveyed that the value of his sons do not matter to him; anyone is replaceable. This also portrays Okonkwo's disdain for Nwoye, treating him like a mosquito that has invaded his home and must be squished. Furthermore, Okonkwo sees his children as instruments to his legacy; if they fall out of order, they become an anathema like Nwoye. Thus, Okonkwo is the prime father however his techniques for raising children may be more devastating and deranged than expected.

Those with prestige are seen as divine saints for their achievements, yet a select few affluent individuals choose to walk a nefarious and wicked path. Above all, Okonkwo is a pompous and appalling man who Umuofians see as righteous--- compared to Nwoye and Ojiugo, who have witnessed Okonkwo's true colors. Clearly, Okonkwo is an Ibo tribesman succeeding in life with two titles, an egwugwu position, many yams, and three wives; however, this does not make Okonkwo a virtuous person, but one vehemently enraged man who will inflict harm on anyone who disappoints him. Overall, Okonkwo is regarded by others for his wealth and prestige, but beyond all his riches lies a hidden ghastly devil that unleashes his wrath whenever displeased.

Fixing It At The Root: The Utilization of CRISPR Stem Cells in Regenerative Medicine by Liam Andrew B. Roldan

Abstract

　　Duchenne muscular dystrophy (DMD) is an inherited disease in children that inhibits muscle growth. It is characterized by slow, progressive atrophy and muscle weakness, and by wasting of skeletal, smooth, and cardiac muscle. Currently, the only treatment for DMD is through chemical treatments or physical therapy, with the critical muscle wasting diseases being abated rather than permanently treated. The utilization of CRISPR technology to engineer stem cells is a promising approach to provide a cure and a more efficient therapy for DMD patients. The purpose of this review is to highlight the promise of CRISPR technology for the rapid regeneration/augmentation of damaged muscles in DMD patients. This aims to delineate specific therapeutic targets that can allow for the human body to accept and create these changes using validated CRISPR techniques. This review supplements our current breadth of knowledge and would serve as a critical addition to the medical field for the treatment of muscle wasting diseases, regeneration of damaged muscles, or simple reinforcement to limit aging.

Introduction

　　2.8 individuals out of 100,000 in the globe suffer from muscular dystrophy (Crisafulli et al. 2020). One of the most common childhood onset diseases, Duchenne Muscular Dystrophy (DMD), occurs in 1 per 3,500 male births. This genetic condition affects males, altering the DMD gene on the X chromosome, with the consequential output of dystrophin, which is a vital protein for muscle construction (Passamano et al. 2012). Cases like this are often remedied through occupational or physical therapy and/or medication such as steroids, to mitigate symptoms. Few therapies aim to target the cause of the degeneration at the root, nor do they aim to regenerate the muscle in its entirety.

　　Muscles, like many other parts of the body, start with a stem cell. Adult somatic stem cells, however, are more limited when discussed in the scope of muscle regeneration, with their regenerative capacity declining with age (Ho et al., 2005). CRISPR-Cas9 protein, functioning as an enzyme, locates target areas of DNA allowing for the alteration of genetic material. The use of CRISPR, in conjunction with stem cells, has the promise to provide those who have suffered

muscular injuries an opportunity to have their atrophied muscles recover within a short span of time, without lengthy physical therapy (Hsu et al., 2019). The work from Hsu et al. suggests that CRISPR technology can also be used to aid in preventing the loss of circulatory functionality by reducing the rate of atrophy in the lungs or heart (Heineke et al. 2010). With proper utilization, CRISPR can also attack the source directly by correcting a dysfunctional dystrophin gene. The increased robustness will protect weak muscles or areas that have been compromised. Current therapies are mostly limited to simple painkillers and physical exercise. Muscle regeneration through these methods is a lengthy process, sapping critical time off modern busy lives. The regeneration is also not strong enough to combat a large-scale degradation of the tissue. This paper reviews the proposed solution of introducing CRISPR engineered adult stem cells, to reconstruct muscle tissue. Augmentation of muscle mass is possible through the modulation of genes that target muscle development using CRISPR technology.

CRISPR Technology

Genome editing itself refers to the act of altering the genome at various locations (Ran et al. 2013). Over the years, scientists have utilized numerous technologies for targeting genes. A widely used gene editing tool named, transcription activator-like effector nucleases (TALENs), is composed of nonspecific DNA-cleaving nucleases that fuse to a DNA-binding domain that can target essentially any sequence allowing for gene editing. Another tool, Zinc-finger nucleases (ZFNs), are targetable DNA cleavage reagents. ZFN induces DSBs which are subject to cellular DNA repair processes that lead to both targeted mutagenesis and targeted gene replacement at remarkably high frequencies (Carroll, 2011).

The most recent, and widely used genome editing tool is called CRISPR (clustered regularly interspaced short palindromic repeats). The CRISPR-Cas9 system was discovered by scientists who were studying how bacteria evade viral infection(Ran et al. 2013). As with other designer nuclease technologies such as ZFNs and TALENs, CRISPR-Cas9 can facilitate targeted DNA DSBs at specific loci of interest in the mammalian genome and stimulate genome editing via non-homologous end joining (NHEJ) or homology directed repair (HDR). Cas9 offers several potential advantages over ZFNs and TALENs, including the ease of customization, higher targeting efficiency and the ability to facilitate multiplex genome editing. It is useful for point mutations, offering a precise and easily interchangeable DNA targeting system, and

remains the most common method of gene editing since 2012 (Rodríguez-Rodríguez et al. 2019). The rapid success of this technology in eukaryotic cells was linked to the fact that eukaryotes employ error-prone NHEJ to repair double-strand breaks introduced by the CRISPR-Cas in the target sequence. This feature allows CRISPR the capability for it to be used as a therapeutic that targets genetic diseases. The application of CRISPR is looking to make headway in new ways as it has recently been clinically tested to treat ATTR amyloidosis, where a significant reduction of the misfolded TTR proteins in patients was observed (Gillmore et al., 2021).

Striated skeletal muscle is composed of myofibers formed from myoblasts. The size of the myofibers is heavily dependent on satellite stem cells. These quiescent stem cells replenish the tissue with new cells and bond to form myofibers (Yin, Price, and Rudnicki 2013). Little is known about how these adult somatic stem cells lose their regenerative capacity in relation to age. This contributes to a definite decrease in muscular mass and regeneration as one ages, with skeletal muscles associated with movement. This process also prevents individuals from unhindered movement and makes them far more injury prone and reliant on others.

Impacts Of Disease On Muscular Development

DMD is caused by mutations in the dystrophin gene, located on the X chromosome. Most patients present large gene rearrangements caused by exon deletions (approximately 60%-65%) or duplications (5%-15%). The actual disease of DMD is characterized by a loss of dystrophin protein that leads to decreased muscle membrane integrity, which increases susceptibility to degeneration. Historically, DMD results in loss of ambulation between ages 7 and 13 years and death in the teens or 20s. They do not have good quality of life during this already shortened existence, possessing poor muscle density and unable to eat, sleep or breathe by themselves, suffering through symptoms of atrophy before the ravages of old age.(Passamano et al., n.d).

CRISPR Targeted Therapies For Muscular Degeneration

With the help of CRISPR technologies however, this fate can be prevented (Li et al. 2020) . CRISPR/Cas9 technology has garnered interest as an avenue for DMD therapy, by which it can restore the disrupted DMD reading frame in DMD and lead to dystrophin restoration. Dystrophin being critical to muscle mass formation with the binding of the actual muscle

proteins. The majority of DMD patients have large deletion mutations in the DMD gene (~60% of patients), the rest having duplications or point mutations. Most mutations disrupt the DMD reading frame, typically creating a premature stop codon that prevents the translation of full-length dystrophin. Delivery systems using adult somatic, pluripotent muscle cells have been demonstrated to work within In Vitro models and hopefully In Vivo (Lim et al., 2018).

Other than the Dystrophin gene, another area of interest to provide remedial muscle growth is through myostatin. Myostatin governs the limits of muscle growth, serving as an inhibitor of sorts. Myostatin inactivation can induce skeletal muscle hypertrophy, while its overexpression or systemic administration causes muscle atrophy, with an increasing amount of myostatin being observed within people as we age. Clinical trials observing its suppression in mice have found to have increased grip strength and muscle mass with no real adverse effects. (Arounleut et al. 2013)
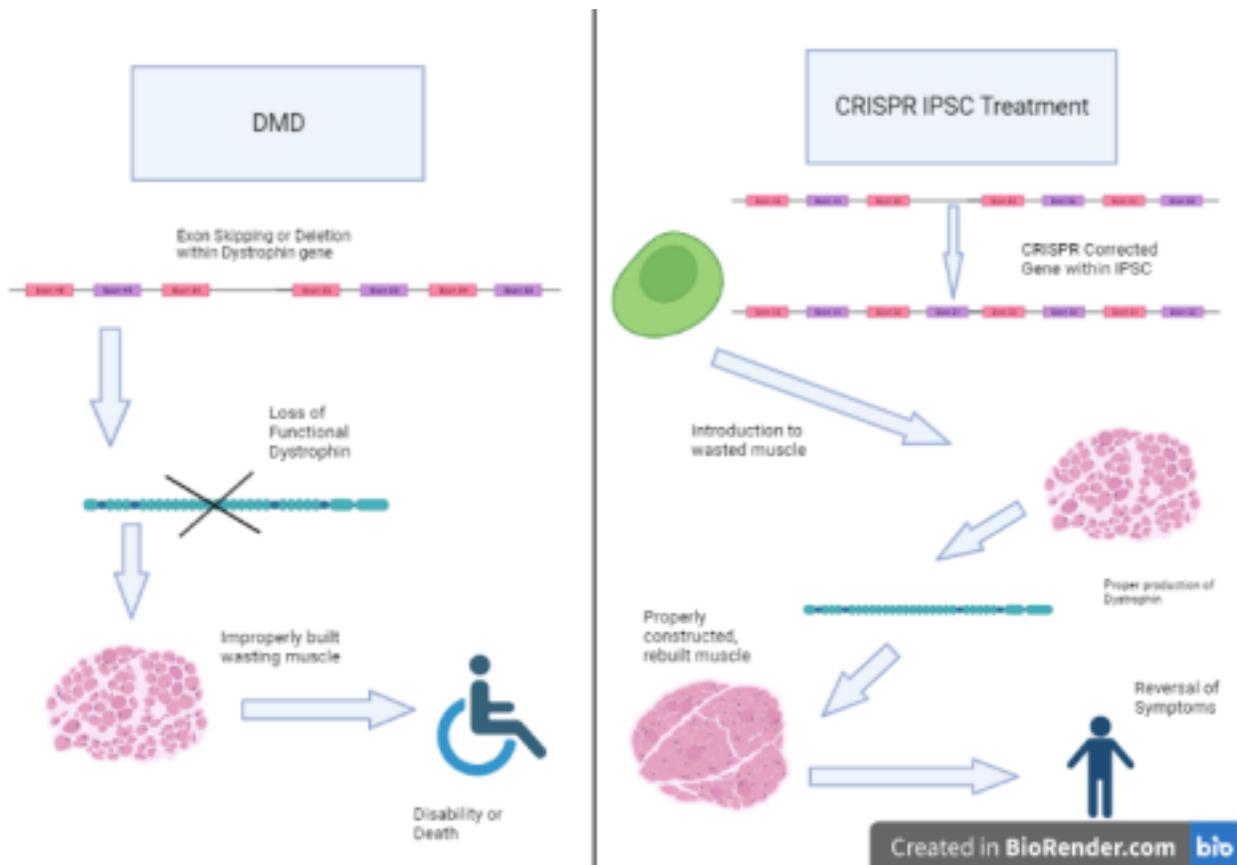
Further Application

  Within this newfound promise also comes newfound challenges. Myostatin induces type II fiber type transformations which are more susceptible to MD, being counterproductive against the very disease it was utilized to combat against, as well as being far easier to strain that type 1 in terms of wear and tear (Rybalka et al. 2020). These fiber types dictate the targets of muscle wasting as well. These challenges can also be broken down to where the different genes originate from, the self (autologous) or externally (allogeneic), meaning that these therapeutic stem cells can be harvested from either the same patient or a different one. Allogeneic sourcing is hard to find in terms of compatibility, with only 20-25% of even sibling donors being compatible for these types of procedures. Autologous sourcing may present trouble and potentially become a source of disease rather than remedy as the patient's cells already have faulty DNA contained within them (Lennard et al., 2001). In cases of methods with autologous origins, tailored personal products may be hard to manufacture on a mass scale, while allogeneic products may be incompatible with the patient (Lennard et al., 2001). When CRISPR does not work, unexpected deletions or insertions can occur, leading to unintended outcomes. The risks associated with allogeneic products may cause complications within mass production if the modified products are not closely monitored.

  However, there are promising cases of the application of CRISPR in the field of muscular generation with the inhibition of myostatin. A trial utilizing CRISPR within multiple goat subjects has created a double muscled phenotype, leading to increased functionality of muscle growth and mass (He et al. 2018) . The increased density of muscle within the goats was evident, as their visual size and mass were far above their control group peers, creating striations in muscle that appear uncommon for that species (He et al. 2018) . Keeping within the theme of medicine, muscles could also be utilized for the aid in the physical development of children, by preventing detrimental diseases that affect structural integrity thus causing malformation of bones by using reinforced muscle to hold it in place. The works of chiropractors will no longer have to go to waste, as decompressed spines are maintained and kept straight with the addition of extra core strength to ensure posture. Most of all, the quality of life will be preserved with muscular dystrophy patients, leaving them able bodied and capable of living on their own, regenerating and preventing any further muscular atrophy. This especially extends to the younger

patients, giving them adequate muscular support and growth as they go through the proper developmental cycles, uninhibited by their muscular dystrophy.

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Sunscreen and its Components: A Meta-Analysis of FDA-Approved Organic and Inorganic UV Filter Products by Andre Qin

Abstract

Recently, most of the news surrounding sunscreen has been about its impact on the environment. Although it is important to bring light to the oceans being slowly damaged by organic chemicals, we delve deeper into the traditional data science finds. Our goal is to find any possible correlations and patterns amongst the data, and we touch on how this could be used practically. In this paper, we will be covering data and interpretations on the current eight most used active ingredients in sunscreens. These are: Avobenzone, Homosalate, Octisalate, Octocrylene, Oxybenzone, Octinoxate, Titanium Dioxide (TiO2), and Zinc Oxide (ZnO). Custom code was written to extract data from FDA databases about registered sunscreen products and their active ingredient percentages. This data was then analyzed and visualized, before some conclusions were drawn. We discuss how this information can be used for future innovations in the field, and how the patterns can be used to optimize the current products.

Introduction

Sunscreen is one of the most widely used cosmetic products in the world. As one of the more practical cosmetic products, wearing sunscreen can lower the probability of skin cancer among people by 50% [1]. As such, it is a product that most people can find in their homes. Monetarily, the sunscreen market as a whole was valued at more than 13.03 billion US dollars in 2019, and is projected to reach over 16.8 billion dollars in 2027 [2].

However, the sunscreen that people smear or spray on their skins is still mysterious to most. Similar to most drugs, sunscreens are made up of active ingredients and filler ingredients, and as such, are marketed and regulated as a drug by the FDA. This paper will be discussing how the eight most widely used [3] UV filters work to prevent UV rays from penetrating the skin. Secondly, we will cover code written to obtain this data from the Federal Drug Administration's (FDA) National Drug Code Directory (NDC).

Methods

      The code to request and parse through data from the NDC was written completely in Python. Overall, the program has three main functions that carry out everything needed to extract data. It will be broken down by section and explained in the following paragraphs.

```python
import requests
import json
from requests.exceptions import HTTPError
import time
import csv
```

These lines import python libraries that allow a user to run commands that other people have already developed. Requests allow a user to automatically access and interact with a website. Json and csv allow for easier handling of .json and .csv file formats, and time is used to slow down requests as to not go over the API Limit set by the FDA website.

```python
drugname = ['Avobenzone', 'Octisalate', 'Octocrylene', 'Homosalate', 'Oxybenzone',
'Octinoxate', 'Titanium+dioxide',
        'Zinc+oxide']
drugname3 = ['avobenzone', 'octisalate', 'octocrylene', 'homosalate', 'oxybenzone', 'octinoxate',
'titanium+dioxide',
        'zinc+oxide']
```

These are lists of the common active ingredients, formatted to match what will most likely be what is returned by the website when requesting information.

```python
api_key = ''
url = 'https://api.fda.gov/drug/ndc.json?api_key='
search = '&search=active_ingredients.name:'
```

```
count1 = '&search='
count2 = '&count=generic_name.exact'
```

These variables help to build the URL that the program will access. The API key has been omitted (but can be found easily at the FDA website), and can be obtained at https://open.fda.gov/apis/authentication/

```
countResults = []
temporaryList = []
finalData = []
```

These three lists are important for holding data, and will be used when writing data into files for later use.

```
spl_id = []
drugname2 = ['avobenzone', 'octisalate', 'octocrylene', 'homosalate', 'oxybenzone', 'octinoxate', 'titanium dioxide',
        'zinc oxide']
```

More lists for later use.

1. Functions

   a. Flattening a list

Flattening a list is important for making data look more organized and easier to work with.

```
def flattenList(array):
    flattened_list = []
```

```
    for sublist in array:
        for item in sublist:
            flattened_list.append(item)


    return flattened_list
```

This function will turn a 2D array (a list full of lists, such as [[1, 2], [3, 4]]) into a 1D or flattened array ([1, 2, 3, 4]). It goes through each sublist in an array, and each item in that and appends it to a temporary new list, which is returned at the end of the function. A 2D array must be inputted, otherwise it will not work.

      b.   Finding duplicates

Finding duplicate entries allows for less requests to be made to the website, allowing for a faster runtime and keeping requests low.

```
def getDuplicatesWithInfo(listOfElems):
    """ Get duplicate element in a list along with their indices in list
    and frequency count"""
    dictOfElems = dict()
    index = 0
    # Iterate over each element in list and keep track of index
    for elem in listOfElems:
        # If element exists in dict then keep its index in list & increment its frequency
        if elem in dictOfElems:
            dictOfElems[elem][0] += 1
            dictOfElems[elem][1].append(index)
        else:
            # Add a new entry in dictionary
            dictOfElems[elem] = [1, [index]]
        index += 1
```

```
dictOfElems = {key: value for key, value in dictOfElems.items() if value[0] > 1}
return dictOfElems
```

As the comments mentioned, this function will get duplicate elements in a list along with their index numbers, allowing a user to quickly remove the duplicates. The dictOfElems contains all elements, including those that have not been repeated.

c. Counting the number of results for each

Using a special link provided by the FDA API, one can count how many results a given search will bring up. Note that this does count duplicates and products that are not relevant, but it is useful to have to estimate how much data one will have to work with.

```
def count():
    for i in range(len(drugname)):
        try:
            r = requests.get(url + api_key + count1 + drugname[i] + count2)
            r.raise_for_status()
            jsonResponse = r.json()
            # print(jsonResponse)

        except HTTPError as http_err:
            print(f'HTTP error occurred: {http_err}')
        except Exception as err:
            print(f'Other error occurred: {err}')

        for j in range(len(jsonResponse["results"])):
            temporaryList.append(jsonResponse["results"][j]["count"])
```

```
        finalValue = sum(temporaryList)


        countResults.append((drugname[i], finalValue))


    print(countResults)
```

The first for loop iterates through all of the drug names already defined in the list drugnames. First, it will try to make a request with the variables created above, with one of the drug names as the search query. The except statements allow the code to keep running if any errors occur, which is unlikely at this stage. The next for loop goes through each of the results (a combination of different drugs), and adds how many results were found for each combination. FinalValue adds all of the results up, and it is attached to the drug used in the search and printed.

     d.   Reading through the NDC

```
finalValues = []
f = open('drug-ndc-0001-of-0001.json', )
data = json.load(f)
```

FinalValues is initialized for further use, while data uses the .load() function to access and store all of the data in the .json file downloaded from the website. Note: this requires the exact filename and for it to exist in the same folder as the program.

```
for i in range(len(data["results"])):
    # brand_name = data["results"][i]["brand_name"].lower()
    try:
        active_ingredients = data["results"][i]["active_ingredients"]
        for j in range(len(active_ingredients)):
            if active_ingredients[j]["name"].lower() in drugname2:
```

```
        spl_id.append(data["results"][i]["spl_id"])
   except KeyError as e:
      print("Key error occurred at " + str(data["results"][i]["product_ndc"]))
      continue
```

In the for loop, it goes through every entry under the key "results". It tries to find each entry's nested key "active_ingredients", which will have a list of the drug's active ingredients. If one of those names are in the list drugname2, its unique spl_id will be appended to a list. If any error occurs, it will print an error message and continue.

```
spl_id_dict = getDuplicatesWithInfo(spl_id)
for key, value in spl_id_dict.items():
   print('Element = ', key, ' :: Repeated Count = ', value[0], ' :: Index Positions =  ', value[1])
   if len(value[1]) > 1:
      finalValues.append(value[1][1:])


flattened_finalValues = flattenList(finalValues)


flattened_finalValues.sort(reverse=True)
print(str(flattened_finalValues))


for i in range(len(flattened_finalValues)):
   spl_id.pop(flattened_finalValues[i])
```

Using a function from before, an spl_id dictionary is created that shows each spl_id and how many times it has been repeated. Those that have repeats will have all of the indexes (not including the first occurrence) appended to the list, finalValues. This list is flattened, sorted from highest to lowest, and then those indexes and their data are removed from the original spl_id list. Going backwards allows for indexes to remain unaffected by previous actions, while going forward the index number will shift after an item is removed

e. Taking data with an SPL ID

This function allows a user to input an index from spl_id, as well as the full response from the website and will return the SPF and active ingredients, as well as the percentage of each active ingredient.

```python
drugInfo = []
spf_info = []
try:
    data_elements = str(apiResponse["results"][0]["spl_product_data_elements"][0]) +
str(apiResponse["results"][0]["package_label_principal_display_panel"][0])
    data_elements.lower()
    d_e = data_elements.split(" ")
    for i in range(len(d_e)):
        if d_e[i] == "spf-" or d_e[i] == "SPF-":
            spf_info = str(d_e[i][3:])
            break
        elif d_e[i] == "spf" or d_e[i] == "SPF":
            spf_info = str(d_e[i + 1])
            break
        elif d_e[i].find("SPF") > 0 or d_e[i].find("spf") > 0:
            spf_info = str(d_e[i][2:])
            break
        else:
            print("no spf data found for spl_id" + str(spl_id[spl_id_index]))

except Exception as e:
    print("SPL product data does not exist for spl_id " + str(spl_id[spl_id_index]))
```

drugInfo and spfInfo are created as lists to hold data. The program first tries to find any SPF numbers/data from the response. The two places where this can be found are under the keys

"spl_product_data_elements" and "package_label_principal_display_panel". All of the data under those two keys are appended into data_elements, converted completely to lowercase (which consistently didn't work) and then split into a list by each space. Each word was iterated through by the for loop, looking for "spf-30", "spf 30", or "spf30". If any of these were found, it would attempt to isolate the number and then break out of the for loop. If an error was thrown, an error message would be printed.

```python
active_ingredient_info = []
try:
    table_data1 = str(apiResponse["results"][0]["active_ingredient_table"][0])
    for h in range(len(table_data1)):
        table_data_list = list(table_data1)
        if table_data1[h:h + 3] == "tita":
            table_data_list[h + 8] = "+"
        if table_data1[h:h + 3] == "zinc":
            table_data_list[h + 4] = "+"
    table_data = "".join(table_data_list)
    table_data.lower()
    t_d = table_data.split(" ")
    for i in range(len(t_d)):
        if t_d[i].find("<TD>") > 1 or t_d[i].find("<td>") > 1:
            found_active_ingredient = t_d[i][t_d[i].rfind("<td>"):]
            found_active_ingredient += t_d[i + 1]
            str1 = ''.join(found_active_ingredient)
            active_ingredient_info.append(str1)
```

These lines look for any active ingredient data from the table on any drug products. It changes titanium and zinc slightly to work better with splitting later on, and any data (active ingredient and percent) is appended to active_ingredient_info.

```
except KeyError as e:
  try:
    ingredients1 = str(apiResponse["results"][0]["active_ingredient"][0])
    for h in range(len(ingredients1)):
      ingredients_list = list(ingredients1)
      if ingredients1[h:h + 3] == "tita":
        ingredients_list[h + 8] = "+"
      if ingredients1[h:h + 3] == "zinc":
        ingredients_list[h + 4] = "+"
    ingredients = "".join(ingredients_list)
    ingredients.lower()
    ingr = ingredients.split(" ")
    for i in range(len(ingr)):
      if ingr[i].upper().lower() in drugname2 or ingr[i] in drugname:
        ingredients_plus_value = (ingr[i]) + (ingr[i + 1])
        str1 = ''.join(ingredients_plus_value)
        active_ingredient_info.append(str1)
```

In the case that a table is not provided or found, the program will search under the active ingredients key and run commands similar to the block above.

```
url2 =
'https://api.fda.gov/drug/label.json?api_key=(api_key_here)&search=openfda.spl_id.exact:'
for i in range(len(spl_id)):
  try:
    r = requests.get(url2 + spl_id[i])
    r.raise_for_status()
    jsonResponse2 = r.json()


    try:
```

```
            purpose = str(jsonResponse2["results"][0]["purpose"]).lower()
            if purpose.find("sunscreen") > 0 or purpose.find("spf") > 0:
                # print("value found")
                a = takeData(i, jsonResponse2)
                finalData.append(a)
        except KeyError as e:
            try:
                brandnamecheck = str(jsonResponse2["results"][0]["brand_name"]).lower()
                if brandnamecheck.find("sunscreen") > 0 or brandnamecheck.find("spf") > 0:
                    # print("value found")
                    a = takeData(i, jsonResponse2)
                    finalData.append(a)
            except KeyError as e:
                pass
```

This makes sure the product is sunscreen before going to request and document the data. If it determines a product is sunscreen, it will append the return of takeData (above) to finalData.

The full code will be provided as a reference.

Results

The data acquired was found on the FDA website (https://www.accessdata.fda.gov/scripts/cder/ndc/index.cfm), and custom code was written to extract that data (see Methods). Data was quantified and visualized in Microsoft Excel. The SPF ranges of 0-15, 15-30, 30-50, and 50-100 were chosen due to their widespread use and significance, and because research has already been done on these specific values. A product with SPF 15 will protect against 93.3% of UV rays, products with SPF 30 will filter 96.7% of UV rays, and SPF 50 is defined as protecting against 98.3% of UV rays [4].

Figure 1 shows how many products in a given SPF range include a specific active ingredient. These active ingredients include organic UV filters such as Avobenzone, Homosalate, Octinoxate, Octisalate, Octocrylene and Oxybenzone. They also include the inorganic UV filters:

Titanium Dioxide and Zinc Oxide. All of the active ingredients are present mainly in products between SPF 15 and 30, and the least between SPF 50-100 (Figure 1). Octocrylene has the most products between SPF 15 and 30, at 550 (Figure 1a). Avobenzone and Octisalate are next, with 540 products each (Figure 1b, 1c). They are followed by Titanium Dioxide, Homosalate, Zinc Oxide, and Octinoxate, with 475, 441, 415, and 406 respectively (Figure 1d - 1g). Finally, Oxybenzone has the least amount of products within this range, with 217 products (Figure 1h). In the range with the lowest amount of products, SPF 50 to 100, none of the active ingredients total more than 100 products. Within this range, the highest observed was Octocrylene, at 98 products (Figure 1a), and the fewest was Octinoxate, at 23 products (Figure 1g).

Figure 1: Number of UV Filter Products Stratified by Major SPF Levels

(a)

(b)

(c)

(d)
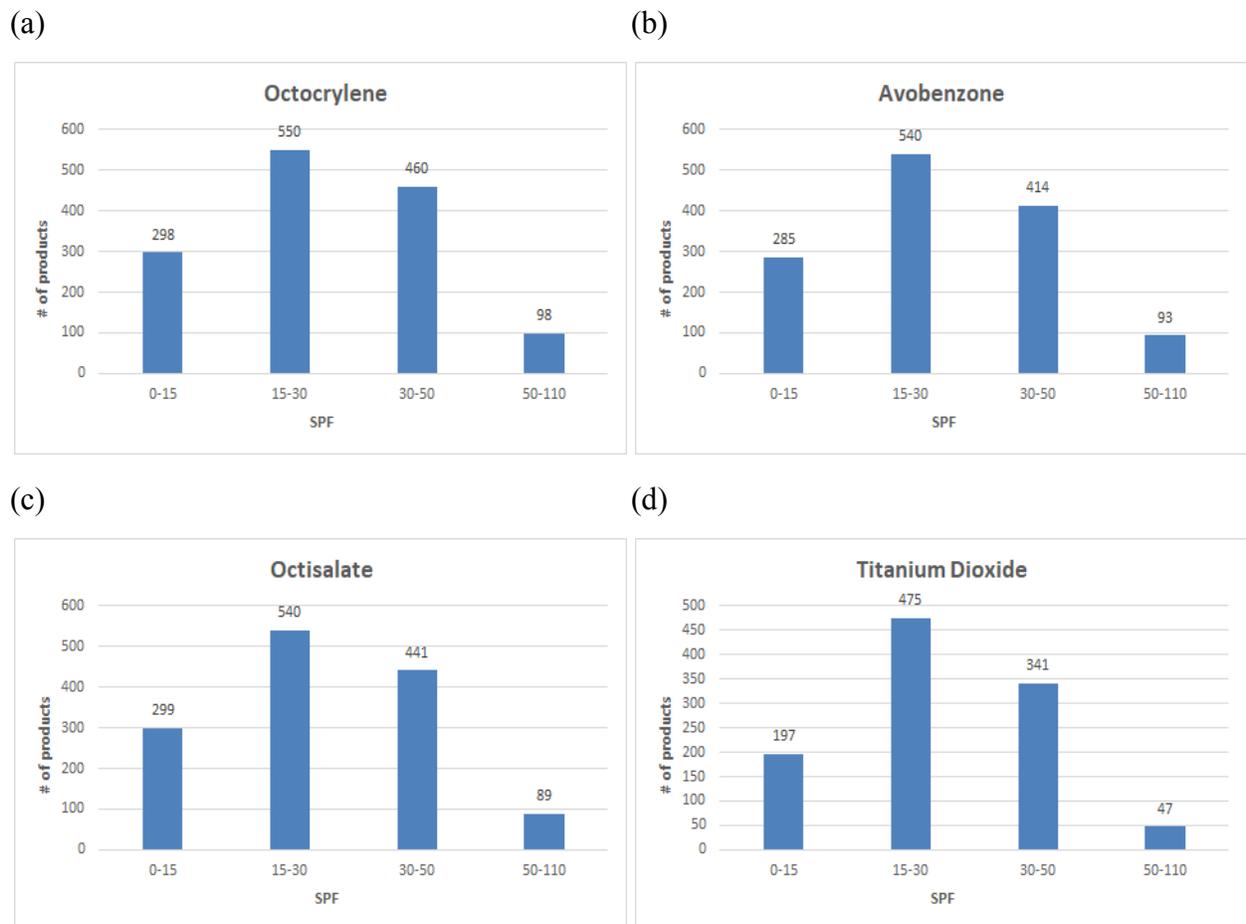
(e)
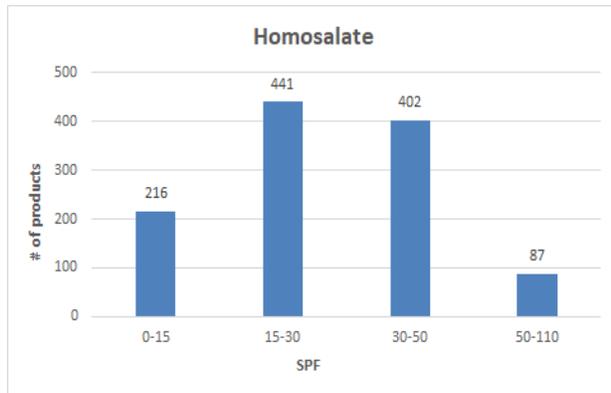
(f)
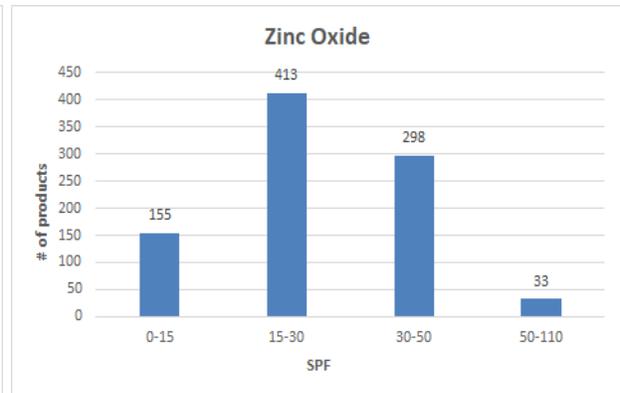
(g)
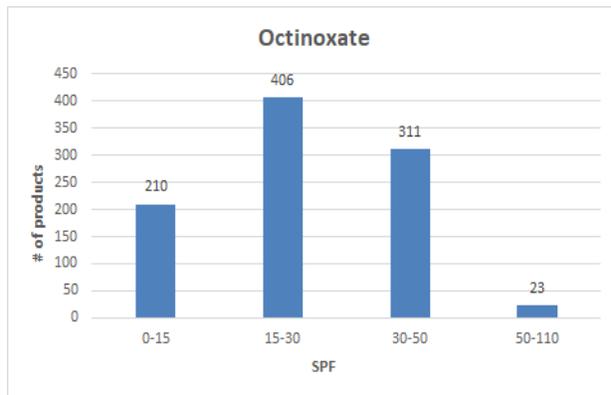
(h)
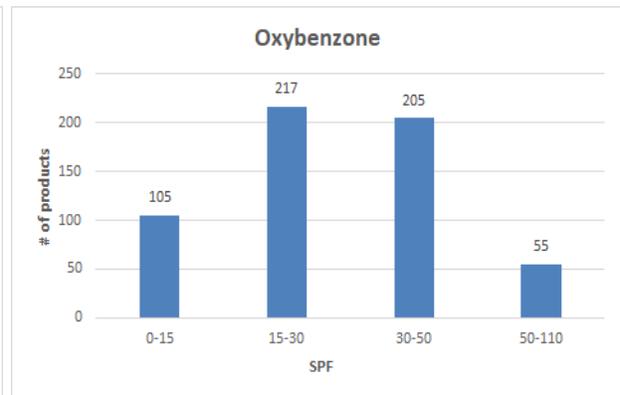
Figure 1. Number of UV Filter products, separated by SPF ranges and active ingredients. The bar graphs show the number of products in physiologically relevant SPF ranges. Totals are shown at the top of each bar. (a) Octocrylene (b) Avobenzone (c) Octisalate (d) Titanium Dioxide (e) Homosalate (f) Zinc Oxide (g) Octinoxate (h) Oxybenzone.

Figure 2: Average Active Ingredient percentage for each SPF level

(a)

Octocrylene

(b)

Oxybenzone

(c)

Homosalate

(d)

Zinc Oxide

(e)

Titanium Dioxide

(f)

Avobenzone
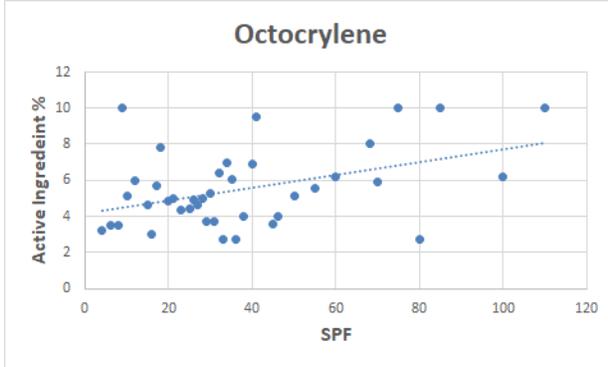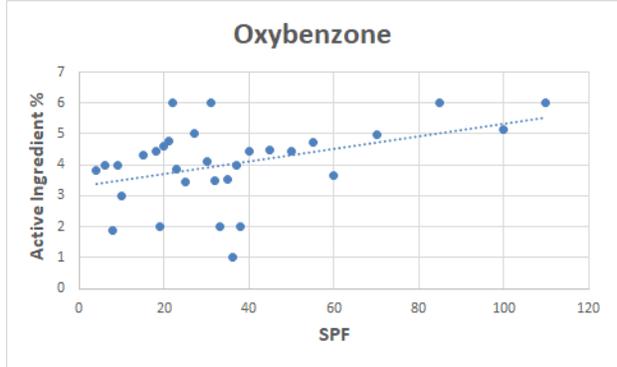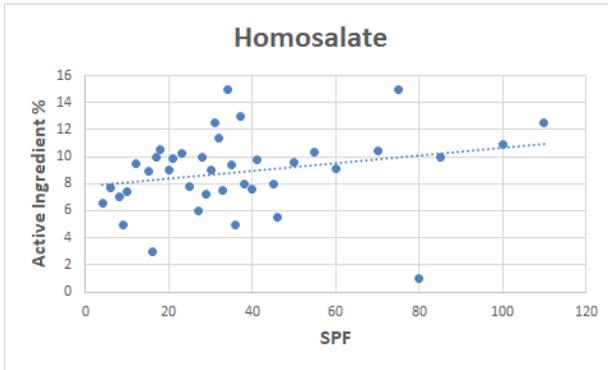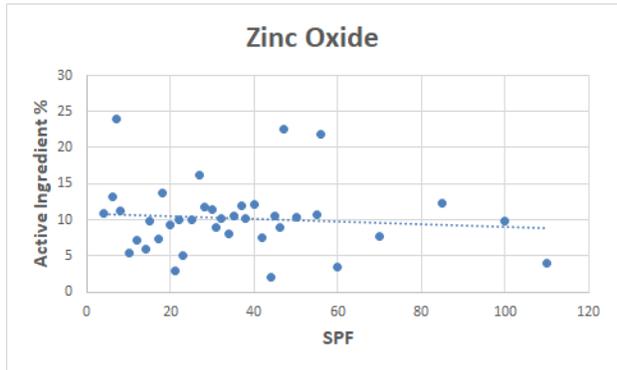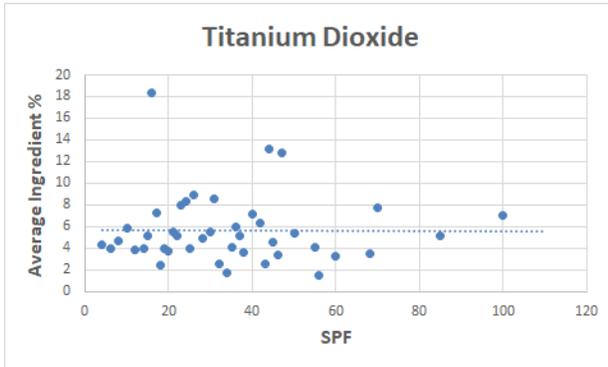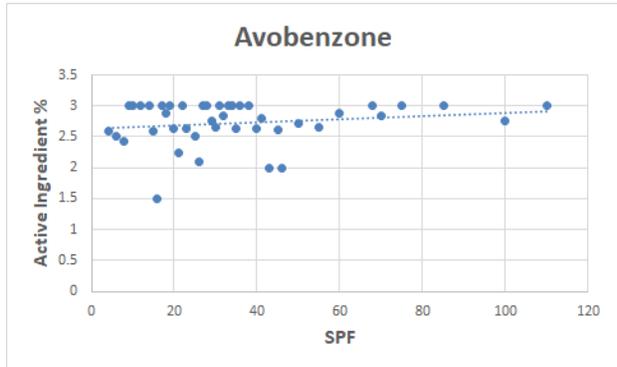
(g)

(h)
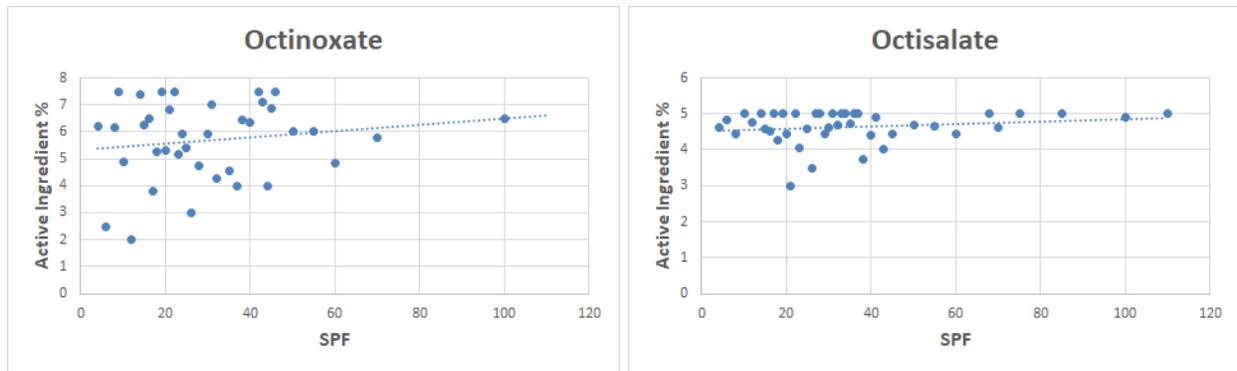
Figure 2. Average active ingredient percentage at all reported SPF levels, plotted against SPF. Each point is an average of all the percentages at a given value, and a trendline has been drawn through each graph. (a) Octocrylene (b) Oxybenzone (c) Homosalate (d) Zinc Oxide (e) Titanium Dioxide (f) Avobenzone (g) Octinoxate (h) Octisalate.

Figure 2 shows the average active ingredient percentage at each recorded SPF level, and plots it against the SPF. All zero values were excluded from this graph to make the trendline more accurate. Octocrylene and Oxybenzone both have a moderate correlation between active ingredient percentage and SPF ($r = 0.425$ and $r = 0.421$, respectively) (Fig 2a - 2b). Homosalate shows a weak correlation between average active ingredient percentage and the product's SPF ($r = 0.258$) (Fig 2c). All of the other organic UV filters report little to no correlation, with r-values no higher than 0.2. The two inorganic UV filters, Zinc Oxide and Titanium Dioxide, report r-values of nearly zero ($r = -0.100$ and $r = -0.010$, respectively) (Fig 2d - 2e).

Figure 3 shows the percentages of each active ingredient within each SPF range (0-15, 15-30, 30-50, 50-100). Throughout all of the SPF ranges, the ingredients maintained fairly similar percentages (See Table 1), with the exception of the final range, SPF 50-100. The three largest consistently represented active ingredients are Avobenzone, Octocrylene, and Octisalate (Fig 3).

Figure 3: UV Filter Active Ingredient Percentage Stratified by Major SPF Levels
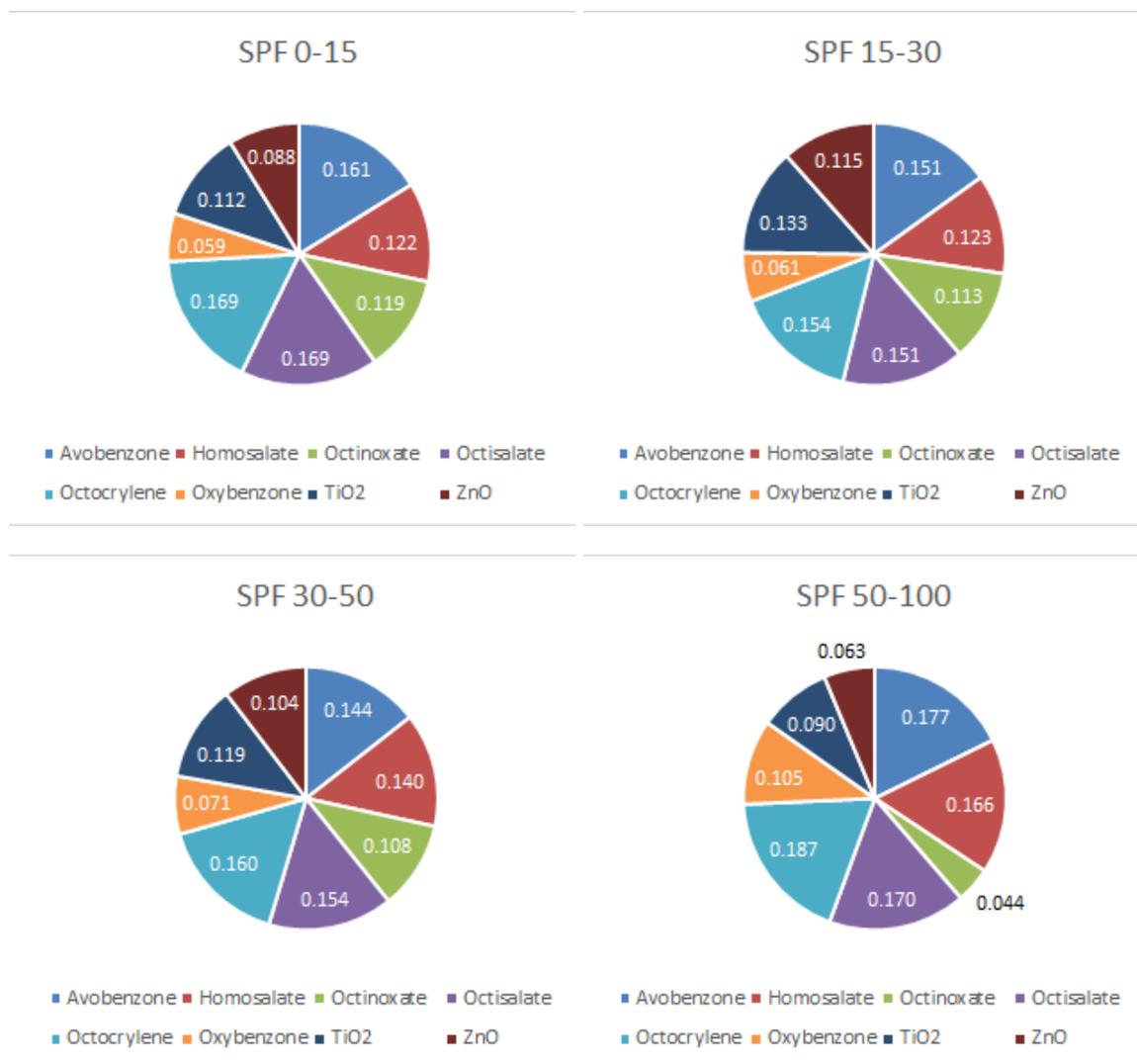
Figure 3. A pie chart showing each active ingredient and their percentages in a specific SPF range. Each slice represents an active ingredient, and is color coded using the legend found below the graph.

Table 1: Percentage of UV Filter Active Ingredient According to Major SPF Levels

SPF	Avobenzone	Homosalate	Octinoxate	Octisalate	Octocrylene	Oxybenzone	TiO2	ZnO
0-15	16.1%	12.2%	11.9%	16.9%	16.9%	5.9%	11.2%	8.8%
15-3	15.1%	12.3%	11.3%	15.1%	15.4%	6.1%	13.3%	11.5%

45

0								
30-50	14.4%	14.0%	10.8%	15.4%	16.0%	7.1%	11.9%	10.4%
50-100	17.7%	16.6%	4.4%	17.0%	18.7%	10.5%	9.0%	6.3%

Discussion

In this study, we found how different active ingredients and percentages affected the final product's sun protection factor. Custom code was used to extract and parse data from the FDA website, and Microsoft Excel was used to format the data. This information will help to provide recent information about sunscreens on the market and their efficacy. While most recent papers about sunscreen focus on its environmental effects, data becomes more and more outdated. This paper aims to provide recent data and ideas for future improvements of sunscreen products.

Figure 1 shows how many products exist in a specific SPF range, with the ranges being decided by biological significance to humans and widespread use. The results show that most products range between SPF 15 and 50, regardless of active ingredient. This information most likely means that products outside of this range are simply less in demand by the general public. This is for good reason, as anything below this range is not recommended by the FDA [5]. Above this range, a higher SPF will show diminishing UV protection.

Figure 2 plots the average SPF of a product at a given percentage, and attempts to find some correlation. Octocrylene and Oxybenzone are the only two active ingredients that have a moderate positive correlation with SPF. This indicates a possibility that for these two active ingredients, percentage of active ingredient matters in the potency of the product. On the other end of the spectrum, the only two inorganic active ingredients approved by the FDA both show very low, almost zero correlation. This suggests that these, and possibly non-approved inorganic filters, could have a lower active ingredient percentage and not suffer significant losses in SPF. However, it is conceivable that other active ingredients within the same product synergize with these inorganic filters to boost its effect.

In Figure 3, we attempted to visualize the percent distribution of UV active ingredients stratified by SPF levels. Because UV products are all different in chemical makeup, we hypothesized that there might be differences in the representation of these products within certain SPF levels. We found that there were no significant differences in the representation.

Overall, this paper provides a meta-analysis and visualizations about active ingredients in the UV protection products that many use in their daily lives. However, more research should be done for definitive conclusions about active ingredients and the optimal amount of active ingredient to use for each given sunscreen, specifically more controlled SPF tests with little to no additives. This would help improve the current products on the market currently, as this future research might be able to show the most optimized way to make a sunscreen with a specific SPF.

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The Japanese Economic Miracle: From Ruin to Superpower by Aiden Harpel

Abstract:

After World War II, Japan and its economy were in ruins. Industrial production fell about sixty-five percent compared to pre-war levels. However, in the post-war era the Japanese were able to turn around their economy. Few if any governments have achieved economic growth at the levels of the Japanese post World War II. The Japanese Economic Miracle was a period in which Japan's per capita GDP increased at an average annual rate of 7.1 percent and its overall economy grew on average 9.7 percent per year. Japan's economy became the second largest in the world behind only that of the United States. This paper provides an explanation of this unprecedented economic growth, addressing many of its core causes. It then discusses what is today known as the burst of the "bubble", in which real estate prices plunged about seventy percent and the Japanese stock market collapsed by about eighty percent. Ultimately this burst demonstrated that the rapid growth of the Japanese economy was unsustainable.

The Japanese Economic Miracle: From Ruin to Superpower by Aiden Harpel

From the end of World War II through the 1980s, the Japanese economy grew at an unprecedented rate. World War II destroyed Japan and its economy. Industrial production fell about sixty-five percent compared to pre-war levels, Japanese investments in Asia became worthless, and urban housing as well as industrial plants were destroyed.[1] To put it lightly, the economy following the war was in ruins. World War II, as a result, forced the Japanese to embark on rebuilding their economy. This reconstruction process led to what is now known as the Japanese "Economic Miracle," a period of robust economic growth in Japan. Between 1945 and 1956, Japan's per-capita G.D.P.[2] increased at an average annual rate of 7.1 percent[3]. Between 1956 and 1970, Japan's overall economy grew on average 9.7 percent per year.[4] While the Japanese economy grew at a considerably slower rate after 1970, it nevertheless would surpass Britain's economy to become the second largest economy in the world after that of the U.S.

Democratic governments commonly seek to achieve economic growth in their respective countries because it typically correlates with an improvement in domestic living standards. If there is more money circulating in an economy, businesses can make more money and in turn pay their workers more in wages. If workers earn more, they can spend more. And if they spend more, businesses can earn more and, in turn, reinvest in their enterprises by, for example, creating more jobs and investing in innovation. This virtuous cycle can then repeat itself. In recognition of this circular effect, the Japanese government -- aided by the U.S., the Korean War, and technological improvements -- achieved strong domestic economic growth by strengthening industry and turning the country into a manufacturing powerhouse.

Having defeated the Japanese in World War II, the United States military, led by General Douglas MacArthur, occupied Japan between 1945 and 1952.[5] While in Japan, MacArthur,

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[1] G.C. Allen, *The Japanese Economy* (New York: St. Martin's Press, 1982), 19.
[2] Gross domestic product, or G.D.P., is the universal measurement used to describe the total value of the goods and services produced in a country. When one refers to an increase in G.D.P., one is referring to economic growth since it involves an increase in the production of goods and services in an economy over a period of time.
[3] Okazaki Tetsuji, "Lessons from the Japanese Miracle: Building the Foundations for a New Growth Paradigm," Nippon, accessed April 16, 2021, https://www.nippon.com/en/in-depth/a04003/#.
[4] Masaaki Shirakawa, "The Transition from High Growth to Stable Growth: Japan's Experience and Implications for Emerging Economies," Bank of Japan (5 May 2011), Slide 2.
[5] Richard J. Smethurst, "The Allied Occupation of Japan: 1945-52," University of Pittsburgh, accessed May 10, 2021, https://www.japanpitt.pitt.edu/essays-and-articles/history/allied-occupation-japan-1945-52.

acting on behalf of U.S. interests and those of its allies, imposed reforms on Japan that helped drive the country's economic transformation.

Under U.S. occupation, Japan reduced its military expenditures through demilitarization. Japan dissolved its standing military and ended the production of military materials and weapons.[6] To mitigate the risk of re-militarizing, the government removed from positions of power individuals who were militant nationalists.[7] The Japanese government codified its stance on militarization when it enacted the Japanese Constitution of 1947. As part of its signing, Japan permanently renounced the right to use military force and instead agreed to rely on the U.S. for its protection.[8] Japan's demilitarization was important for the Japanese economy because it allowed monies the government had previously spent on the military to be channeled into the country's broader economy.

American forces that occupied Japan also contributed to the breakup of the Zaibatsu, powerful business conglomerates that dominated many Japanese industries. One reason for their dissolution was to fully destroy Japan's military power both institutionally and psychologically, as the Zaibatsu were responsible for the mass production of military-grade materials and weapons.[9] The main basis for disbanding these business conglomerates, though, was to spark greater competition among Japanese companies. Through breaking up the Zaibatsu into independent companies, the number of businesses in Japan's economy increased and so did competition among them.[10] Two laws were also put in place to create greater competition. The first was an anti-monopoly law, which prevented a single company or a small handful of companies from taking over a given industry.[11] In other words, the law prohibited all cartel activities. The second was a decentralization law, which forced holding companies to shrink if any of the businesses under them amassed too much market power.[12] Competition encourages companies to innovate and improve their products. By increasing competition in various industries, these two laws along with the collapse of the Zaibatsu helped foster Japan's economic growth.

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[6] Masahiro Takada, "Japan's Economic Miracle: Underlying Factors and Strategies for the Growth," Lehigh University (23 March 1999), 6-7.
[7] James I. Matray, *Japan's Emergence As A Global Power* (Westport: Greenwood Press, 2001), 156.
[8] "Occupation and Reconstruction of Japan, 1945–52," U.S. Department of State, accessed May 11, 2021, https://history.state.gov/milestones/1945-1952/japan-reconstruction.
[9] Takada, 7-8.
[10] Matray, 6.
[11] Ibid.
[12] Takada, 7.

Given the limited number of employers in Japan prior to the U.S. Occupation, the Zaibatsu were able to exploit Japanese workers for a long time. However, workers eventually grew angry and formed labor unions with the help of the U.S. The formation of labor unions benefited the Japanese economy because it led to greater employee satisfaction and, in turn, greater workforce productivity. The percentage of workers organized into labor unions climbed from zero in 1945 to about 60 percent in 1948.[13] Clearly labor reforms played a significant role in the creation of labor unions, as there were no labor unions prior to the U.S. Occupation. Lobbying efforts by these unions led to the enactment of the Trade Union Law, which outlined basic workers' rights -- such as the right to strike and the right to bargain collectively -- and prohibited unfair and exploitative employer practices. Tangible outcomes of the Trade Union Law included higher wages and improved working conditions.[14] With workers earning higher incomes, consumer spending increased which, in turn, contributed to domestic economic growth. In addition, a lifetime employment system was established, and this arrangement fostered loyalty between employees and their employers.[15] Such loyalty increased workforce productivity. In summary, the formation of labor unions improved the relationship between workers and employers. In the end, it boosted Japanese corporate profits and economic growth.

After the U.S. Occupation laid the foundation for the resurgence of the Japanese economy through Japanese demilitarization, the dissolution of the Zaibatsu, and labor reforms, the Dodge Plan was executed. This plan was designed to facilitate Japan's economic recovery without American aid. It accomplished this objective through the introduction of five major policies. The first was to create a more balanced government budget in order to lower inflation, as too much government spending can cause inflation to accelerate.[16] This plan was implemented successfully, as a 90 billion yen budget deficit in 1946 turned into a 155 billion yen surplus in 1949.[17] Second, the Reconstruction Finance Bank refined its lending practices so as to reduce the number of bad loans it granted.[18] Similarly, the Japanese government began to more strictly regulate the issuance of government subsidies, making sure that these subsidies were actually put

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[13] Ibid., 9.

[14] Koichi Hamada and Munehisa Kasuya, "The Reconstruction and Stabilization of the Postwar Japanese Economy: Possible Lessons for Eastern Europe?," *Yale University, Economic Growth Center, Center Discussion Paper, No. 672* (September 1992), 10; Takada, 9.

[15] Takada, 9.

[16] James D. Savage, "The Origins of Budgetary Preferences: The Dodge Line and The Balanced Budget Norm in Japan," *Administration and Society* (July 2002), 270.

[17] Ibid., 268.

[18] Takada, 10.

to use to promote industry.[19] Additionally, a more efficient and strong tax collection system was formed to further discourage tax evasion and to provide the government quicker access to monies received through taxes.[20] Finally, as part of the Dodge Plan, a fixed exchange rate of 360 yen to 1 U.S. dollar was established to keep Japanese export prices relatively low and, in turn, encourage U.S. citizens to buy Japanese goods.[21] While the U.S. Occupation set the groundwork for a Japanese economic rebound, the Dodge Plan was crucial for Japan because it allowed the country to become economically independent.

Shortly after the Dodge Plan was carried out, the Korean War began in 1950. The start of the Korean War resulted in a major stimulus to Japanese production. Before entering the Korean Peninsula, United Nations forces stationed themselves in Japan. While in Japan, they made large-scale purchases of Japanese goods such as clothing and beds. These orders provided a strong boost to the manufacturers of these goods.[22]

While the Korean War gave the Japanese manufacturing industry a much-needed jolt, the sustained growth of the industry can be attributed in part to technological improvements. Japanese companies imported various technologies from foreign countries, acquired technological know-how from them, and used that know-how to develop their own technologies. Technological advances helped Japanese companies grow more profitable and, in turn, contributed to the growth of the domestic economy overall. Due to technology, Japan transitioned from primarily being a low-productivity, low-growth agricultural-driven economy to a high-growth manufacturing-driven economy.[23] It began producing high-tech, relatively expensive goods such as cameras, televisions, automobiles, and ships.[24] Higher-priced goods meant Japanese companies generated greater revenues. In addition, greater use of technology provided Japanese manufacturers with economies of scale.[25] Japanese manufacturers were able to increase the unit volumes they produced while decreasing their cost per unit of output. In short, technology contributed to G.D.P. growth in Japan because it enabled Japanese companies

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[19] Ibid.

[20] Savage, 270.

[21] Ibid, 278.

[22] W.G. Beasley, *The Rise of Modern Japan: Political, Economic, and Social Change Since 1850* (New York: St. Martin's Press, 1995), 244.

[23] Tetsuji.

[24] Katsuro Sakoh, "Japanese Economic Success: Industrial Policy Or Free Market?," *Cato Journal* 4, 2 (Fall 1984), 538.

[25] Stephen G. Bunker and Paul S. Ciccantell, *East Asia And The Global Economy* (Baltimore: The John Hopkins University Press, 2007), 2.

to increase their profit margins by decreasing production costs, increasing revenues, or some combination of the two.

Taking into account recent developments in technology, the Japanese government set aggressive goals for Japan's economy. One of these goals involved the Income Doubling Plan of 1960, designed by Prime Minister Ikeda Hayato. The plan's objective was to double per capita income within a ten-year period and to raise the living standards of the Japanese population. In order to achieve this goal, the government sought to achieve annual economic growth of nine percent during the plan's first three years.[26] The government wanted to expand Japanese exports by ten percent annually as well.[27] Furthermore, the government's Economic Stabilization Board aimed to restore levels of production to peak levels prior to World War II.[28] The goals set by Hayato and the Economic Stabilization Board provided Japan with tangible outcomes to work towards and would help guide Japanese economic policy.

The Japanese government adopted an economic development model that involved heavy state-sector-firm coordination.[29] In other words, the government aided the development of certain industries and specific companies within those industries. It did so through many economic policies. First, it kept interest rates relatively low to encourage Japanese businesses to borrow money.[30] There were three main economic institutions or programs through which businesses received low-interest loans: the Japanese Development Bank[31], the Export-Import Bank of Japan[32], and the government's Fiscal Investment and Loan Program[33]. In addition to distributing low-interest loans, the government provided subsidies to Japanese companies.[34] The government also issued domestic companies licenses for foreign technology[35] and maintained low tax rates[36]. Interestingly, Japan maintained the lowest ratio of taxes to national income among all countries belonging to the Organization for Economic Cooperation and

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[26] Matray, 170-171.
[27] Beasley, 248.
[28] Ibid., 245.
[29] Bunker, 1.
[30] Sakoh, 541.
[31] Takatoshi Ito, "Japan and the Asian Economies: A 'Miracle' in Transition," *Brookings Papers on Economic Activity* (1996), 225.
[32] Jeffrey M. Herbener, "The Rise and Fall of the Japanese Miracle," Mises Institute, accessed April 8, 2021, https://mises.org/library/rise-and-fall-japanese-miracle.
[33] Sakoh, 526.
[34] Ito, 225.
[35] Bunker, 11.
[36] Sakoh, 524.

Development.[37] Such a low rate of taxation allowed Japanese consumers to spend money that would otherwise have gone to the government in the form of taxes. Low corporate tax rates also enabled companies to re-invest in their businesses. Finally, the Japanese government kept a favorable exchange rate that discouraged imports and promoted exports.[38] All of these policies were intended to support Japanese industry. Without such assistance, many domestic private enterprises likely would not have achieved the level of growth that the government desired.

In addition to these economic policies, the government to some degree regulated domestic and international competition. While competition among Japanese companies benefited the domestic economy, the Japanese government feared that too much competition would be detrimental to the development of the economy. The government supported certain companies in the country's most promising industries and, with too much competition, the government feared that the growth of those specific companies potentially would be hindered. Thus the government restricted entry of new competitors to sectors that were already overly crowded.[39] In order to protect Japan's domestic industries from foreign competition, the government adopted a policy of protectionism. One measure it took was to impose import quotas, which limited the number of goods that Japan would import from other countries. By 1962, Japan had 492 different products under import quotas.[40] The government also imposed high tariffs on products made internationally in order to discourage Japanese citizens from buying foreign-made goods rather than domestic manufactured goods.[41] By regulating competition to an extent, the Japanese government turned what previously was a trade deficit -- where Japan was importing more than it was exporting -- into a trade surplus whereby Japan began to export more than it imported.

While government regulation of competition was certainly a factor that contributed to Japan's trade surplus, this surplus can also be attributed to the many Japanese industries that experienced exponential growth after World War II. For example, the steel industry in Japan underwent rapid growth as annual steel output increased from 22 million tons to 93 million tons between 1960 and 1970.[42] Japanese steel exports increased from 8.8 percent of total world

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[37] Ibid., 530.
[38] Robert J. Crawford, "Reinterpreting the Japanese Economic Miracle," *Harvard Business Review* (January-February 1998).
[39] Ito, 225.
[40] Sakoh, 531.
[41] Ito, 226.
[42] Beasley, 247.

exports in 1960 to a peak of 40.8 percent in 1976.[43] Another industry that grew rapidly post World War II was the shipbuilding industry. During the war, ships were mainly built for military use. After the war, Japanese shipbuilding companies started producing commercial ships for export. By 1957 Japanese shipbuilding production exceeded its 1944 wartime peak.[44] From the 1960s through the 1980s, Japan manufactured about half of the world's new shipping capacity.[45] A third industry that expanded greatly during this same period was the automobile industry. At Toyota, a major Japanese car manufacturer, the number of vehicles manufactured per worker per year tripled between 1955 and 1957 and then increased another 60 percent by 1964. By 1965, Toyota workers' productivity levels actually surpassed those of the Big Three American automakers -- i.e., General Motors, Ford, and Chrysler.[46] An increase in productivity levels was widespread among Japanese car manufacturers, as Japanese annual manufacturing output increased from 70,000 cars in 1955 to 3,146,000 cars in 1967.[47] The steel, shipbuilding, and automotive industries developed into three of Japan's largest industries. In reality, though, the Japanese economy as a whole flourished during this period at an unprecedented rate.

   The rapid growth of the Japanese economy, however, could not be sustained through the 1980s. The Bank of Japan's decision to maintain low interest rates backfired, as the easy and relatively cheap access to capital that was made possible by low interest rates caused a lot of business and household borrowing, which in turn led to heavy investment in residential, commercial, and office real estate; stocks; and factories and capital equipment. Robust investment in real estate caused domestic real estate prices to soar and, because of the large land holdings of many Japanese public companies, stocks to soar as well. In addition, Japanese companies used their high stock prices to raise additional capital which subsequently would be used to drive further investment in real estate, industrial plants, and capital equipment. All of this demand and speculation drove domestic asset prices through the roof. For example, the value of residential real estate in Japan's major cities rose 167 percent between 1985 and 1990.

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[43] Bunker, 71.
[44] "Japan's Shipbuilding Industry," Cross Currents, accessed April 28, 2021, http://www.crosscurrents.hawaii.edu/content.aspx?lang=eng&site=japan&theme=work&subtheme=INDUS&unit=JWORK049#:~:text=Japan's%20modern%20shipbuilding%20industry%20began,shipbuilding%20nation%20in%20the%20world.
[45] Ibid.
[46] Michael A. Casumano, "Manufacturing Innovation: Lessons from the Japanese Auto Industry," *M.I.T. Sloan Management Review* (15 October 1988).
[47] Allen, 113.

Economic growth in the late 1980s averaged nearly five percent annually, which off a relatively high base of G.D.P. was especially strong.[48]

As is the case so often with speculative booms, people believed that asset prices would only increase and therefore that it would be impossible for one to lose money. However, the surge in asset prices ended when the Bank of Japan realized that it needed to hit the brakes to avoid the risk of inflation spiraling out of control. The Bank of Japan's new Governor, Yasuchi Mieno, commenced a round of steep interest rate increases towards the end of 1989. With access to credit curtailed and the cost of borrowing increasing, Japan's speculative frenzy abruptly ended. Real estate prices, the stock market, and corporate investment activity reversed course and started to fall. Prices of real estate, for example, plunged about seventy percent between 1989 and 2001. Japan's stock market, in addition, collapsed by about eighty percent between its peak in late 1989 and its pre-Global Credit Crisis trough in the early 2000s.[49]

In conclusion, the economic policy implemented by the Japanese government in conjunction with U.S. assistance -- along with the outbreak of the Korean War and the evolution of technology -- resulted in the Japanese "Economic Miracle." Japan's businesses, especially those in the manufacturing sector, thrived in the post-war period and Japan achieved global trade dominance. After experiencing accelerating economic growth from 1980 through 1988, when Japan's growth peaked, the country's "Economic Miracle" began to unravel and its so-called "bubble" burst.[50] From 1989 through 1999, Japan's economic growth decelerated and eventually turned negative.[51] Though the Japanese "Economic Miracle" ultimately proved unsustainable, it was a truly remarkable "event" in Japan's history in that the government took an economy decimated by World War II and transformed it into the second largest in the entire world.

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Colorism And The Role It Plays In The Media by Terefech Johnson

Black is black, white is white, right? Well, actually according to society, it gets slightly more complicated than that. Unfortunately, discrimination based on ethinc background and skin color goes further than simply racism. It goes so far, that even those who belong to the same race, treat each other differently based on the shade of their skin. For decades now, conversations about underrepresentation and discrimination within the media have been igniting all across the United States. In television, sports and even literature, there have been many breakthroughs when it comes to the inclusion and recognition of people of color, but what doesn't seem to be talked about as much is the underrepresentation of and descriminaton against different skin tones.

What is this called, you may ask? Well, The textbook term is Colorism. Colorism is the prejudice against individuals with a darker skin tone as well as the glorification of those with a lighter skin tone. This can occur outside or within a racial or ethinic group. Because Colorism in media isn't as discussed as much, the underrepresentation of darker skin tones isn't as easily identified, and many go day by day without recognizing it.

Magazines are a popular form of media, typically amongst the younger generations, and they often contain models or cartoons of people to engage readers, make the magazines more visually appealing and even sell specific products. But, is there prejudice when it comes to choosing the skin color of the models or characters in the cartoons? Is there underrepresentation of darker skin tones, but overrepresentation of lighter skin tones? Does Colorism play a role in what skin tones we see when we open a magazine? My data science class and I, decided to collect, analyze, and compare multiple different articles and ads from seven magazines, National Geographic, The New Yorker, Sports Illustrated, Food and Travel, Vogue, People, and PlayStation, in an attempt to answer these questions.
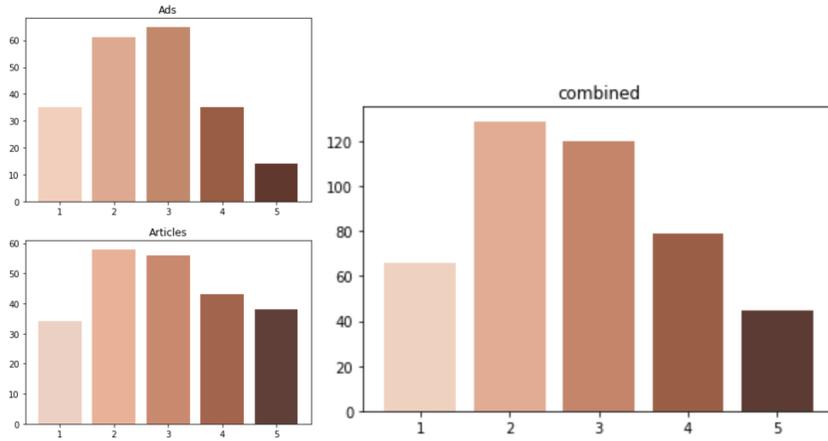
The bar graph above presents the results after collecting and categorizing the different skin tones found on the models or characters in the ads and articles, from the seven different magazines. The skin tones categories are, pale, light, tan, brown and deep and each skin tone collected is placed into one of these categories. As you can see, the two middle bars on the graph, which are the light and tan categories, lead with the highest representation across the Ads and articles in all seven magazines. On the opposite end of the spectrum, the pale (found on the left) and the deep tend to have least representation across the ads and articles. Despite both having little representation, deep is significantly lower than all the other categories in ads and has the overall lowest representation across all the magazines combined.
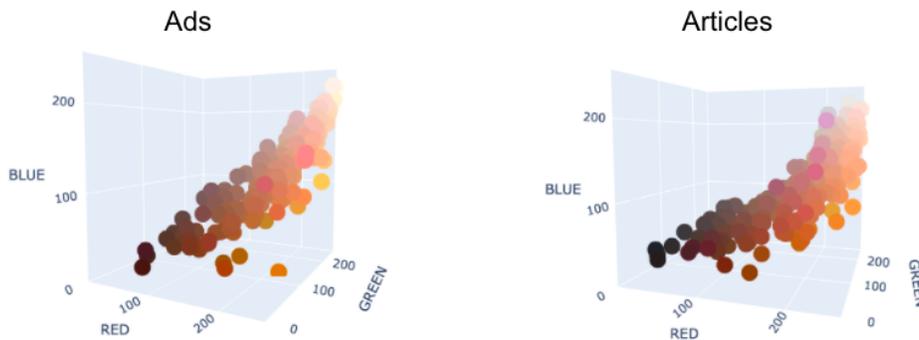
To create these models we took samples of skin color from each page we gathered from the ads and articles. The scatter plot shows all the the samples organized by color and it goes darkest to lightest. Just like the bar graph, the scatter plot highlights the underrepresentation on darker skin colors by displaying more light samples than dark samples.

This data concludes that across magazines, there is a trend of underrepresentation of darker skin tones. This happens when magazines choose to display lighter skin models and lighter skin cartoon characters rather than a variety of skin tones. This conclusion can tell us a lot about society and its values. It communicates that in America, lighter skin tones are held on a pistol while darker skin tones tend to be ignored or overlooked. Acknowledging this problem and having more conversations about it in the media, is the first step in removing this tendency and injustice, which would allow us to progress as a whole.

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Accessed 2 Feb. 2022.

What Is Colorism? by Aidan Miller

Both terms often get thrown around so much, it is difficult to even discern the difference between the two. From *Oxford Languages*, the textbook definition of racism is "prejudice, discrimination, or antagonism directed against a person or people on the basis of their membership in a particular racial or ethnic group, typically one that is a minority or marginalized." Unlike colorism, racism is prominent in our society today and affects a wide array of people. Problems that are known are easier to fix and contain. However, the term colorism is a foreign idea to most, therefore, making it an enigma to a lot of conversations about race.

According to *Oxford Languages*, Colorism is "prejudice or discrimination against individuals with a dark skin tone, typically among people of the same ethnic or racial group." The reason why colorism isn't talked about on a larger scale is that most people are so focused on a White VS Black image when race topics come to mind, yet forget about racism that could occur within different races and ethnicities.

In a TED Talk, by Chika Okoro, she talks about the many experiences she's had with the modeling and acting industry and how light-skinned individuals had a more favorable chance of getting an acting role than a darker-skinned person simply because lighter-skinned people typically allude to beautiful and esthetical unlike black people, who are seen as dirty and ugly. These flagrant beauty standards lower the self-confidence of darker-skinned people and turn them against themselves.

Later in the TED talk, Okoro mentions how her black classmates were calling her "pretty for a black girl". It is evident how not only the beauty standard affects the opportunities of darker-skinned people, but it also tears the black community apart rather than mending it together.

In a study conducted at Brooklyn Prospect Charter School's Data Science class it was found that in the articles section of the Vogue magazine, light-skinned people were represented in 42% of the images. In contrast, brown-skinned people weren't represented at all.

Vouge	# in article	# in ads	Total
Pale	11.54%	6.25%	17.79%
light	42.31%	43.75%	86.06%
Med	34.62%	18.75%	53.37%
Brown	0.00%	25.00%	25.00%
Dark brown	11.54%	6.25%	17.79%
	100.00%	100.00%	

(Brooklyn Prospect Vogue data analysis)

In another table from the same study, from a Forbes magazine in the articles section, there is barely any representation from darker-skinned people. This data table demonstrates the very little influence that darker-skinned people have in the general entertainment industry. The fact that pale-skinned people are 20x more represented than darker skinned people in the articles section of this magazine is insane and immoral.
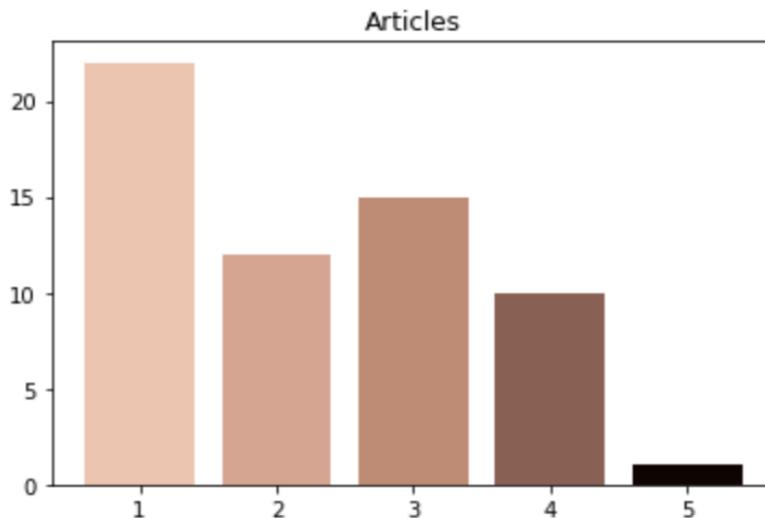
(Brooklyn Prospect Forbes data analysis)

When society constantly tells you that you aren't meant to succeed or you don't deserve to succeed, it plummets your self-confidence and you soon start to find yourself giving up on all of your hopes and dreams. Despite this, we are in times where debunking and overturning the harmful beauty standards that were imposed to set up darker-skinned people for failure is in reach.

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Organic Architecture Beyond Frank Lloyd Wright by Olivia Kim

The purpose of this paper is to redefine "organic architecture" by expanding it from Frank Lloyd Wright's original definition to one inclusive of the wide range of architectural environmental integration that had occurred before Wright's legacy, and that continue on past it. Organic Architecture is loosely defined as architecture structured with organic or naturalistic forms in mind as opposed to the traditional rectangular forms in most architecture. Typically this definition was tied to an example of Wright's architecture, whether it was organic by building a home in the middle of nature, or organic in the circular forms of a building. Organic forms originated from nature, and humans adapted by creating within forms that already existed, such as the Hoodoos. Architects were inspired by nature and pulled from repeated forms bringing to life the similarities between the Hoodoos and the cylindrical shapes atop Gaudi's roof.

Although Organic Architecture is intrinsically linked with the name of architects, the aesthetic theory itself originates from theories by Louis Sullivan, Ralph Waldo Emerson, and Horatio Greenough. Organic Architecture, thus, began more as an idealistic theory studying the structural properties of natural living forms such as animals or plants before natural non-living formations, such as rock formations. The parameters of the artistic style had already existed but weren't directly applied in an architectural form. So when architects like Wright began to create forms that incorporated nature or organic symbolism, the theory expanded from a somewhat philosophical constructional theory into architectural styles. Lastly, the parameters of organic forms were loose and focused more on the notion of studying nature rather than describing exactly how the principles could be applied in architecture.

> "Horatio Greenough proposed an aesthetic theory based on the close study of nature. He observed plant and animal structures in order to define the *great principles of construction.* If, as the first step in our search after the great principles of construction, we but observe the skeletons and skins of animals…are we not as forcibly struck by their variety as by their beauty? There is no arbitrary law of proportion, no unbending model of form." (Mumford, 26).

Regardless of the association of Wright's work with Organic Architecture, there are many other forms of architecture around the world that previously defined Organic Architecture's characteristics such as the ancient Cappadocia Hoodoos located in Urgup, Turkey. Even though

the Cappadocia Hoodoos existed long before Wright's discovery of Organic Architecture, it fits the architectural definition of Organic Architecture that was only ideated in Wright's architectural era thousands of years later. Organic Architecture is closely associated with Frank Lloyd Wright's innovative American architecture which borrows from indigenous cultures rooted in America and in the far east. Wright claimed that Japanese woodblock prints, the Froebel Kindergarten Gifts, and Louis Henri Sullivan were his three main influences on his work. Since then, this architectural form has been defined by his impact with most organic architects compared to Wright. This paper examines the chronology of Organic Architecture in its many forms and argues that a more fluid definition should be applied to the architectural style rather than consistently referencing Wright's formidable style (Mumford, 27).

One building that represents the pinnacle of Wright's Organic Architecture style would be Falling Water (1936-1939). As Kaufmann Jr. elaborates,

> "[Wright] understood that people were creatures of nature, hence an architecture which conformed to nature would conform to what was basic in people. For example, although all of Falling Water [sic] is opened by broad bands of windows, people inside are sheltered as in a deep cave, secure in the sense of the hill behind them." (Kaufmann Jr., 4)

This idea implies that Wright's Falling Water was built to give a sense of security to humans by using nature itself rather than the walls of architecture. Conversely, The Guggenheim Museum (1959), located in New York City, is an iconic building that also represents Wright's Organic style; however, it uses the organic form of a circle rather than nature's resources. Herein lies the fault of the definition. There are two completely different buildings created by Wright both argued to be Organic Architecture although they are immensely different: one is "Organic Architecture", Falling Water, and the other is "organic" architecture, The Guggenheim. The Guggenheim is "organic' simply because of the spherical shape of nature, while Fallingwater is organic because of its harmony with nature; these are two different associations and uses of organic to define a style proving that Organic Architecture was less so an arguably dogmatic style rather an effervescent definition loosely applied to all of Wright's work. Frank Lloyd Wright established the term Organic Architecture by defining it as a type of architecture that imitates the forms and functions of nature. Although Frank Lloyd Wright coined the term Organic Architecture and architects solely use it when discussing his work, other historic forms

arguably displayed the same characteristics far prior to Wright's work, such as the Cappadocia Hoodoo's.

The Cappadocia Hoodoos in Urgup, Turkey is renowned for their unique shapes and features; they are usually tall, narrow, and phallic. The Cappadocia Hoodoos are naturally made sedimentary forms dating back to the 3rd-millennium BCE, and over time, humans built within the forms, creating architecture from a structure that nature made. Because no individual could be associated with how the momentous forms were built, they were credited in spiritual practices turning the Hoodoos into sacred territories. Moreover, different empires that entered Turkey added their own interpretations of the purpose behind the naturally formed monumental landmarks and gave them new architectural interpretations. Similar to the Hagia Sofia which transferred from a church to a mosque and back to a church, the Hoodoos served a similarly adaptive purpose (Atchison, 3). For instance, in 300 BCE, these forms were used as war zones, but during the 10th and 11th century AD, they were used as refuge sites or churches. Although Wright was given the description of "organic" architecture for creating seamless forms in nature, the Cappadocia Hoodoos were created by nature itself and, thus, acted as a natural form for humans to build homes in. This literally could be interpreted as a superior organic form since nature itself brought about the structure by which humans could innovate and create art within (Richberg). Although one could marvel at the fortitude of nature's ability to create, modern architects and scholars cite the mastermind of the individual artist more than nature itself. Consequently creating a need for an artist, an architect, a human to be doled out the responsibility of creating organic architecture. Therefore, it intrinsically misses the element of the architect or the person who created the forms. More comparably to Wright, as opposed to the earlier Hoodoos, Gaudi was the creator of multiple organic forms challenging the earlier norms of traditional European architecture.

Antoni Gaudi is a 19th-century Catalan architect who specialized in neo-gothic techniques and oriental styles. His inspirations were mostly geometric paraboloid or hyperboloid forms that he claimed to be found in nature. For example, Casa Milla (La Pedrera), one of his famous buildings, has a rooftop containing cylindrical shapes very similar to the Cappadocia Hoodoos. Gaudi and Wright are similar to each other in that they celebrate nature in their work; they were each coined masterminds of the architectural styles they developed; however, very rarely are they grouped in the same style. I argue that in Gaudi's architectural forms and the

principles proposed by Greenborough, Gaudi should be included in the same grouping as Wright. Gaudi's forms, also inspired by nature, within the bustling city life of Barcelona, created a juxtaposition inherent to a city's purpose whilst Wright was adamant about providing spaces for humans that seamlessly blended into nature. Thus, which form of architecture could be argued to be more organic? Wright took part in creating natural organic forms in the city as well (Guggenheim Museum); however, he is most well known for Falling Water which is a clear example of organic architectural inspiration created within a natural environment. Therefore, Gaudi's work, similarly to the Hoodoos, embodies the complexity and inherent variation within the Organic Architecture style further proving that the craft has been solely associated with Wright when, in reality, the definition should be broadened to include the likes of Gaudi, potentially. Beyond Europe and America, other architects have created organic forms spanning towards the East in Korea with the likes of the architect Moon hoon. Given the historical focus on European and American architecture in the Organic Architecture space, it is pivotal to recognize the diversity within the term that has typically always been associated with a genius White Male architect.

Moon Hoon is a Korean architect known for his playful and distinctive design style, fusing art and architecture. Some of his work includes projects that resemble hairdryers, owls, and lollipops (Hoon). Moon Hoon's architectural forms are contemporary Organic Architecture that continues beyond Wright. This finality of the architectural interpretation of Wright's work inherently works against the terms "organic" and "nature" because the academic institutions and scholars do not allow the descriptions to evolve and change as organic forms and nature evolve Dennis, 13). Therefore, Moon Hoon is a perfect example of a contemporary architect challenging the traditional forms of architecture and creating space for further organic manipulative forms in city space and natural landscapes. According to Wright's definition, Organic Architecture typically limits the involvement of art and solely emphasizes the role of the architectural form, not adornment. However, Moon Hoon creates space for the development and inclusion of art on the facades of the forms; "there are no boundaries in the inspiration game," Moon Hoon implies (There).

Organic Architecture is more than an environmentally adaptive functional structure – it is also a form that merges structures with nature. Moon Hoon's blueprints are often, intentionally or unintentionally, similar to representational animals or living forms. Thus we can infer that by

using living organisms as inspiration, just as Greenbourough stipulated, Moon Hoon sees organic forms as living in their own right taking inspiration from living forms that nature created. Organic architecture is constantly evolving and changing just as nature does, providing room for new interpretations rather than the peremptory style that Wright's organic architecture currently embodies. Gaudi and Wright were infamous masterminds behind their styles, though each uniquely addressed organic forms. Lastly, Moon Hoon contemporarily exhibits the ability of Organic Architecture to evolve and change with the times. Organic Architecture came to light with Wright's creations but now illuminates much more of architectural forms and history that should also be classified as part of the style. While the credit certainly goes to Wright for encouraging the fervent defining of his architectural style, the expansive landscape and broad interpretation of organic architecture need a pragmatically inclusive definition to correctly define the forms that led to Wright's creations. Organic Architecture, thus, should not be defined solely as a style that Wright brought about but rather a theme that various architects interpreted over the past millennia from building within eroded phallic rock formations to building in nature or utilizing circular forms. Ultimately, Organic Architecture effervesces into all styles that are inspired by nature, surrounded by nature, or defined by nature.

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Social Stigma: The Implications of Mental Health Days in American Public Secondary Schools by Ashley Hodge

Introduction

The National Institute of Mental Health, the leading federal agency for mental illness research, found that an estimated 31.9% of American adolescents aged 13–18 suffer from anxiety disorders and an estimated 13.3% of American adolescents aged 12–17 have experienced at least one major depressive episode ("Statistics: Major Depression;" "Statistics: Any Anxiety Disorder"). Despite mental health treatment for these disorders provisioning benefits such as an extended lifespan and decreased suicide risk, the Centre for Addiction and Mental Health, a hospital setting the standards for mental disorder care and research, reported that societal stigma against psychological disorders prevents 40% of those with anxiety and/or depression from seeking this crucial medical care ("The Importance of Seeking Mental Health Treatment;" "Addressing Stigma"). Because the aforementioned adolescent demographics are also the primary population attending American secondary schools, and the average American student attends school for about 6 hours daily, it could be reasoned that supporting secondary students by implementing solutions to address this detrimental stigma is a schoolwide responsibility (Camp and Kocivar). Potentially, one such solution is to allow mental health days to be taken as excused absences. Debbie Plotnick, the vice president for mental health and system advocacy at Mental Health America, asserts that this implementation would lead to more students seeking treatment for their psychological disorders, create dialogue about psychological health, and, hence, reduce mental health's stigma (Walker). Thus, the question arises: should American public secondary schools introduce excused absences for mental health days in order to reduce mental disorder stigma?

Adolescent Experiences with Stigma

Detailing the issue of mental health stigma in secondary schools, from an adolescent perspective, mental health stigma is significantly prevalent. For example, a survey published in the American Journal of Orthopsychiatry explained how those within the secondary school age demographic expressed a desire to socially distance from hypothetical students with mental illnesses (DuPont-Reyes et al). Likewise, Jennifer Wisdom, the director of a research center

seeking to improve access to mental health care, found that depressed adolescents are more likely to be viewed as unlikeable than their non-depressed peers (Wisdom et al.). As secondary students with mental disorders feel the stigma these two examples demonstrate manifestations of, 92% of them claim stigma to be a barrier to mental health treatment; they fear social repercussions from their peers if they were to seek such care (Radez et al.). Considering such, mental disorder stigma can be discerned to be a prominent issue and impediment in American secondary schools.

Despite this, others allege that most adolescents support those suffering from depression and anxiety, suggesting the presence of limited stigma. Pew Research Center in particular highlights how, in 2018, compared to the 4% who view depression and anxiety as nonexistent issues, 70% of American adolescents aged 13–17 years believe these medical-care-requiring disorders to be major issues in their communities (Horowitz and Graf). This statistic demonstrates awareness about mental illness, and, because greater knowledge contributes to lesser prejudice, a view of limited mental health stigma in secondary schools is presented (Borenstein). However, The Lancet, an acclaimed peer-reviewed medical journal, illuminates how this acceptance is not synonymous with the absence of stigma; acknowledging depression and anxiety to be major issues compelling medical care does not inherently prevent social stigma (Thornicroft et al.). Thus, due to both this and the aforesaid evidence exemplifying the vast percentage of mentally ill adolescents who experience the impact of mental health stigma, prejudice amongst peers is still a momentous force burdening American secondary students.

Mental Health Days as Schools' Intervention

Excused absences for mental health days present themselves as a plausible solution to secondary schools' obligation to address the discussed stigma amongst their students. Drawn from what Mina Fazel, an adolescent psychiatry associate professor at Oxford University focusing her research on the youth's access to mental health interventions, retains, secondary schools possess the responsibility to address mental disorder stigma due to their instrumental influence on children's peer relationships, emotional control, moral development, and, thus, mental health and psychological disorders (Fazel et al.). By fulfilling this obligation through the implementation of mental health days, proponents like Jennifer Rothman, the senior manager of youth initiatives at the National Alliance on Mental Illness, claim to be raising psychological

disorder awareness (DeNisco). Rothman specifically proposes that this implementation would demonstrate how secondary schools place the same value on mental health as they do on physical health and reduce shame, and, thus, stigma around mental illnesses (DeNisco). Because mental health days can reduce stigma, from the schools' perspective, their utilization could mitigate what has been previously mentioned to be a significant barrier to mental health treatment, hence provisioning the aforesaid extended lifespan and decreased suicide risk for adolescents with mental disorders and realizing American secondary schools' obligation to address their students' psychological well-being.

Parental Reluctance Towards Mental Health Days

Unfortunately, the efficiency of excused absences for mental health days comes into question when examining parents' relationships with mental health stigma. Underscoring the prevalence of mental disorder stigma amongst parents, Denise Chavira, a recipient of funding from the aforementioned National Institute of Mental Health to research barriers to psychological treatment, conducted a study identifying 36% of parent participants to voice they would perceive themselves to be failures if their child received mental health treatment (Chavira et al.). Moreover, Chavira's findings recognized a trend of parents socially distancing themselves from minors they knew to be mentally ill, paralleling the American Journal of Orthopsychiatry's prior discussions of adolescents' mental disorder stigma (Chavira et al.). Mental health days would only be effective if parents allow their children to remain home for emotional necessities, yet, due to this expressed stigma within parents, many may not currently allow for this vital action to be taken. This renders mental health days' benefits nonexistent in terms of encouraging conversation and awareness, reducing stigma, and promoting crucial medical treatment.

Still, it is to be understood that some parents do support and would allow their children to take advantage of excused absences for mental health days, preserving these benefits. In a recent national poll, The University of Michigan reported 1-in-3 parents strongly supporting mental health programs in schools; the proposed solution is one example of a mental health program in American secondary schools (Mostafavi). Furthermore, Davis School District noted how, although there is avoidance of the term "mental health days," many parents already allow their children to remain home from school for emotional illnesses, suggesting that some parents would welcome the proposed solution as a method to reduce the stigma around a practice they already

engage in (DeNisco). Despite this, it still remains that Chavira's research highlights how numerous parents' mental health stigma would prevent a significant portion of secondary students from utilizing mental health days. It is apparent that prejudice in secondary schools is a prevalent issue the institution must remedy; however, parental stigma creates significant inequity between students who would and wouldn't benefit from excused absences for mental health days. Thus, it becomes difficult to see how this solution could independently yet adequately address mental disorder stigma.

Conclusion

Considering all perspectives, excused absences for mental health days display themselves as a partially effective but not all-encompassing solution to addressing mental disorder stigma in American public secondary schools. Therefore, excused absences for mental health days should be considered by school districts as only the first step preceding further action.

However, this solution is limited. Because it necessitates further action to construct greater equity, this solution cannot function independently. Moreover, these additional operations have not yet been determined, so this implementation also compels an abundance of time. Still, mental health days remain a logical first step in addressing mental health in secondary schools because of their potential to reduce mental disorder stigma and, hence, protect lives.

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The Advantages of Intranasal Vaccination Against SARS-CoV-2 by Vivian Wang

Introduction of SARS-CoV-2

Since December 2019, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has been widespread in the world and poses a great threat to personal and public health. Faced with such pressure, scientists from all over the world have made joint efforts to develop vaccines through different technologies, including licensed vaccines, which are already in application, based on inactivated virus, DNA, and RNA.

SARS-CoV-2 is an enveloped, non-segmented positive-stranded RNA virus.(Ku et al.) Virions enter the human body through the respiratory system. The spike protein on their surface binds with angiotensin converting enzyme 2 (ACE2) to allow the virus to enter human cells. Inside the human cell, viral RNA is released, replicated and translated. Then, the viral proteins and RNA assemble into new viruses and travel through the ER-Golgi-exocytosis pathway into the extracellular space. The new viruses can now infect more human cells and replicate much faster. SARS-CoV-2 infected patients have different levels of symptoms: Asymptomatic patients and patients with mild symptoms may not need hospitalization, while severe symptoms can be life-threatening, including acute respiratory distress syndrome and systemic multi-organ collapse.(Trougakos et al.)

During the natural immune response to SARS-CoV-2, both the innate and adaptive immune system works together. Innate immunity consists of different cells and mechanisms and generally defends the human body in the first line. In innate immunity, dendritic cells are activated in response to SARS-CoV-2 viral RNA. The adaptive immune system provides specific protection against SARS-CoV-2 and can react to the virions faster and more effectively in the case of subsequent infection. Adaptive immunity comprises cellular immunity and humoral immunity. In cellular immunity, activated dendritic cells carry antigens to lymph nodes, and present them to T cells. Activated T cells will divide into effector T cells, which kill infected cells, and memory T cells, which remain in the lymph node to prepare for the next possible infection. In humoral immunity, B cells use their receptor to recognize different antigens and divide into plasma cells and memory B cells with the help of helper T cells. Plasma cells will then produce more anti-S protein antibodies of SARS-CoV-2 to block the virions from binding with human cells. The job of vaccination is to mimic pathogen entrance without actual harm. An

effective vaccine needs to activate the innate immune system and generate both cellular and humoral immunities.

Advantages of intranasal vaccination

Among numerous SARS-CoV-2 vaccine candidates in development, scientists are also constantly trying new technical means, such as intranasal (IN) administration of vaccines. Traditional needle injection has many potential problems, including pain, needle-phobia, needle stick injury, and various diseases spread by using needles repeatedly. However, IN vaccination can effectively solve these problems and also make many other benefits. Traditional injections need to be performed by professionally trained nurses, but IN vaccination, as a noninvasive procedure, may be easier to apply.(Zheng et al.)

The idea of IN vaccine delivery has a long history. At present, IN vaccines against other diseases have been licensed in different countries and achieved positive results. For example, there are two IN vaccines licensed for Influenza, Flumist in the U.S. and Nasovac in India. They are both live, attenuated virus intranasal vaccines. In one study, researchers studied the efficacy of live attenuated IN vaccines among children in India. They found that vaccine efficacy was 40% compared with controls in year one and 51.9% in year two. There was no report of serious symptoms caused by vaccines. This study supports that intranasal vaccination could be safe and efficacious.(Krishnan et al.)

SARS-CoV-2 intranasal vaccines in development

IN delivery for SARS-CoV-2 vaccination can effectively stimulate mucosal immunity and systemic immunity at the same time, which may effectively protect against infection and also limit viral shedding and spread. The mucosal immune system is an important component in the whole immune system. It locally defends against pathogens entering through mucosal membranes. Since SARS-CoV-2 usually enters the human body through the upper respiratory tract, nasopharynx-associated lymphoid tissue (NALT) will induce the first immune response. NALT consists of lymphoid tissue, B cells, T cells and antigen presenting cells. NALT along with other mucosal inductive site tissues all produce the antibody immunoglobulin A (IgA). IgA plays an important role in mucosal immunity, including neutralization, preventing pathogens from direct contact with the mucosal surface, and inhibition of virus intracellular

replication.(Wang et al.; Russell et al.)

In one preclinical study in mice, researchers compared IN boost and intraperitoneal (IP) boost of a lentiviral vaccination vector that encodes SARS-CoV-2 glycoprotein. After the injection of both prime and boost, they pretreated mice with an adenovirus encoding the human ACE2 receptor in the airway, to make them susceptible for infection. The results showed that an IP prime with an IP boost reduced lung viral loads, but an IN boost caused a much more significant reduction. With IN boost, there was no detectable virus by qRT-PCR in the lungs from two of the five mice treated. Additionally, while the IP boost and IN boost generated roughly the same amount of Anti-SARS-CoV-2 IgG in serum, only IN boost generated detectable amounts of Anti-SARS-CoV-2 IgA in mice lungs, resulting in a statistically higher neutralization in mice with IN boost. In conclusion, a mucosal IN boost may provide better protection against SARS-CoV-2 infection.(Ku et al.)

Shedding and transmission is another important factor to be considered. Current vaccination can prevent people from being infected and harmed, but these people may still become asymptomatic carriers and spread the diseases to other people around them. One study investigated some vaccinated health care workers and their household members in Scotland. Although the results suggest that vaccination can reduce transmission, there was still evidence of transmission among the vaccinated.(Anoop S.V. Shah et al.)

Another group of researchers investigated whether IN vaccination may reduce shedding. In the experiment, hamsters were vaccinated with ChAdOx1 nCoV-19/AZD1222, a chimpanzee adenoviral vector vaccine containing the SARS-CoV-2 structural surface glycoprotein antigen gene, through the IN route, intramuscular (IM) route, or with a control vaccine. The IN vaccination led to similar IgG titers in peripheral blood as IM vaccination, but higher neutralizing antibody titers. Researchers performed nasal and oropharyngeal swabs for seven days after the infection to assess viral load. Compared to the control group, the amount of viral RNA decreased significantly in nasal swabs of IN-vaccinated animals, and the amount of infectious virus also decreased significantly in oropharyngeal swabs of IN-vaccinated animals. However, there was no significant difference between IM-vaccinated animals and control animals. In order to better model natural infection, the researchers housed vaccinated and infected hamsters in the same cage. Again, the researchers observed a significant reduction in the amount of shedding both for viral RNA and infectious virus in IN-vaccinated animals but not in

IM-vaccinated ones. This experiment suggests that an IN vaccination, unlike IM vaccination, can cause a significant reduction in shedding and protection of the respiratory tract.(van Doremalen et al.)

Apart from humoral immunity, IN vaccination for SARS-CoV-2 may also trigger significant cellular immunity. While tissue-specific cellular immunity after IN vaccination has not been assessed in humans, natural infection can generate CD4+ T, CD8+ T, and B cell memory for up to 6 months post-infection, including responses in the lungs and NALT (Poon et al.). Since natural infection can generate durable immunity in the lungs, we can hope for IN vaccines to accomplish the same, given that IN vaccines target the same tissues as natural infection. In another study, researchers developed a chimpanzee adenovirus-based vaccine. In the experiment, researchers did not detect any increases in lung-resident memory T cells in the lungs of mice with IM vaccination compared to the control group using flow cytometry, which showed that IM vaccination could not induce significant mucosal cellular immune response. However, a marked increase in T cells was detected in the lungs of IN vaccinated mice. This suggests that IN vaccination can induce significant mucosal cellular immunity in animal models and may induce similar mucosal cellular immunity in human bodies.(Hassan, Kafai, et al.)

The durability of immunity generated by vaccination is another important factor. In this aspect, one study also showed that IN vaccination performed better than IM vaccination. In the study, mice immunized with an intranasally administered spike protein-based chimpanzee adenovirus-vectored vaccine through either IM or IN route were challenged with SARS-CoV-2. Researchers tested the amount of viral RNA in different organs in different times after the infection, and found significantly less viral RNA in lungs after IN immunization than IM immunization. This study supported that IN vaccination can induce a more durable immunity than IM vaccination.(Hassan, Shrihari, et al.)

Conclusion

Based on the preclinical researches discussed above, there is enough evidence to support that intranasal vaccination for SARS-CoV-2 is more effective than other routes, including intraperitoneal and intramuscular vaccination, in various aspects. Intranasal delivery vaccination has the potential to help stop the pandemic around the world.
A variety of intranasal vaccines against SARS-CoV-2 are also under clinical study. Seven

companies have already started clinical trials for intranasal vaccination for SARS-CoV-2, including Meissa, Codagenix, and others.(Frances E. Lund and Troy D. Randall) BBV154, developed by Bharat Biotech, is the first one that received the approval for phase 2 trials. But there is no published data for all of them, which is worth continuous attention.

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To What Extent Did Operation Titanic Affect the Victory of the Allies in the Invasion of Normandy in 1944? by Eva Xu

The D-Day invasion's airborne component was one of WWII's major airborne missions. On June 6th, 1944, about 2,500 paratroopers landed in Normandy, commanded by the Royal airforce and Special air service. The Allies used deception tactics to thwart Germany's response to the invasion, and Operation Titanic was one of the deception operations (Thompson-7). To a large extent, Operation Titanic affected the allies' victory in the invasion of Normandy in 1944. This essay investigates firstly how the primary mission of the German forces was diverted by deceptive techniques used in Operation Titanic. Then, how Operation Titanic wasn't the sole cause for the allies' victory during the d-day, but other military deceptions operations also assisted the allies' victory. Finally, because the Germans failed to recognize the deception, Operation Titanic was a success, with only minor Allied casualties.

Through deceptive techniques, Operation Titanic effectively diverted German troops from their primary objective of defending the beachheads and strategic sites like Caen. According to the London Controlling Section (LCS), Operation Titanic relied heavily on dummy paratroopers. Internally, the dummies had rifle and machine gun simulators that exploded and made fire sounds. To add confusion, after the dummies fired their simulators and released their compounds, they would self-destruct, leaving only the burnt remains of a parachute, implying that a paratrooper attempted to burn his chute to conceal proof of his landing. The German High Command was undoubtedly delayed in providing reinforcements to Caen and the Cotentin-Peninsula because of Operation Titanic (Thompson-12). This ultimately suggests that the paratrooper dummy in Operation Titanic successfully deceived the Germans since they were so focused on reacting to the perceived threat at the moment that they left the post they were supposed to defend, contributing to the success of operation-titanic. Since the dummies created were incredibly realistic, it also assisted in diverting the German troops from their original posts as they believed the dummies were a genuine threat. This was also a time when Germany was most dominant in Europe and renowned for its war strategies. Therefore, this was an exceptionally remarkable feat on the allies' part. Additionally, other than the dummy paratroopers, metalized paper, known as chaff, was also dropped by some planes, which can blind and confound radar. ("D-Day's Parachuting Dummies and Inflatable Tanks"). This was an

essential component of dropping the dummy paratroopers as it concealed the size of the false paratroopers and further deceived the Germans into believing there were more paratroopers than there were, which aided the success of the paratrooper-dummies. This also insinuates that more Germans will divert from their original posts to attack the false enemy troops as they assume that they were under attack by a large-scale army. Essentially, the paratroopers and chaffs were a crucial component of Operation Titanic in diverting German troops from their primary intent of defending the beachheads and strategic sites like Caen, which contributed to the allies' victory in D-day.

Moreover, the allies' victory during the invasion of Normandy was the result of Operation Titanic and other military deceptions such as Operation Quicksilver. According to historian Paul Pattinson, The primary objective of Operation Quicksilver was to stage a predominantly false invasion force in southeast England to distract the German army situated at Pas De Calais since it wasn't lightly defended. General Eisenhower sent two army groups to southeast England: General Montgomery's 21st British Army Group (The actual army) and General Patton's 1st US Army Group (The false army). This was ingenious on General Eisenhower's part since he engineered a plan where he could misdirect the German's attention and effort as their effort was now put towards the false army instead of where they were needed, similar to what happened during Operation Titanic. The false army was invading Pas De Calais as it is the closest point to the U.Ks border. The Germans assumed that it wouldn't make sense if they chose a longer route as more difficulties would arise. While the false army was invading Pas De Calais, the actual army would invade Normandy without any strain. Patton's army, which included inflatable tanks, jeeps, and planes, conducted "training drills" and communicate critical information such as battle orders and battle strength over the radio. The continual use of lights and campfires signalled the presence of a vast force. They docked landing craft at the ports of southeast England. The FUSAG succeeded in diverting Germany's attention away from the actual landing craft concealed in Southern England (Thompson 11). This ultimately highlights the allies' resourcefulness as they used various deceptive strategies to achieve their end goal of invading Normandy. The allies' attention to the minor details of their plan made their operations successful. There is an explicit link between Operation Quicksilver and Operation Titanic, as Operation Quicksilver didn't provide the Allies with a permanent answer to their issues. The LCS had to consider the German Army defending the Atlantic Wall despite Operation

Quicksilver keeping the German Army occupied at Calais. As a result, Operation-titanic was created. In Essence, Operation Quicksilver, in conjunction with Operation Titanic, aided the allies' victory in the invasion of Normandy.

Consequently, Operation Titanic succeeded as the Germans failed to recognize the deception, leading to minimal Allied casualties during the invasion of Normandy. This viewpoint has been agreed upon by historians such as Ben Macintyre and Michael Howard since the allies' won the invasion of Normandy with their deceitful tactics and led to only 226,386 casualties of the two million+ allied forces. However, Mary Barbier refutes many usual arguments about the impact of deceptive tactics. She believed D-day would have been a success for the allies even without the deceptive operations used by the allies (Maxmin 8). Although historian Mary Barbier is predominantly right with her claim that D-day would have been a success even without the allies' deceptive operations like Operation Titanic, the invasion would have led to many more casualties without the deceptive tactics used since the German soldiers wouldn't have been distracted by the threat they perceived to be genuine and would be more focused on attacking the allied troops, ultimately allowing them to be more efficient at their tasks. According to historian Antony Beevor, Operation Titanic was successful because it caught the Germans by surprise. The losses on Omaha Beach were lower than expected, and the Allies escaped very lightly on the Gold, Juno, and Sword beaches, with only 11% of total casualties. This indicates that there were very few allied casualties because Operation-titanic and many other deceptive operations were a success. It gave the allies more time to invade Normandy and the Germans less time to respond and defend themselves as they failed to recognize the deception. This shows how important of a component deception is in warfare strategy as it could significantly lower casualty rates and lead people to success and victory. Therefore, because the Germans were unaware of the deception, Operation Titanic was successful, resulting in few Allied casualties during the invasion of Normandy.

Ultimately, Operation-titanic diverted German troops effectively from their primary objective of defending the beachheads and strategic sites through deceptive techniques. However, Operation Titanic would not have been successful if it didn't work in conjunction with other deceptive operations. Though, Operation Titanic was a success as the Germans couldn't recognize the deception, which led to minimal Allied casualties. Therefore, Operation titanic affected the Allies' victory in Normandy.

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The Structural and Functional Differences in the Amygdala in Children and Adolescents With Autism and How They Contribute to Symptom Presentation by Tara Girisaballa

Abstract

Early brain lesion research revealed that individuals with amygdala defects or dysfunction showed certain emotional, cognitive, and social deficits. These are somewhat similar to the typical symptoms observed in ASD such as impairments in social judgment, emotion inference, and social reciprocity. This was the basis for the amygdala theory of autism [Baron-Cohen, S., Ring, H. A., Bullmore, E. T., Wheelwright, S., Ashwin, C. & Williams, S. C. (2000) The amygdala theory of autism. Neuroscience and Biobehavioral Reviews 24:355–64.] which states that the amygdala in ASD has a social function, and that, differences in the amygdala may underlie certain ASD symptoms. From here, current research has used more modern neuroimaging techniques to further our understanding of the differences in the amygdala in ASD and how it might impact the typical symptomatology of autism. This paper investigates the structural and functional differences of the amygdala in children and adolescents with ASD and how they correlate with symptom presentation to further understand ASD etiology.

What Is ASD?

Autism spectrum disorder (ASD) is a neurodevelopmental disorder that can cause significant social, emotional, and behavioral challenges. It is clinically characterized by deficits and impairments in social communication, restrictive and repetitive behaviors, and aspects of executive dysfunction (Hyman et al. 4). ASD is a spectrum disorder, ranging from low functioning to high functioning. The neurodevelopmental disorder is highly prevalent: Approximately 1 in 44 children are diagnosed with ASD, and over the last two decades, the number of ASD diagnoses has more than doubled (Maenner et al. 1).

Symptoms can manifest itself in various ways and categories, such as social, communicative, and behavioral deficits (DSM-5). A lack of social reciprocity can be presented as difficulties in maintaining relationships, adjusting behavior to fit different social contexts, or sharing interests and interacting with peers. They may have trouble understanding and functionally utilizing body language or important social cues, such as eye contact and facial

expressions. However, our understanding of the underpinnings of the spectrum of symptoms is limited.

This raises an urgent need to investigate this disorder and underlying mechanisms in the brain that could explain the typical impairments in social intelligence

A Social Theory of ASD

Social intelligence is the ability to interpret others' thoughts, intentions, emotions, and behavior, in terms of mental states, in order to interact in socially normative ways. One of the central features of ASD is impairments in social functioning and intelligence. Social tasks that a neurotypical person conducts on a daily basis without an effort, such as responding to initiations, maintaining eye contact, empathizing with others, or sharing enjoyment, may be more difficult for autistic individuals (Baron-Cohen et al. 44).

These impairments are thought to be associated with a core deficit in Theory of Mind. Autistic individuals sometimes lack the capacity to form second-order representations and engage in perspective-taking, a crucial part of social interactions. Recognising another individual's feelings and thoughts, and responding to it with appropriate emotion, is a key characteristic of empathy, which is a current area of research related to autism. Evidence has shown that most children with autism may treat people and objects alike, thereby facing difficulty while understanding the emotional content of facial expressions (Hobson 333), failing to point to interesting toys (Mundy et al. 662-665), and understanding the concept of pretend play (Brothers 85).

The ability to conceive mental states and infer that other people know, want, believe, and feel emotions and things, is highly diminished. There is a neural network comprised of certain regions of the brain which underlies these deficits in fundamental social skills. There are several indications that social intelligence is a function of the limbic structures, such as the orbital frontal cortex, hippocampus, and the amygdala. Indeed, early literature suggests that brain lesions and abnormalities in the limbic and other social structures of the brain result in deficits in social behavior and intelligence (Bauman and Kemper 870-871).

The Amygdala as a Window into Understanding ASD & The Amygdala Theory of ASD The amygdala is a collection of nuclei located in the medial temporal lobe, near the base of the brain. It lies adjacent to the hippocampus, and is a part of the limbic system. The amygdala, despite its miniscule size, plays a significant role in social intelligence and the processing of

emotions in the brain. The amygdala is most widely known for processing fearful or stressful emotions, and emotional stimuli with a strong positive or negative component (Davis and Whalen 18). However, recent discoveries have revealed deeper involvement in the neurobiological basis of social interaction, Theory of Mind, and symptom presentation in ASD. The amygdala theory of autism (Baron-Cohen et al. 355-364), serves as a foundational basis for the link between amygdala lesions and impairments in social intelligence, judgment, and reciprocity. This theory states that the amygdala in ASD has a social function, and abnormalities in this structure underlie certain social symptoms of ASD.

In fact, past research also compared individuals with ASD to those with amygdala lesions, revealing similar emotion and cognition-related deficits (Pelphrey et al. 258) such as difficulties in direct eye gaze (Adolphs et al. 237). A study by Adolphs et al. dealt with a patient with severe amygdala damage: she had deficits in recognizing fear expressions, abnormal viewing patterns of the face region, and displayed decreased face and eye fixation. This was likely due to the fact that she looked more at the mouth than the eyes while processing facial expressions (68-70). A similar mechanism can be observed in individuals with autism, who face difficulties looking at the eye region specifically and display less eye fixation (Dalton et al. 524). To better understand how the amygdala might contribute to ASD symptoms, neuroimaging studies using a variety of methods have investigated differences in size, growth, and functional activity between autistic individuals and typically developing controls. This literature review will discuss the structural and functional differences in the amygdala and how they contribute to ASD symptom presentation.

Structural Differences

Neuroimaging research depicts a strong relationship between amygdala size/volume and ASD symptom presentation. Magnetic resonance imaging (MRI) and functional MRI (fMRI) studies provide more insight into the differences between amygdala size, volume, and function between individuals with ASD and age-matched controls.

Some research has indicated that the amygdala is significantly smaller in adults and adolescents with ASD compared to controls (Baron-Cohen et al. 358-360). Smaller amygdalae also reflected more symptomatology; individuals with ASD displayed slower judgment time for emotional expressions, decreased face and eye fixation, and more significant levels of

impairment in social reciprocity (Nacewicz et al. 1421). Reduced amygdala volumes also correlated with higher levels of restrictive and repetitive behavior in autistic adults. Individuals with ASD also scored lower on a basic emotion recognition test. These findings indicate that autistic individuals with smaller amygdala volumes had more social cognitive deficits (Dziobek et al. 1894-1895). Relatedly, individuals with ASD that exhibited more difficulties and errors on a gender recognition test using pictures of eyes and a Theory of Mind task, had smaller amygdala volume as compared to controls (Baron-Cohen et al. 361). Moreover, smaller amygdala volumes correlated with a failure of identifying mental states or emotional information from complex visual stimuli (such as the eye region). These results support the idea that mental state concepts, such as attaching emotional valence to people and facial expressions, are processed in the amygdala, and therefore, it is possible that smaller amygdala volumes may be associated with ASD-related symptomatology. This may help to shed light on the underpinnings of ASD symptoms and provide a deeper understanding of ASD etiology.

However, some studies have found that children with ASD had larger amygdalae compared to age-matched controls (Sparks et al. 188). Specifically, in a study conducted by Schumann et al., it has been found that young children with autism had a 16% larger right amygdala and a 13% larger left amygdala compared to typically developing controls (6399). Amygdala enlargement in autistic children aged 2 to 4 years old also correlated with impairments in joint attention and facial emotion processing (Mosconi et al. 513-515). In contrast to the above, it is also possible that larger amygdala volumes contribute to ASD-related symptoms. As such, atypicalities in amygdala volume at both extremes– small and large– may contribute differentially to symptom presentation.

Some research highlights an atypical change in amygdala size in subjects with ASD from childhood to adolescence. It has been shown that amygdala volume increases throughout adolescence in typically developing male adolescents (aged 17 to 18) but not in male adolescents with autism (Schumann et al. 947). In contrast, research investigating autistic children suggests that the growth rate of the amygdala is significantly increased- this abnormal growth is thought to begin before three years of age, and accelerates during the next several years (Nordahl et al. 56-57). Taken together, evidence may indicate that the amygdala is initially larger than normal in children with ASD, due to more initial growth, but later, it does not undergo the age-related increase in volume that takes place in typically developing children (Schumann et al. 6392).

As discussed above, findings differ related to amygdala change over time based on the participants' ages. Nevertheless, there are some inconsistencies. Some structural neuroimaging studies have reported an increase in amygdala volume with age, from childhood to adolescence (Schumann et al. 6399), whereas other studies have reported a decrease in amygdala volume with age (Nacewicz et al. 1421-1423). These inconsistencies may have been influenced by the methods, specifically the population, and methods of analysis within the split groups. In the Schumann et al. study, four diagnostic groups were created, each with participants of low functioning autism (19 individuals), high functioning autism (27 individuals), Asperger syndrome (25 individuals), and typically developing controls (27 individuals). All individuals were between the ages of 7.5 and 18.5. The method used for analysis in the Nacewicz et al. study has an important distinction: it has 2 cross-sectional studies. The first one consists of 12 individuals with ASD and 12 controls, and the second uses 16 individuals with ASD and 14 controls. All individuals in the cross-sectional studies were between the ages of 8 and 25. The differences in the methods of analyses, age range, and population of the participants in both these studies provide insight into the reason behind conflicting results regarding amygdala expansion over time, since different growth patterns were observed during different times of development. Some postmortem studies have revealed cellular differences in the amygdala between individuals with autism and typically developing controls. A study by Bauman and Kemper revealed abnormalities in amygdaloid nuclei in postmortem ASD cases (184). Increased cell packing density and smaller neuronal cell size was observed in the central, medial, and cortical nuclei in the autism case, and these findings may be due to arrested development in certain regions of the amygdala. Another study by Schumann and Amaral found that, compared with age-matched controls, the autistic brains had significantly fewer neurons in the amygdala and its lateral nucleus (7674). Overall, postmortem findings can help elucidate the neuropathology of the amygdala in autistic individuals and its association with amygdala-related dysfunction and impairment in autism.

Functional Differences

Differences in amygdala size and growth in individuals with ASD compared with controls have shown to contribute to the deficits in social cognition: however, it is not the only contributor. Research involving certain social cognition abilities, behavioral tasks, and fMRI

scans have provided insight into the abnormal functionality of the amygdala in individuals with ASD as compared to that of typically developing and age-matched controls. The functional aspects of the amygdala, such as its responsiveness and activity, are also directly linked with ASD symptom presentation (Guo et al. 52).

An fMRI study by Baron-Cohen et al. revealed that individuals with ASD showed significantly less amygdala activation during a theory of mind task (1895). The individuals were presented with photographs of eyes and were asked to describe the mental state of the photographed person. The control group displayed a significantly more robust response in the left amygdala, whereas the autism group did not activate the amygdala at all- instead, compensated for the amygdala abnormality by processing the information in other temporal lobe structures. The left amygdala may therefore be critically involved in identifying mental state/emotional information, a key aspect of social cognition. As such, dysfunction in the left amygdala correlates with a deficit in emotion processing in ASD (Baron-Cohen et al. 360). Similarly, decreased functional connectivity between the left amygdala and other nearby regions of the brain was also observed in individuals with ASD (Guo et al. 51). Autistic individuals were also observed to have an increased judgment time and lower level of response in the amygdala towards fear-related stimuli, as compared to age-matched controls. Thus, underdevelopment in the amygdala of neural systems and connections that subserve social and emotional capacities may be underlying certain social and cognitive deficits (South et al. 49). Autistic individuals also displayed slower judgment of standardized pictures of facial expressions, decreased face and eye fixation, and higher levels of impairment in social reciprocity, as compared to typically developing and age-matched controls (Nacewicz et al. 1426-1427). A study by Dziobek et al. reported that individuals with ASD showed less amygdala activation when inferring mental states from eyes compared to controls, and hence faced more difficulties and errors in a basic emotion recognition, social cognition, and theory of mind task (1893)

Although most literature report a decreased level of amygdala response and functional connectivity, some studies have reported the opposite. Some social and emotional deficits related to facial expressions, face and eye fixation, and social reciprocity in ASD are associated with exaggerated amygdala response (Nacewicz et al. 1424-1425). When shown pictures of faces, individuals with ASD showed less eye gaze towards the eye region of the faces: this reduced eye gaze was associated with higher threat ratings of neutral faces, which might have been due to an

abnormally elevated amygdala response (Tottenham et al. 112-113). When they were exposed to neutral facial expressions, individuals with ASD displayed significant levels of amygdala hyperarousal (Kleinhans et al. 470). Hence, amygdala hyperarousal may be a key contributing factor of ASD symptomatology, such as impairments in joint attention, eye gaze, responses to social and emotional stimuli, facial recognition, and perceiving emotions associated with facial expressions. Overall, abnormalities in amygdala response present itself at both extremes- hypoactivity and hyperactivity- and both forms of dysfunction contribute to ASD symptomatology differentially.

Discussion

Overall, several neuroimaging research has revealed amygdala abnormalities in children and adolescents with autism related to size, volume, functionality, and growth, which contribute to certain social cognition deficits of ASD differentially. Some MRI studies have measured the amygdala's size and volume in individuals with autism and healthy, age-matched controls (Baron-Cohen et al. 358-360), and also investigated how certain symptoms may be attributed by these structural differences (Dziobek et al. 1894, Nacewicz et al. 1421).
Most studies reported that smaller amygdalae in adolescents with ASD strongly correlated with cognitive and social deficits (Mosconi et al. 510), restrictive and repetitive behaviors (Dziobek et al. 1897), and impairments in assessment of emotional content and Theory of Mind (Baron-Cohen et al. 1894). However, autistic children were also found to have larger amygdalae as compared to those of typically developing controls (Schumann et al. 6392), which reflected certain ASD symptoms related to social cognition. There is a clear association between the amygdala's size in autistic individuals, and deficits in fundamental social, cognitive, and emotional concepts.

Although evidence depicts that the amygdala's abnormalities- both structural and functional- contribute to ASD symptomatology, the mechanism by which the amygdala is related to certain symptoms is still unclear. Structural neuroimaging studies reveal that larger amygdalae contribute to cognitive deficits in children with ASD, although, autistic adolescents that display similar symptoms have smaller amygdalae (Mosconi et al. 510). Simillary, many functional neuroimaging studies observed either hypoactivity or hyperactivity of the amygdala, in autistic individuals but not controls (Nacewicz et al. 1424-1425, Dziobek et al. 1893). Due to these

disparate findings, the underlying mechanism by which the amygdala's abnormalities contribute to certain ASD symptoms is still uncertain. Both types of neuroimaging studies (structural and functional) do not reveal conclusive findings, and not all studies provide the same correlation. It is unclear how and why the differences in functionality contribute to ASD symptoms differentially- however, findings related to structural and functional differences connote that the size and response levels are either below or above the normal, typical range.

These structural findings also helped elucidate the change in size that takes place from childhood to adolescence in individuals with autism. Unlike the growth of the amygdala that takes place in typically developing controls, the amygdala in autism grows to a larger size during childhood, and becomes smaller than normal during adolescence. Some fMRI studies have also dived deeper into the amygdala functioning and how abnormalities in amygdala response are associated with impairments in social cognition and emotional judgment (Baron-Cohen et al. 360). Several studies involving emotion recognition and Theory of Mind tasks provide insight into the dysfunction of the amygdala in ASD, and help form a relationship between amygdala response levels and a deficit in Theory of Mind (Dziobek et al. 1893-1897).

Some confounding findings, however, may be related to the methods of particular studies. When investigating changes in the structure of the amygdala in autism over a long period of time, from childhood to adolescence, it is important that the age ranges of the sample are consistent, since studies that may have used different age ranges might produce conflicting findings. A study that has an extremely wide age range, for instance, a sample that ranges from ages eight to 18, may observe different changes in amygdala size compared to a study that makes use of a restricted and narrow age range- for instance, a sample that ranges from ages 12 to 18. Different growth patterns or trajectories are observed throughout stages of development, and growth patterns therefore differ by the stage at which they are measured-hence, different developmental stages need to be taken into account. Therefore, findings from such studies with varying age ranges can not be compared effectively, and as a result, produce conflicting results. A majority of the studies surrounding the amygdala in autism have not investigated the impact of sex differences. It has been shown that amygdala size enlargement in females with autism is more significant compared with age and sex-matched controls, than in males with autism (Schumann et al. 944-945). Therefore, inconsistent findings may be attributed by the participant sex breakdown of the control groups and the ASD groups. The number of males and females in

each group may have influenced overall results, since the growth rate and functioning of the amygdala in females with autism may be different for that of males. The participant sex breakdown of the groups (both ASD and control groups) of the literature reviewed in this paper are inconsistent, and as a result might be contributing to some of the conflicting findings regarding overall growth of the amygdala over time. Studies that have split groups for males and females with ASD and controls, or those whose samples only consist of either males or females, may provide more accurate and consistent findings.

Another important factor to be considered while analyzing inconsistent findings, is the possibility of comorbidities in the sample. A study by Mosconi et al. did not observe a difference in the rate of amygdala growth for individuals with autism compared with controls. This finding is inconsistent with other findings that have reported a significant difference in the growth rate of the amygdala between individuals with ASD and controls. However, this may be because their control group consisted of a mixture of typically developing controls and children with developmental delays without autism- 22 typically developing children and 11 developmentally delayed children were a part of the control group, which totally consisted of 33 individuals (510-511). That being said, it is difficult to directly compare the study's findings with other similar studies, since the control group consists of an irregular sample. If samples were screened for comorbidities and other psychiatric conditions, it would reduce the risk of inconsistencies in similar studies.

There is also a lack of research investigating the full range of the spectrum disorder. Most of the studies reviewed in this paper have compared individuals with high functioning autism (HFA), with typically developing, age and sex-matched controls. Autism is a spectrum disorder, and thus, symptoms present at different levels of severity. Several studies have revealed significant differences between HFA (high functioning autism) and LFA (low functioning autism), on measures of cognition and executive dysfunction (Ehlers et al. 210). Furthermore, other studies have suggested that emotional and cognitive deficits may not be evident in autistic individuals with higher verbal ability, verbal IQ, and full scale IQ; possibly due to compensatory strategies (Prior et al. 596). These findings shed light onto the differences in the neuroanatomical underpinnings of HFA and LFA, and raise an important question- If the amygdala has shown to be associated with cognitive deficits and executive dysfunction in autism, would there be

structural and functional differences in the amygdala in individuals with HFA compared with LFA?

In summary, the amygdala in autistic individuals is abnormal- both structurally and functionally- and these abnormalities likely contribute to cognitive, social, and emotional deficits and impairments differentially in both children and adolescents. Neuroimaging research (both MRI and fMRI) sheds light onto the abnormal growth rate of the amygdala from childhood to adolescence, and most findings support the amygdala theory of autism (Baron-Cohen et al. 355-364), which states that the amygdala has a social function in autism, and abnormalities underlie certain symptoms. Ultimately, although these studies have provided new lines for understanding the neural mechanisms and underpinnings of autism, there is a lot of room for more amygdala-related research in ASD. Future research will need to investigate which of the thirteen amygdalar nuclei are impaired and abnormal, and which are not, to better understand the underpinnings of ASD symptomatology. Nearby brain regions may also be associated with the amygdala, such as the hippocampus and orbitofrontal cortex. Exploring the connectivity between the amygdala and these brain regions or structures may also help explain the amygdala's function in ASD symptomatology, and the neural network underlying cognitive deficits in autism. There is also a need for more advanced and precise technology for neuroimaging, since current technology may not be sensitive enough to capture small changes in size and volume in the amygdala and its nearby regions, as well as miniscule changes in activity and response levels. This research may help to understand the neuropathology of the autistic brain and the etiology and underpinnings of certain symptoms; hence, findings can help to inform targets for medication, and can be implemented in treatment interventions and therapies.

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Using Deep Learning to Calculate the Effectiveness of Aerial Dispersants on Varying Chemical Compositions of BAL 150 Asphaltenes by Ishan Chawla

Abstract

Chemical dispersants were designed to treat traditional crude oil during an oil spill disaster such as Deep Water Horizon (DWH); surface oil, however, commonly gets photo-oxidized, making dispersants ineffective, magnifying the dangers posed to ocean water and the marine ecosystem. A deep neural network (DNN) can predict whether dispersants will be effective on the given oil, based on the chemical composition of the BAL 150 asphaltenes, with 95.45% accuracy. Chemical changes in the asphaltenes, rather than structural or environmental changes, result in greater insolubility, resulting in less effective dispersals. Upon closer inspection, five compounds were found to significantly impact the crude oil's solubility: methanol, triethylamine, chloroform, ether, and ethanol. Specifically, ethanol was found to significantly impact the chemicals in crude oil, even reversing the outcome of some solutions. The following paper provides greater insight into the photo-oxidized oil's differences and chemicals that drive resistance to dispersants, providing a greater understanding of crude oils, allowing researchers to develop more effective dispersants.

Introduction

Approximately twelve years ago, the Deepwater Horizon Oil Rig collapsed in the Gulf of Mexico, releasing almost 134 million gallons of oil [15] onto the ocean's surface and along the ocean floor over 87 days [8]. BP and private companies applied 972,880 gallons of dispersants to the ocean's surface, with a similar amount applied to the ocean floor. Clean-up costs are estimated to be around one billion dollars. The response to this incident was also prolonged, with some supplies not coming until two months after the collapse. At this time, individuals agreed that chemical dispersants would still reduce interfacial tensions between the oil and water, allowing the oil to form droplets that disperse along the water column and are subject to dissolution, volatilization, sedimentation, and microbial degradation, leaving ocean water and the marine ecosystem relatively clean. This dispersal, however, did not occur. Instead, the dispersants were ineffective, allowing oil to remain at this location today. As a result, scientists theorized insoluble oil to be directly caused by an abundance of microbial degradation. Recently,

however, many studies refute this claim. Instead, these researchers theorize that microbial degradation is not an important factor in crude oil's insoluble characteristics; instead, photo-oxidation is the sole contributor to crude oil's insoluble characteristics [14].

Photo-oxidation, the deterioration of a surface due to light and oxygen, is now believed by many to be the leading cause of crude oil's insoluble characteristics over time. These studies, however, do not explain the differences in photo-oxidized crude oil or its key components. Little is also known about the significance of chemical or structural changes in photo-oxidized asphaltenes, dense structures of hydrocarbons found in heavy distillations of crude oil [1]. The purpose of this paper is to (i) identify chemical changes between components in soluble and insoluble crude oil, (ii) compare these changes with solubility over time to determine a possible relationship between both characteristics, and (iii) characterize the chemical structure and its relation to solubility.

Materials & Methods

Photo-oxidized BAL 150 asphaltenes were studied to determine the root cause of their insoluble properties. A linear regression model was used to find missing, in-between values in the dataset. Datasets containing information about crude oil's solubility over time were also studied. A deep neural network (DNN) was created to find a correlation between solubility and the new variable, ultimately determining a relationship between chemical composition and solubility over all other variables. A change in the chemical composition of asphaltenes was the only changed variable that proved to be correlated with solubility and dispersant resistance.

The deep neural network was created to find a relation between the mass of the compounds comprising asphaltenes and the solubility of the crude oil. The DNN takes in eleven input variables: hexane, hexane/toluene, chloroform, chloroform/ether, ether/ethanol, methanol, ethanol/chloroform, ethanol/THF, ethanol/pyridine, pyridine, and triethylamine mass composition in asphaltenes. Each variable had 22 mass values over 140 days. Each percent of solubility effectiveness, from 68-90, was accompanied by one mass value of 11 compounds.

The DNN stored input and output variables in a 2D array and had four layers. The first layer was an input block with twelve nodes: eleven variables and one output binary value. The second and third layers were used as neural network layers with eleven nodes, using the ReLU

activation function. Finally, the fourth layer, the output layer, had one node to output the binary value of each asphaltene composition.

New values were found between provided values by a simple linear regression model to feed more training values into the model. All data points were multiplied by a constant to allow the model to analyze the data and make predictions with more accuracy. This DNN was also trained through around 150 epochs to prevent overfitting on small batch sizes. As the model had 11 x values and one output y value (using the sigmoid function), binary cross-entropy allowed the DNN to train on a limited number of data values. A simple 1, effective dispersant use or a 0, ineffective dispersant use was all the DNN would output [4]. Dispersant effectiveness was measured with an 80% or greater dispersal of oil. While analyzing asphaltene composition and these values, the model could predict whether chemical dispersants would be effective on the given crude oil sample. After training, the DNN achieved a remarkable 95.45% accuracy.

$$\text{Log loss} = \frac{1}{N} \sum_{i=1}^{N} -\left(y_i * \log(p_i) + (1-y_i) * \log(1-p_i) \right)$$

This Binary Cross Entropy Function uses the Log computation to show differences between predicted and corrected probabilities. This function is similar to the one used, except pi represents the "1" and 1-pi represents the "0". Class one uses the beginning of the formula, while class 0 uses the end, calculating the binary cross-entropy [7].

Results

The DNN's 95% accuracy proved a strong correlation between the chemical composition of BAL 150 asphaltenes and the crude oil's ability to disperse upon treatment. This proves that photo-oxidation, rather than causing a direct structural change or environmental change, causes the compounds in asphaltenes to either bind or dissolve in other parts of the crude oil.

	Hexane	Hexane/Toluene	Chlorof-orm	Chlorof-orm/ether	ether/eth-anol	Meth-a-nol	ethanol/chloro-form	ethanol/THF	ethanol/pyridine	pyridine	triethyla-mine

90%	1.500	0.500	32.400	20.200	2.800	2.800	9.500	4.500	4.300	1.600	1.000
89%	1.240	0.440	33.060	19.960	2.780	2.920	8.440	4.660	4.380	1.660	1.060
88%	0.980	0.380	33.720	19.720	2.760	3.040	7.380	4.820	4.460	1.720	1.120
87%	0.720	0.320	34.380	19.480	2.740	3.160	6.320	4.980	4.540	1.780	1.180
86%	0.460	0.260	35.040	19.240	2.720	3.280	5.260	5.140	4.620	1.840	1.240
85%	0.200	0.200	35.700	19.000	2.700	3.400	4.200	5.300	4.700	1.900	1.300
84%	0.331	0.231	35.762	19.015	2.677	3.408	4.207	5.276	4.715	1.876	1.276
83%	0.461	0.261	35.823	19.031	2.654	3.415	4.215	5.253	4.731	1.853	1.253
82%	0.592	0.292	35.884	19.046	2.631	3.423	4.223	5.230	4.746	1.830	1.230
81%	0.723	0.323	35.946	19.061	2.608	3.430	4.230	5.207	4.762	1.807	1.207
80%	0.854	0.354	36.007	19.076	2.585	3.438	4.238	5.184	4.777	1.784	1.184
79%	0.984	0.384	36.069	19.092	2.562	3.446	4.246	5.161	4.792	1.761	1.161
78%	1.115	0.415	36.130	19.107	2.538	3.454	4.253	5.138	4.807	1.738	1.138
77%	1.246	0.446	36.192	19.123	2.515	3.461	4.261	5.115	4.823	1.715	1.115
76%	1.376	0.476	36.253	19.138	2.492	3.469	4.269	5.092	4.838	1.692	1.092
75%	1.507	0.507	36.315	19.153	2.469	3.476	4.276	5.069	4.853	1.669	1.069
74%	1.638	0.538	36.376	19.169	2.446	3.484	4.284	5.046	4.869	1.646	1.046
73%	1.768	0.568	36.438	19.184	2.423	3.492	4.292	5.023	4.884	1.623	1.023
72%	1.900	0.600	36.500	19.200	2.400	3.500	4.300	5.000	4.900	1.600	1.000
71%	1.867	0.600	35.000	19.067	2.333	4.833	4.233	5.100	4.766	1.633	1.366

70%	1.834	0.600	33.506	18.933	2.267	6.166	4.167	5.200	4.633	1.666	1.733
69%	1.800	0.600	32.010	18.800	2.200	7.500	4.100	5.300	4.500	1.700	2.100

Table I. The mass of all compounds in BAL 150 asphaltenes change with dispersant effectiveness.

Photo-oxidation is the direct cause of the decreasing effectiveness of aerial dispersants on crude oil. In addition, chemical composition mass changes are the result of photo-oxidation. Table I [2] shows the compounds' breakdown of asphaltenes, the data fed into the DNN, proving strong correlations between composition and dispersal effectiveness. Although the model's training cannot be directly observed due to machine learning's inherent lack of explainability, many compounds were likely to have multiplication factors of 0. These have no significant changes or increase and decrease with seemingly no relation to dispersal effectiveness.

Some compounds, including hexane, hexane/toluene, and chloroform alone, were unrelated to dispersant effectiveness. Other compounds' abundance was likely directly proportional to dispersal effectiveness. Solutions of chloroform/ether were directly correlated to greater dispersal effectiveness, likely increasing the solubility of the asphaltenes; solutions of ether/ethanol and solutions of ethanol/chloroform also had similar results. On the other hand, methanol had an inverse relationship with dispersal effectiveness. There were approximately 2.8 grams of methanol when the dispersants were 90% effective and approximately 7.5 grams when the dispersants were only 69% effective.

Discussion

BAL 150 asphaltenes, however, cannot be oversimplified into heterogeneous compounds; they are complex structures, dictating many of crude oil's properties. Asphaltenes are the most refractory component of crude oil, making its changes an ideal gauge of photo-oxidation (SD). This compound can also measure the amount of oil lost in a spill, while other measures overlap in their resulting characteristics. These compounds form when at least 40 volumes of alkanes are added during the conversion process. Asphaltenes have the lamellae orientation and are macromolecules resulting from the condensation of various types of nuclei. Although the weight can vary, the shape remains constant as linked bridges alkyl, sulfur, and oxygen. The polycyclic

sheets are cross-linked with these bridges and can trap aliphatic hydrocarbons. These sheets form the micelles that disperse among the crude oil's hydrocarbons and resins [2].

Asphaltenes also negatively impact the economic value of crude oil due to their physical characteristics and tendency to flocculate. This compound exists in a solid state and can inhibit the flow of refined petroleum. Asphaltene content can range from 0% to 40%, and as this happens, the crude oil thickens, becoming denser and darkening the oil's color. If enough asphaltenes are present in the crude oil, it can have properties similar to solids such as coal and other brittle minerals. Photo-oxidized oil also contains a greater quantity of asphaltenes. Well-head oils typically contain 0.9% to 1.0% asphaltenes, while photo-oxidized oil can contain 7% to 23% [5].

While liquid and gas components of crude oil are treated as chemicals, such as methane, propane, or ethane, asphaltenes are not typically identified by their chemical composition. Instead, asphaltenes are typically defined by solubility characteristics. In an oilfield setting, large solids mainly composed of n-heptane, straight-chain alkanes consisting of carbon and hydrogen that separate from crude oil are commonly referred to as asphaltenes. Undersaturated oil, oils high in gas, initially contain a low asphaltene concentration. This, however, changes during refinement and production; the crude oil is highly compressible and experiences a significant reduction in pressure. This increases density, causing the straight-chain alkanes to form by flocculating [2].

During production, the temperature and pressure of the crude oil drop below a certain bubble point, and dissolved gas will increase the asphaltenes' solubility by separating from the oil. In contrast, asphaltene formation occurs reversely: when the internal pressure exceeds the bubble point's pressure. From production, the asphaltenes, according to the Yen-Mullins Model, can be separated into three distinct groups. The first group is whole asphaltene molecules, found in only low concentrations in the most volatile oils. The second group consists of nanoaggregates of asphaltene molecules. These nanoaggregates are amphiphilic block copolymers and can be found in higher concentrations of black oils. The final group is simply clusters of the nanoaggregates, typically resulting in unique characteristics like the ability to flocculate. These are often found in the highest concentrations due to their attractive nature. The Yen-Mullins Model estimates the properties of asphaltenes, ultimately showing asphaltene predictions based on the crude oil [6].

Upon photo-oxidation, asphaltenes significantly change in chemical composition. Other studies have concluded that, In simulated light for roughly 23 hours, carbonyl groups increased from <1% to over 3% mass composition. Viscosity also increased nearly seven-fold, while density had a slight increase. This study concluded that photo-oxidation caused a four-times larger decrease in dispersion effectiveness than evaporation. Light exposure had a steep linear relationship with dispersant effectiveness. The difference in viscosity proves that the differences in solubility are accredited to a change in chemical composition [14].

Solutions containing two compounds were the only proportions of the BAL 150 asphaltenes' chemical composition, resulting in a directly proportional relationship with dispersal effectiveness. An increase in a solution never resulted in a decrease in dispersion effectiveness. Only five out of the eleven samples tested impacted dispersion.

Compound	Effect	Relative Percent Change	Absolute Mass Change
Chloroform/Ether	Directly Proportional to Dispersant Effectiveness	-6.931%	-1.4 g
Ether/Ethanol	Directly Proportional to Dispersant Effectiveness	-21.429%	-.6 g
Ethanol/Chloroform	Directly Proportional to Dispersant Effectiveness	+56.843%	+5.4 g
Methanol	Inversely Proportional to Dispersant Effectiveness	+167.857%	+4.7 g
Triethylamine	Inversely	+110.000%	+1,1 g

	Proportional to Dispersant Effectiveness		

Table II. Five compounds seem to be related to an increase or decrease in dispersal effectiveness.

Methanol had the most significant percent change as the asphaltenes were photo-oxidized, decreasing solubility. This compound was also inversely proportional to dispersal effectiveness, meaning that the compound inhibited solubility. Methanol, CH3OH, is a simple methyl attached to an alcohol group but is a highly flammable compound with twice the mass of water [12]. Triethylamine is another compound that produces a decrease in solubility. Its chemical formula is $C_6H_{15}N$, ammonia with an ethyl group replacing a hydrogen atom. Like methanol, triethylamine is soluble in water and miscible in common organic solvents, including acetone, ethanol, diethyl ether, methanol, and chloroform [13].

Other compounds which produce a change in dispersal effectiveness are combinations of other compounds. For example, chloroform, $CHCL_3$, present in two compounds, is a byproduct of chlorinated water; this compound is much denser than and primarily insoluble in water [9]. This compound is combined in two solutions with ether and ethanol, respectively. Ether, an aprotic solvent, is the byproduct of the condensation of alcohols. It is also less dense than water and primarily insoluble in water [11]. Ethanol, on the other hand, does not follow this pattern. Instead, it is a polar solvent miscible in water, meaning it is soluble regardless of the proportion. Ethanol's chemical structure is ethane with a hydroxyl group substituted for a hydrogen atom: C_2H_6O. It is also a highly flammable drug used in many medical compounds such as hydrogen peroxide, ammonium chloride, and isopropyl alcohol [10].

Methanol, triethylamine, chloroform, ether, and ethanol, are present in the liquid state. Crude oil, however, is commonly around 500 degrees Fahrenheit when produced and refined, past these compounds' boiling point. In the gaseous phase, compounds dissolved in water become less soluble with an increased temperature. Conversely, compounds dissolved in organic solvents become more soluble with an increased temperature. Increasing pressure increases solubility; however, this is a constant value, trifling this factor. These solubility rules remain

constant with the chemical findings of which compounds are soluble and produce a direct relationship between their presence and solubility [3].

Methanol, triethylamine, and ethanol/chloroform inhibited the crude oil's solubility and the dispersal's effectiveness. Conversely, chloroform/ether and ether/ethanol's presence in the BAL 150 asphaltenes increased the solubility of the crude oil. Ethanol was present in both groups and is a soluble compound, meaning the ether was most likely the most insoluble compound. The chloroform is also insoluble; however, the ethanol's solubility made it a helpful solution when exposed to chemical dispersals. This means that the ethanol was a strong chemical and would be helpful in future aerial dispersals. Although an atom-by-atom observation is not available of the BAL 150 asphaltenes, it is possible that the sunlight provided enough energy and began the endothermic process of breaking the chloroform's bonds. An exothermic process began, where chloroform's carbon and hydrogen atoms bonded to create more ethanol, while the chlorine atoms remained in the oil in a diatomic state.

Conclusion

These findings provide greater insight into crude oil's solubility change when photo-oxidized. Past findings have concluded that photo-oxidation is responsible for the solubility change in crude oil. This project was able to prove a correlation between the chemical composition of the asphaltenes and the crude oils' solubility,

The compounds' properties were found to have correlations between the given data, unlocking new insights into the nature of crude oil and asphaltenes. Ultimately, this research project aims to provide insight into creating better dispersals. Ethanol and methanol showed that these compounds could be used in the subsequent chemical dispersals on photo-oxidized crude oil. In the future, a simple composition test could be done to find the extent to which the oil has been photo-oxidized and which chemical dispersant would be the most efficient, saving billions of dollars on clean-up costs and mitigating the disastrous effects oil spills have on ocean water and marine life.

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