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# **Long-Term COVID-19 Neurological Symptoms: A Review of Epidemiology, Pathophysiology, and Treatment by Jasleen Grewal**

## **Abstract**

The World Health Organization (WHO) announced the discovery of a novel coronavirus, called COVID-19, in Wuhan, a central city in China, on January 10, 2020. Additionally, COVID-19 has been known to lead to many neurological dysfunctions including anosmia, dysgeusia, stroke, anxiety, depression, and memory loss/brain fog. Here we highlight neurological complications related to COVID-19 infection and cover epidemiology, current understood pathophysiology, and treatment options available.

## **Introduction**

The World Health Organization (WHO) announced the discovery of a novel coronavirus, called COVID-19, in Wuhan, a central city in China, on January 10, 2020. This virus spread throughout the world and became a global pandemic. It is a very contagious and harmful virus that has similar symptoms to a cold, flu, or pneumonia but can lead to hospitalization and death. Schools were forced to convert to online learning in many areas which in the following years led to a shortage of teachers. Many people lost their jobs and homes, there was less social interaction as everyone was forced to stay home, and only go out wearing a mask. In the long run, this affected the mental and social well-being of individuals. As of December 2022, there have been 645 million cases and 6.6 million deaths.[\[40\]](#) In the United States, there are 4 approved vaccines which include Pfizer-BioNTech and Moderna COVID-19 which are mRNA vaccines.[\[38\]](#) There is also the Novavax COVID-19 which is a protein subunit vaccine. Lastly, there is Johnson & Johnson's Janssen, a viral vector vaccine that may be administered in certain circumstances. The Novavax vaccination was 100% effective against moderate and severe disease and 90% effective against lab-confirmed, symptomatic infection before the Omicron variant. By 14 days following immunization, the Johnson & Johnson vaccine had a 67% efficiency in avoiding moderate to severe/critical illness and a 66% efficiency by 28 days. 95% efficiency was displayed by Moderna. Pfizer-BioNTech also demonstrated 95% efficiency, however real-world effectiveness for adults demonstrates that the protection from the mRNA two-dose primary series wanes with time. [\[17\]](#) A booster dosage (for eligible individuals) restores the immune function to resilient

levels. Risk factors for severe COVID-19 can include asthma, old age, obesity, diabetes, and people who are immunocompromised.[\[39\]](#) The percent range of asymptomatic infection is between 9-36%. More asymptomatic infections were seen in younger individuals. 50-70% of individuals have a cough and/or fever in COVID-19.[\[19\]](#)

Additionally, COVID-19 has been known to lead to many neurological dysfunctions including anosmia, dysgeusia, stroke, anxiety, depression, and memory loss/brain fog. This review paper will highlight neurological complications related to COVID-19 infection and will cover epidemiology, current understood pathophysiology, and treatment options available.

### **Anosmia and Dysgeusia**

Anosmia and dysgeusia are very common acute COVID-19 symptoms affecting approximately 83% and 89% respectively. The majority of people regain their sense of taste and smell within six weeks. Paderno et. al. reported that 87% of patients with anosmia recovered and 82% with dysgeusia recovered. [\[29\]](#) Unfortunately, some people also have anosmia and dysgeusia as long-term lingering symptoms. 8-16% of people have anosmia and 6-14% have dysgeusia 3 months after the onset of COVID-19. [\[30\]](#) These symptoms occur for 3 months in most patients after which they regain their sense. But, in some patients, they persist even after 5 months after which they are less likely to recover. [\[30\]](#) Risk factors of anosmia and dysgeusia include current smokers, histories of allergies, particularly respiratory allergies, and hospitalization.[\[13\]](#) There are theories linking low zinc levels to anosmia and dysgeusia, however further clinical studies are needed to fully evaluate these theories. [\[18\]](#)

The mechanism behind anosmia and dysgeusia is still under investigation however several studies point to potential underlying pathophysiology. Based on an MRI study, COVID-19-infected patients showed a complete obstruction and edema of the olfactory clefts but recovered after a month shown through the improvement of their olfactory score. [\[10\]](#) Anosmia occurs due to nasal obstruction and rhinorrhea, cytokine storm, a substantial injury to olfactory receptor neurons, disability of the olfactory perception, and in some rare cases olfactory cleft syndrome.[\[4\]](#) Since the olfactory epithelium exhibits a notably high amount of ACE2 receptor expression, inflammation in this region may be one of the primary causes of anosmia. [\[28\]](#) Direct toxicity to taste buds or the olfactory epithelium, as well as peripheral neurotropism, are the most likely causes of transitory dysgeusia in COVID-19. Other elements, such as a flaw in the

quantity and quality of saliva, pro-inflammatory cytokines, angiotensin II buildup, systemic illnesses, hypozincemia, and excessive chemical usage, may also contribute to dysgeusia.[27] Khani et. al. reported novel COVID-19 strains that engage with the ACE-2 (angiotensin-converting-enzyme) receptors found on taste buds and sustentacular cells directly harm the gustatory and olfactory systems. Other suggested processes include the virus's infiltration of the olfactory neurons and the subsequent local inflammation. Therefore, neuroprotective, anti-inflammatory, or depolarizing medications may be helpful for COVID-19 individuals who have lost their sense of smell or taste, but additional clinical trials are required.

Corticosteroids have been studied the most among the various drugs mentioned in COVID-19. It should be understood, though, that using systemic corticosteroids to treat SARS-CoV-2-mediated olfactory and gustatory dysfunctions may carry extra hazards and may slow the body's ability to rid itself of the virus. Singh et. al. reported that the utilization of steroids like fluticasone nasal spray and triamcinolone medicine assists in recovery within a week for anosmia and dysgeusia. [33] Olfactory exercises, intranasal or oral corticosteroids, and intranasal sodium citrate are all possible treatments. Tissue engineering and stem cell therapy are two of the innovative therapeutic approaches that are now being researched and developed.[28] One technique for assisting olfactory sense recovery is smell training, which utilizes eucalyptus, lemon, rose, and clove essential oils. Even though evidence shows that they enhance recovery, there are superior compounds for expediting recovery. Numerous phytochemicals have bioactive qualities that have anti-viral and anti-inflammatory impacts. [21] Given that the neuronal pathway plays a role in COVID-19-induced anosmia and/or ageusia, neuroprotective medications like intranasal vitamin A, intranasal insulin, omega-3, statins, minocycline, and melatonin may be able to help patients with persistent anosmia by encouraging the regeneration of the olfactory receptor neurons.[18]

### **Arterial Ischemic Stroke**

Stroke was shown to be a rare but potentially fatal COVID-19 consequence, involving 1-3% of hospitalized patients and up to 6% of those in the intensive care unit (ICU). Males account for roughly 62% of those that develop strokes during COVID-19 since they are more likely to experience severe COVID-19 symptoms during ICU admission. Rarely was a stroke the initial symptom; instead, most instances showed up within 21 days from COVID-19 onset after

respiratory symptoms.[35] In a study of COVID-19 patients with arterial ischemic stroke (AIS), Beyrouti et. al. revealed that the AIS developed 8 to 24 days after the onset of COVID-19 symptoms. These patients had significantly higher levels of lactate dehydrogenase (LDH), fibrinogen, D-dimer, and C-reactive protein in their laboratory tests.[3]

Although the pathophysiology and ideal management of ischemic stroke linked with COVID-19 are still unknown, recent statistics suggest cytokine storm-induced endotheliopathy and coagulopathy as potential targetable mechanisms. [35] Systemic hypercoagulability brought on by COVID-19 results in high levels of D-dimer, fibrinogen, low platelet count, and prolonged coagulation time which are triggers for ischemic strokes. Some studies have therefore hypothesized that COVID-19 causes ischemic stroke by encouraging a hypercoagulable state in affected patients. Patients with severe COVID-19 are more likely to have an arterial ischemic stroke(AIS). [37] Li et al reported COVID-19 in the cerebrospinal fluid (CSF) of patients, alluding to the possibility that this particular virus can cross the blood-brain barrier (BBB) and impair brain tissue. [23] Of note, Oxley et al. found cases of secondary AIS in young COVID-19 patients, some of whom did not have stroke risk factors or elevated levels of D-dimer and fibrinogen.

The majority of individuals had significant vascular risk factors already present, including hypertension and diabetes mellitus. Race and ethnicity are critical risk factors for COVID-19 strokes. This is a result of the prevalence of cardiovascular risk factors in some particular ethnic groups. In one study of 7868 individuals hospitalized with COVID-19, Black patients had the highest rates of obesity, hypertension, and diabetes. Due to these variables, individuals with COVID-19-related stroke are more likely to be from one ethnic group than another. In a recent research of 83 instances, 47% of the patients were Black, 28% Hispanic, and 16% White. In cases of young individuals with stroke, it is often seen that they have large-vessel occlusion. These risk factors are seen more as triggers than independent causes. [35]

According to studies, heparin anticoagulant medication can significantly lower mortality rates of hospitalized COVID-19 patients. Standard anticoagulation therapies like tissue plasminogen activators, thrombolytics, statins, aspirin, and clopidogrel can reduce hypercoagulability in patients with AIS and can be used for COVID positive patients. Prophylactic anticoagulation is advised for patients with D-dimer levels below 1,000 (ng/ml), according to Ouderkerk et al. Therapeutic anticoagulation is advised for patients whose D-dimer



levels are >1,000 (ng/ml) and who also experience progressive D-dimer level increases. Targeting cytokines in COVID-19 patients has become an unavoidable trend because of their critical involvement in causing tissue damage and a hypercoagulable state. These therapies are still being researched and need to be further improved to increase the efficiency in reducing mortality rates and hypercoagulability.[\[37\]](#)

### **Anxiety and Depression**

According to the COVID-19 Mental Disorders Collaborators, in 2020 the pandemic caused a 27.6% increase in cases of major depressive disorders and a 25.6% increase in cases of anxiety disorders worldwide.[\[8\]](#) Deng et al. found 45% depression and 47% anxiety in 31 studies.[\[9\]](#) Anxiety and depression are introduced during COVID-19 and are established post-COVID-19. The odds of depression and anxiety are elongated by COVID-19. Schou et al. reported decreased anxiety at the 1 to 3 months follow up however, it was significantly higher in survivors of COVID-19 compared to non-COVID-19 patients. Additionally, Mazza et al. discovered that at the 3-month follow-up, depression symptoms persisted whereas anxiety had reduced at this point.[\[32\]](#)

The increased cytokine levels seen in COVID-19 patients have been directly linked to lung inflammation and malfunction as well as the emergence of psychiatric disorders, both peripherally and centrally. This connection has already been made in the context of acute COVID-19 patients, where it was discovered that participants who had depression and/or anxiety symptoms tended to have higher levels of the cytokines, specifically interleukin (IL-1 $\beta$ ), than COVID-19 patients who did not show depression/anxiety symptoms. It was also revealed that although women had lower levels of inflammatory markers at baseline, they still experienced anxiety and depression. Therefore further research into the role of inflammatory cytokines and depression/anxiety needs to be conducted in the context of COVID-19 and other diseases. At follow-up, baseline systemic immune-inflammation index (SII) values were positively correlated with depression and anxiety scores.[\[32\]](#) It has been demonstrated that the SII, a composite indicator incorporating platelet, neutrophil, and lymphocyte counts, is a significant prognostic predictor for a number of diseases. This implies that the severity of the depression psychopathology at the three-month follow-up can be predicted by the systemic inflammatory response at admission. Similar to other diseases, the authors also reported that female sex and

prior psychiatric history were indicators of depression and anxiety. COVID-19 can damage endothelial cells by entering through ACE2 receptors, causing inflammation, thrombi, and brain trauma. Additionally, systemic inflammation results in a reduction in neurotrophic factors as well as the formation of reactive microglia, which raises glutamate levels as well as N-methyl-d-aspartate (NMDA) leading to excitotoxicity. The emergence of anxiety and depression is presumably accompanied by this increased inflammatory response. [32]

Risk factors of anxiety and depression in COVID-19 include isolation, quarantine, previous definitive psychiatric diagnosis/disease, hospitalization in the ICU, use of mechanical ventilation, requiring stay in the ICU, pregnancy, etc. This is rarely seen as a severe symptom and is treatable by seeing a psychiatrist or therapist. They would be treated as normal depression and anxiety patients. [9]

### **Memory Loss/Brain Fog**

Cognitive dysfunction and memory loss have been reported in up to 70% of Long COVID-19 patients. Guo et. al. revealed that 77.8% of participants had trouble focusing, 69% had brain fog, 67.5% had forgetfulness, 59.5% had trouble identifying words, and 43.7% had semantic disfluency (speaking or typing an incorrect word). Guo et al. conducted a study and discovered that the presence of neurological symptoms resembling chronic fatigue during the first three weeks substantially predicted the presence of cognitive symptoms later in the future illness. Patients who reported neurological symptoms performed poorly in terms of executive function, memory, and attention, indicating some correlation between symptomatology and the degree of cognitive loss. [15] In COVID-19 patients who were not hospitalized, Graham et al. documented neurological symptoms that persisted for at least 6 weeks following system onset. [14] Seven out of ten individuals with acute COVID-19 infection experience persistent cognitive symptoms for months after the infection, including memory loss, concentration problems, and brain fog. [25]

An Oxford University study has discovered that COVID-19 can cause brain shrinkage by diminishing grey matter in the areas that control emotion and memory. [5] In the orbitofrontal cortex and parahippocampal gyrus, regions connected to the sense of smell, COVID-19 caused a higher loss of gray matter thickness. It also caused a greater reduction in whole-brain volume and an increase in cerebrospinal fluid volume. Additionally, there has been a generalized loss in the

capacity for complicated activities, which on brain scans was linked to atrophy in the crus II region of the cerebellum, a region linked to cognition. [1] The exact mechanisms producing these cognitive deficiencies require more research, however, they most likely involve one or more of the following. They may be brought on by immunological response, neuroinflammation, or even a direct viral invasion of brain cells. Normally, the parasympathetic (PNS) and sympathetic (SNS) nerve systems collaborate to enable your body to react quickly to environmental changes. Long-term COVID-19, however, upsets this equilibrium and results in symptoms like inability to exercise, headaches, blood pressure changes, urine incontinence, heart palpitations, breathing difficulties, brain fog, and memory issues. Even while it is unclear how exactly autonomic nerve system (ANS) dysfunction in long COVID-19 patients results in memory loss, certain research indicates that the ANS is crucial for memory consolidation during sleep and for enhancing working memory. [26]

A neurovascular coupling malfunction can happen after a COVID infection, in which case several brain regions struggle to carry out their activities because they no longer obtain the resources they require. Patients may experience different sorts of physical and cognitive impairments depending on which areas are impacted. Forgetfulness and a decrease in executive function, for instance, are influenced by vascular abnormalities in the hippocampus. Due to this, different types of memories may be challenging for patients to process and retrieve. When a patient has COVID-19, their bodies launch an immunological reaction that draws immune cells to the location of the viral attack to combat the invasive virus. This is a common reaction; in most people, so the immune system settles down after a few days. Unfortunately, this reaction could spiral out of control and cause a hyperinflammatory reaction throughout the body. There is some indication from the evidence that this excessive response may be the cause of working memory and consolidation memory issues in patients with protracted COVID-19. [2]

Long COVID-19 can lead to sleep disturbances in some patients, which can result in memory problems. Memory consolidation is hampered by poor sleep as it throws off sleep cycles. Additionally, studies have shown that those who lack sleep are more prone to creating false memories and have weaker working and visual-spatial memory. [24] [31] Your brain may indicate increased sympathetic nervous system activity when you concentrate, which causes a temporary increase in breathing rates. Under normal conditions, the parasympathetic nervous system restores regular breathing rates. However, the sympathetic branch may continue to

predominate in patients with protracted COVID-19. When it comes to cognitive function, poorer performance in memory and attention are linked to, both increased sympathetic activity and decreased parasympathetic activity. [\[25\]](#) [\[12\]](#)

In order to improve memory issues, you can undergo a series of multidisciplinary cognitive therapies. Some therapies, such as cognitive, sensorimotor, neuromuscular, and visual therapy, to name a few, are combined with aerobic exercise. Combining these treatments will aid in your body's recovery from COVID-19's residual effects. By facilitating the flow of oxygen to the brain, diaphragmatic breathing can also enhance focus and memory. A deep inhalation via the nose while concentrating on using the diaphragm is followed by a gradual exhalation while practicing the diaphragmatic breathing technique. The body can slow its breathing down and activate the parasympathetic nervous system by breathing more effectively. Some home remedies for memory loss are to include physical exercise in your daily routine, challenge your brain with logic puzzles or strategy board games, socialize frequently, get enough sleep, lower your stress levels, have your vitamin levels checked, identify and treat other health issues, follow a healthy diet, and get enough sleep. [\[25\]](#)

## **Conclusion**

Long-term neurological symptoms of COVID-19 include anosmia and dysgeusia, anxiety and depression, stroke, and memory loss. These symptoms occur in almost 20% of COVID-19 patients and can last for over 6 months after the infection has been cleared. While the pathophysiology of these symptoms is still under active investigation, potential mechanisms of these long symptoms include damage to ACE2 receptors in the olfactory epithelium causing anosmia, peripheral neurotropism leading to dysgeusia, cytokine storm-induced endotheliopathy and coagulopathy as potential targetable pathways for ischemic stroke, and memory loss secondary to COVID-19 induced brain atrophy and inflammation. Anxiety and depression may occur through direct and indirect consequences of COVID-19 including social isolation during periods of quarantine. There are few established treatments for these long-term neurological side effects of COVID-19, namely high-risk patients should be placed on prophylactic heparin during the course of the disease.

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# **The Effect of Barometric Pressure and Atmospheric Temperature on Cosmic Rays By Luke Wang**

## **Abstract**

This study aims to analyse the effect of barometric pressure and atmospheric pressure on extraterrestrial cosmic rays. In the next 100 years, humanity is anticipated to make breakthroughs in space travel. Space travel is full of prospects and opportunities. However, a journey through space requires thorough planning, including considering associated risks, such as cosmic radiation (Mars, 2018). Radiation in space comes primarily from cosmic rays with ionising effects, where prolonged exposure is proven to be associated with neurological health risks and carcinogenic (Di Trolio R. et al., 2015). Among other influencing factors, it is known that the atmosphere significantly impacts the rate of cosmic ray arrival (Analysis of cosmic rays' atmospheric effects..., 2019). Understanding how the atmosphere affects cosmic rays allows for more accurate predictions of radiation levels that astronauts and equipment are exposed to in space.

Single event upsets (SEUs) are errors, loss of data or irreparable damage that occur when high-energy particles such as cosmic rays collide with transistors within electronic devices (Single event effects, 2021). Information on how atmospheric pressure affects cosmic rays can enable new designs for radiation-resistant components or incorporated shielding.

Aside from space travel, the results of this study could be applied in a clinical setting, as cosmic rays and resultant extended air showers (EAS) have ionising effects, and exposure elevates health risks (Di Trolio R. et al., 2015). Though the effects of cosmic rays below altitudes of 7620m are negligible, this study would be helpful to individuals continually in the troposphere (around 12-18km up), such as aircraft pilots (Bagshaw M. et al., 2019).

Keywords: Extraterrestrial cosmic rays, barometric pressure

## **Introduction**

Cosmic rays are high-energy particles such as protons and atomic nuclei of extraterrestrial origin (Mcellin, M., n.d.). Ultra High Energy Cosmic Rays (UHECRs) with energies of  $1.0E+16eV$  or more are of extra-galactic origins, receiving energy from “cosmic

accelerators” such as magnetic fields from compact objects like neutron stars or shockwaves from supernovae (K. van Dam et al., 2020).

When a primary cosmic ray incidences the upper atmosphere, it inelastically collides into atomic nuclei in air molecules to produce energetic hadrons, which swiftly decay into secondary particles and electromagnetic radiation. Secondary particles with sufficient energy will continue to generate new particles through further collisions. This extensive cascade of ionised particles and electromagnetic radiation to ground level is an extended air shower (EAS) (P. K.F. Grieder, 2001).

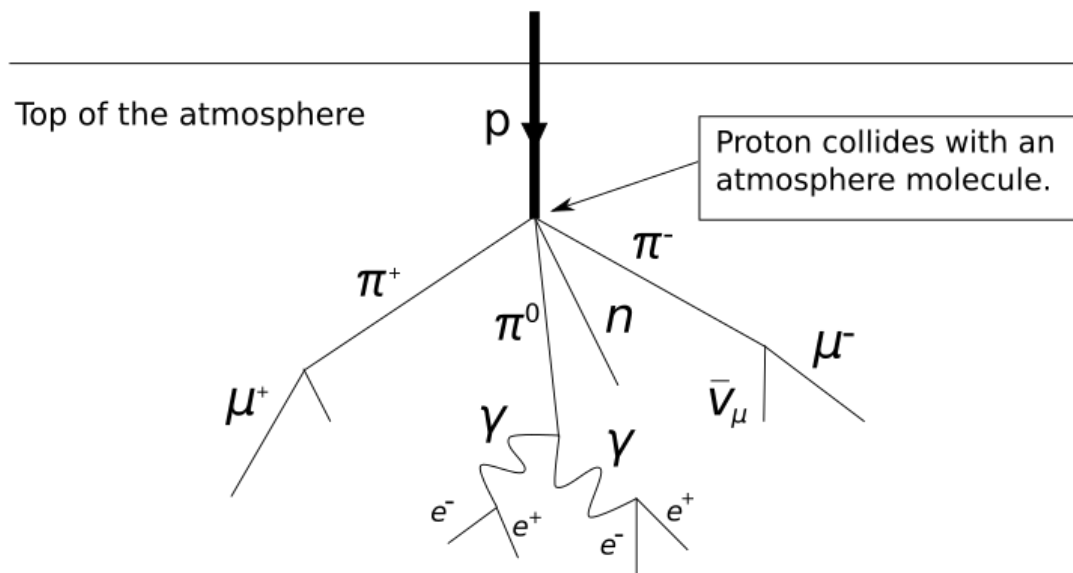


Figure 1. Diagram illustrates the development and various decays in a shower upon the primary ray’s interaction with the atmosphere (Atmospheric Collision, 2007).

In particular, these energised hadrons resulting from the primary ray consist of mesons such as pions and kaons, which decay at an altitude of around 15,000 meters to become muons (Davies, B., 2022).

Muons only have a half-life of  $1.56\mu s$ , which without accounting for relativity, would only enable them to travel 660m without decaying. However, due to time dilation in the rest frame of the muon, combined with the fact that muons are energetic but have weak interaction

with other particles, they can travel much longer distances and be detected at ground level. As most other particles are attenuated by the atmosphere, cosmic ray showers observed at sea level are almost exclusively from muons (Le Boulicaut, E., 2018). Using cosmic ray detectors, high-energy cosmic rays are identified and recorded by detecting particles such as muons resulting from air showers.

## **Method**

### **The HiSPARC Project**

The HiSPARC project is a collection of cosmic ray detectors in a network of high schools and universities mainly situated in Holland. Students build them for detecting UHECRs for research. Air showers produced by UHECRs can span up to 1 km<sup>2</sup> in surface area. Properties of the original cosmic ray can be determined through computer simulations if the density of secondary particles in the shower can be determined in several locations. These clusters of detectors record events of cosmic rays, which are transmitted to the central database, which can be downloaded from the web (de Vries, L., 2012).

Each HiSPARC station consists of two or four individual detectors, each consisting of 3 main components: A scintillator, a photomultiplier tube (PMT), and an electronics box. Scintillators are materials that release photons when irradiated, used to detect charged particles such as muons resulting from air showers. When charged particles resulting from cosmic rays pass through the scintillator, their energy is absorbed through ionisation, which excites electrons within. These electrons then re-release the energy in the form of light and return to the ground state. The released photon will travel through the scintillator plate to a PMT, which converts to an electrical signal via the photoelectric effect. These signals are converted through analogue-digital converters (ADC) and interpreted by HiSPARC electronics (Umesh, K., 2020).

### **Considering Approach**

The direction information of cosmic ray events is registered in HiSPARC stations containing four detector plates, particularly detectors of universities in the Netherlands. Multiple environmental parameters are separately recorded along with cosmic rays by detectors, such as barometric pressure, atmospheric temperature, humidity, wind speed, and other factors.

The accuracy of the direction information has been calibrated against data from professional laboratories for student use so that they can be relied upon without further consideration; hence, sample data will be readings from the Nikhef 501 detector (in NIKHEF, Amsterdam).

It would be better to correlate the rate of arrival of cosmic rays against the air mass encountered on each track. Hence, air mass per unit area will be the plot's independent variable. In contrast, the dependent variable will be the density of shower tracks per hour per unit of solid angle (Mcellin, M., n.d.).

The download file logs any EAS events at any point in time, which allows the EAS rate to be recorded per unit of time, per range of zenith angle. However, zenith angle distribution is two-dimensional, describing to the angle between the direction of incoming EAS events and the direction perpendicular to the surface of the detector.

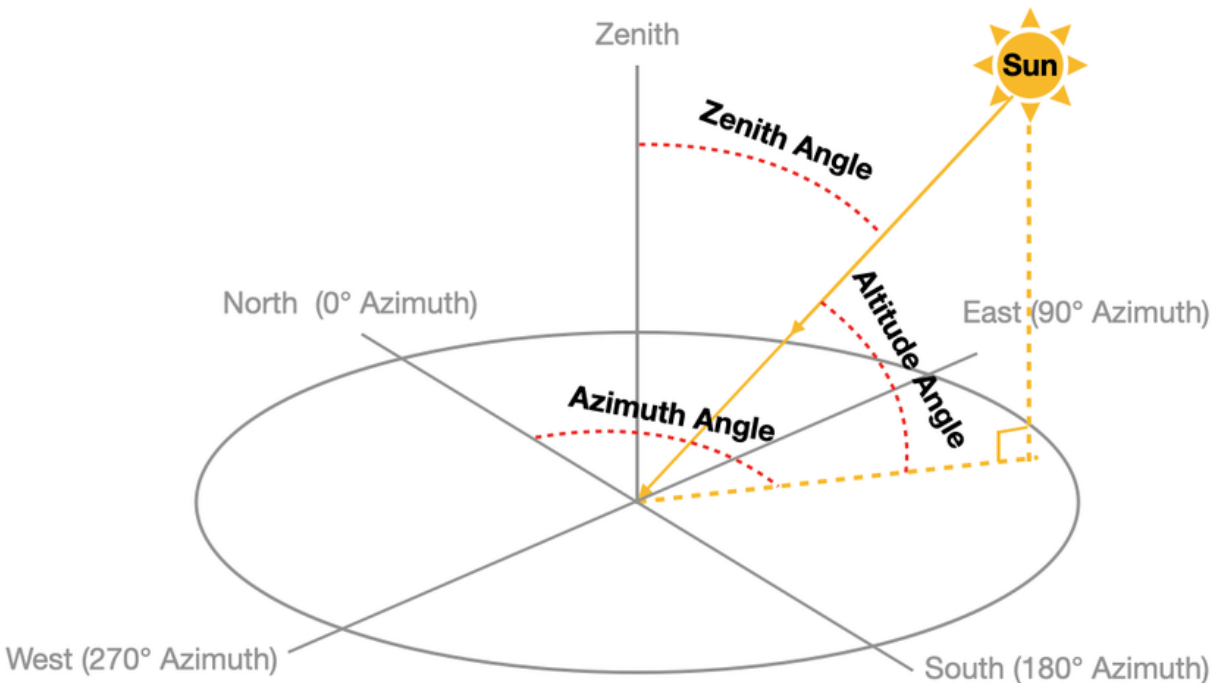


Figure 2. Visualisation of zenith angle (Zhang, Y., 2021).

As cosmic rays arrive in three-dimensional space, EAS count rate per zenith angle range per unit time is divided by correction factor  $F$  to make it in terms of steradians, a unit of solid angle. This is to account for the varying amounts of atmosphere hence total air mass in tracks that cosmic rays at different zenith angles encounter.

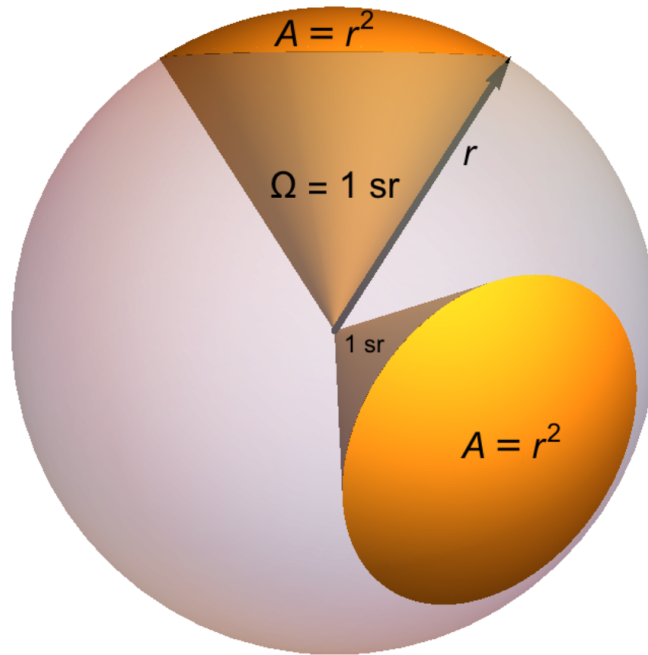


Figure 3. Steradian. (Anderson, A, 2019).

Only showers arriving directly from the zenith has exposure to the entire region of detector plates. The projected area in the sky reduces by a factor of  $\cos(\theta)$ , proportional to the zenith angle. This decrease in the projected area results in a corresponding decrease in the EAS trigger rate of the detector by  $\cos(\theta)$ , so therefore, a factor of  $\cos(\theta)$  must be divided to predict the trigger rate of a detector plate perpendicular to a shower arriving at zenith angle  $\theta$ . Since the amount of atmosphere each shower encounters varies between the zenith angles, between angles  $\theta$  and  $\theta + d\theta$  on a sphere of radius  $R$ , there is an area of  $2\pi R \sin(\theta) R d\theta$ , which corresponds to a solid angle of  $\text{Area}/R^2 = 2\pi \sin(\theta) d\theta$ . This represents the variation in the detection rate of EAS events with a zenith angle  $\theta$  for a uniformly sensitive detector to all directions.

However, as the detector is not uniformly sensitive since it lacks full sky exposure, the previous  $\cos(\theta)$  factor must also be accounted for in the projection of the detector plate area. Therefore, the variation of EAS event rates with a zenith angle for any range of angles between  $\theta$  and  $\theta + d\theta$  is given by  $2\pi \sin(\theta) \cos(\theta) d\theta$ . The detection rate divides into ranges of 10 degrees, so an integral is used to sum the areas between the upper and lower angles.

$$F = \int_{\theta_1}^{\theta_2} 2\pi \sin(\theta) \cos(\theta) \cdot d\theta \text{ (Mcellin, M., n.d.)}$$

Simplifying the equation above:

$$\int_{\theta_1}^{\theta_2} 2\pi \sin(\theta) \cos(\theta) \cdot d\theta = 2\pi \int_{\theta_1}^{\theta_2} \sin(\theta) \cdot d(\sin(\theta))$$

$$2\pi \int_{\theta_1}^{\theta_2} \sin(\theta) \cdot d(\sin(\theta)) = \pi (\sin^2(\theta_2) - \sin^2(\theta_1))$$

$$F = \pi (\sin^2(\theta_2) - \sin^2(\theta_1))$$

Hence, EAS count rate must be divided by this factor  $F$ .

### Organising Data

A program downloads and reads HiSPARC's weather data file and finds the average barometric pressure, atmospheric temperature, and count of cosmic ray events in each zenith angle band for each hour.

Then, it iterates through the zenith angle count-rate, and for each angle per hour is the output: air mass/unit area by dividing pressure by the cosine of the zenith angle; EAS event rate/steradian by dividing event rate by factor  $F$ .

### Statistical Analysis

This study applies linear regression to examine the correlation between barometric pressure and cosmic ray event rate by plotting air mass/unit area against EAS/steradian for each hour.

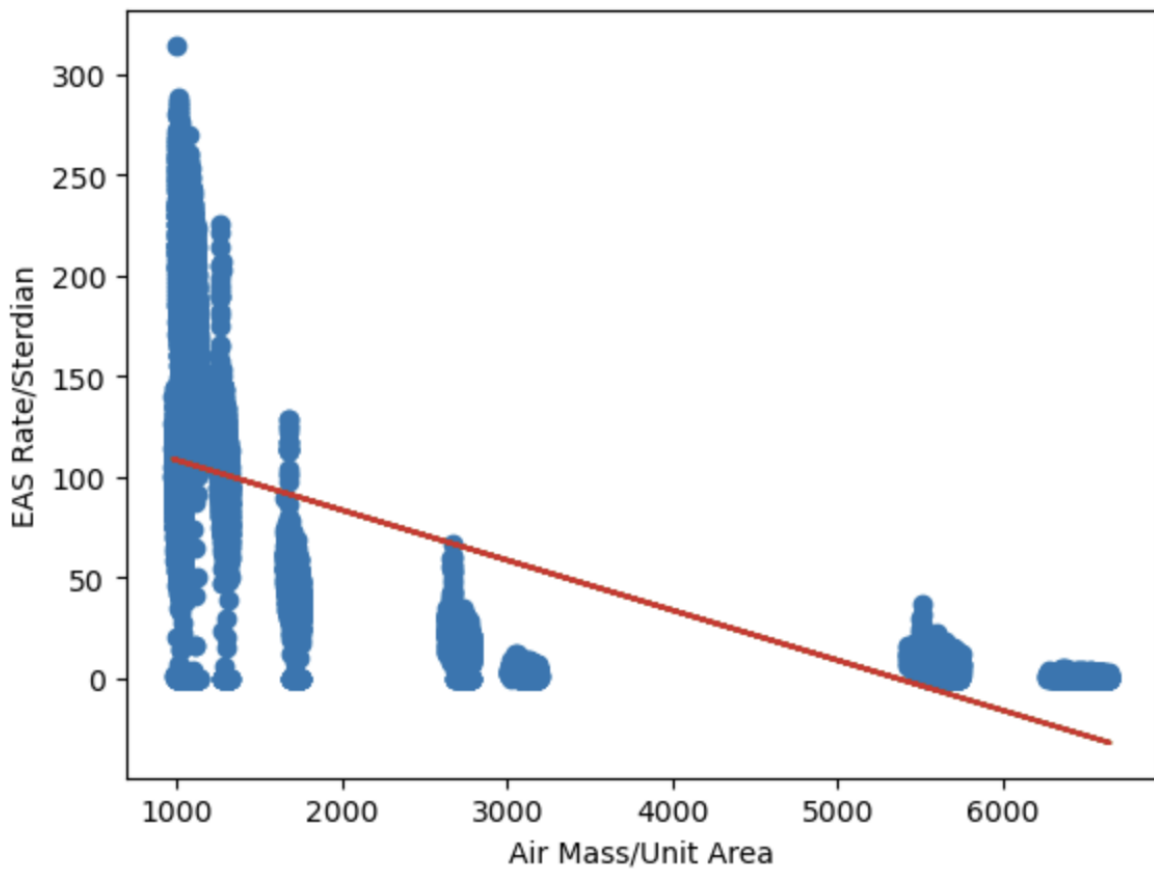
A residual plot from the difference between observed data from fitted values produced by the model's predicted values using Python's matplotlib library evaluates the performance of the linear model. If a linear model is appropriate, then a nonlinear model will be used instead. I will

also examine if there are any other factors influencing the variation in the rate of events and identify them.

## Results and Analysis

Modelling air mass/unit area against event rate/steradian with linear regression can give an estimate and assess the strength of their relationship. The strength and direction of the plot are quantified by the Pearson correlation coefficient  $r$ , a measure of linear association between two variables.

Figure 2. Scatterplot of linear regression for air mass/unit area against event rate/steradian



$$r = -0.71$$

$$R^2 = 0.5$$

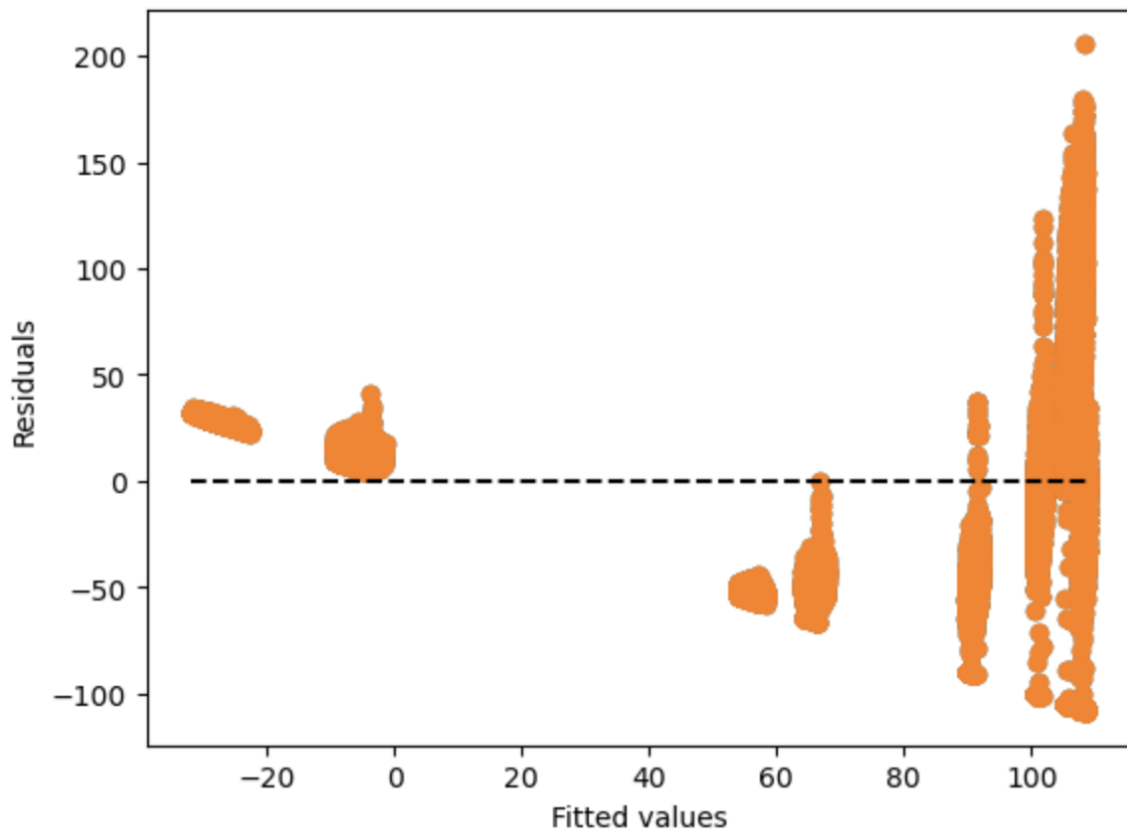


Pearson correlation coefficient  $r = -0.71$  indicates a strong negative linear relationship between the air mass/unit area and EAS rate/steradian. On the other hand,  $R^2 = 0.5$  states that only half the variability in EAS rate/steradian is accounted for by air mass/unit area.

As cosmic rays are of extraterrestrial origin, the intervals of their arrival are fundamentally random, which can lead to inexplicable variations in cosmic ray events hence the EAS count rate. However, there are likely other factors aside of barometric pressure causing variation in cosmic ray events. Hence, several different tests are initiated in an attempt to identify them.

From the linear regression model above, the residuals between air mass/unit area and EAS rate/steradian can be obtained, which is the difference between the observed values of the response variable and the fitted values predicted by the model. The fitted values are the mean of the values predicted by the model based on the given predictor variable, air mass/unit area. By plotting fitted values against residuals, it can be checked to see if the assumptions of the linear model for air mass/unit area against EAS rate/steradian are met (Frost, J., 2017).

Figure 3. Scatterplot of pressure-fitted event rate/steradian residuals against fitted values



$$r = 1.13e-14$$

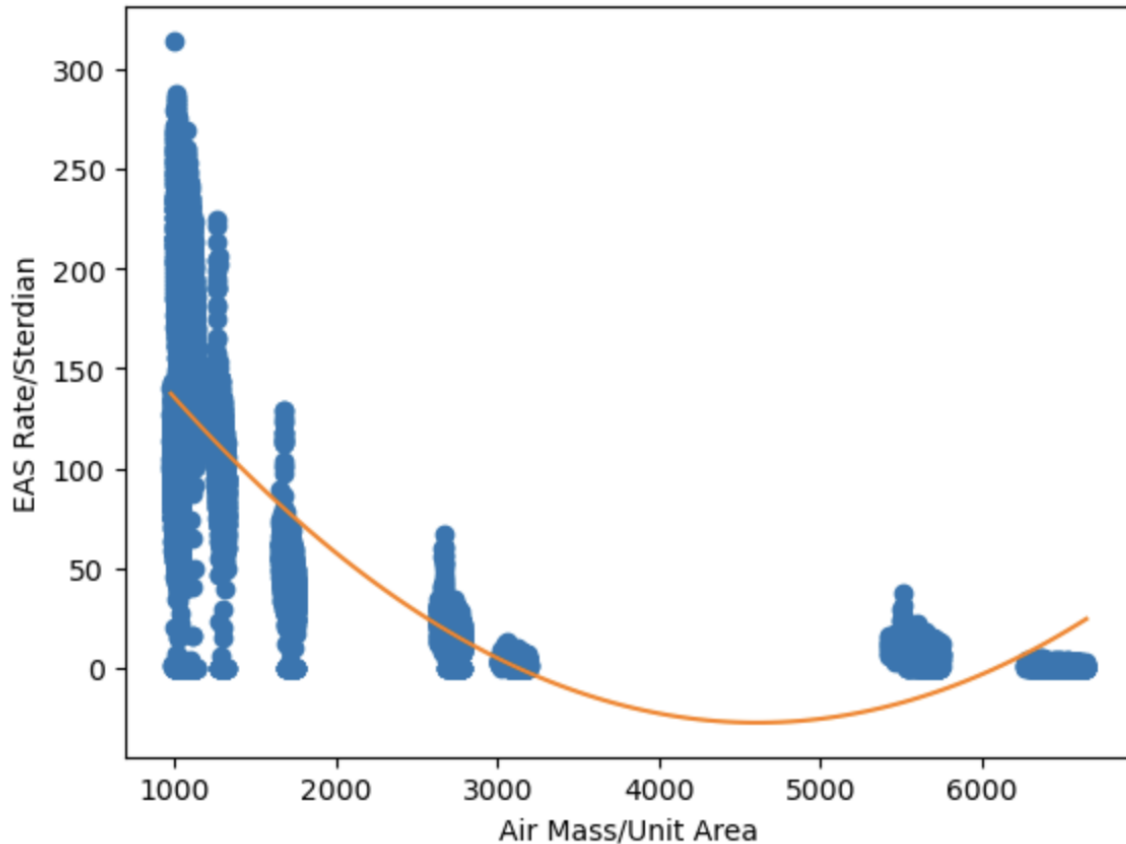
The plot's Pearson correlation coefficient of  $1.33e-14$  indicates no linear correlation between fitted values and residuals. By eye, the plot shows that residuals are mostly positive values  $< 50$  when the fitted value is small, while there are no instances of residuals in intermediate values and a wide spread of residuals ranging from  $-100$  to  $200$  when fitted values are significant.

The fitted line does not describe how residuals change with respect to fitted values, which indicates non-linearity in their relationship. This can indicate that a linear relationship is not suited to describe air mass/unit area against EAS rate/steradian or that other underlying factors are not accounted for in this model.

Hence, a new scatterplot using regression of a degree 2 polynomial is created. As the scatter for the previous plot appeared monotonic, the strength of the correlation is quantified by

Spearman rank correlation coefficient  $\rho$  and Kendall's tau coefficient  $\tau$ , both non-parametric measures of the strength and direction of nonlinear monotonic relationships.

Figure 4. Scatterplot of quadratic regression between air mass/unit area and EAS rate/steradian



$$R^2 = 0.73$$

$$\rho = -0.88$$

$$\tau = -0.71$$

A coefficient of determination  $R^2 = 0.73$  indicates that a quadratic model can account for approximately 73% of the variance in response variable EAS Rate/Steradian, which is a significant portion but not a perfect fit.

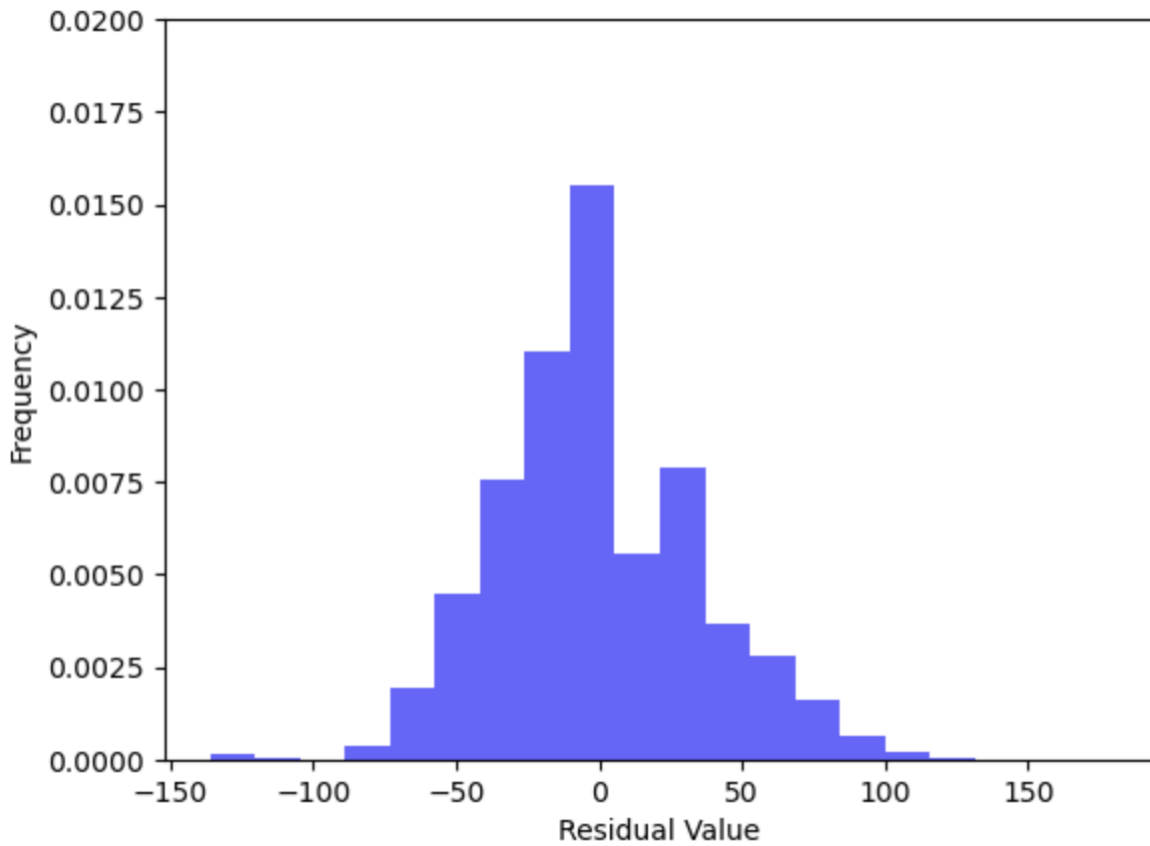
A value of  $\rho = -0.88$  indicates a solid negative monotonic relationship between air mass/unit area and EAS rate/steradian, which is notably higher than the previous coefficient of  $R = -0.71$ . This implies that a more complex nonlinear relationship is more suited to describe the relationship between air mass/unit area and EAS Rate/Steradian.

A value of  $\tau = -0.71$  indicates a strong negative correlation between air mass/unit area and EAS Rate/Steridian, though not as high as  $\rho = -0.88$ .

The Poisson distribution is a statistical distribution commonly used to model the number of occurrences of an event within a given period, area, or volume. It is a discrete probability distribution characterised by a single parameter, the expected value, representing the mean rate at which the event of interest occurs.

From the histogram plot, the standard deviation  $\sigma$  can be derived, a measure of the dispersion of data values.

Figure 5. Histogram plot for pressure corrected residuals



$$\sigma = 35.32$$

$$\sigma/n = 0.097$$

The histogram overall follows a form relatively similar to a normal distribution. However, there is a noticeable fall in frequency between residual values 0 and 25, then an

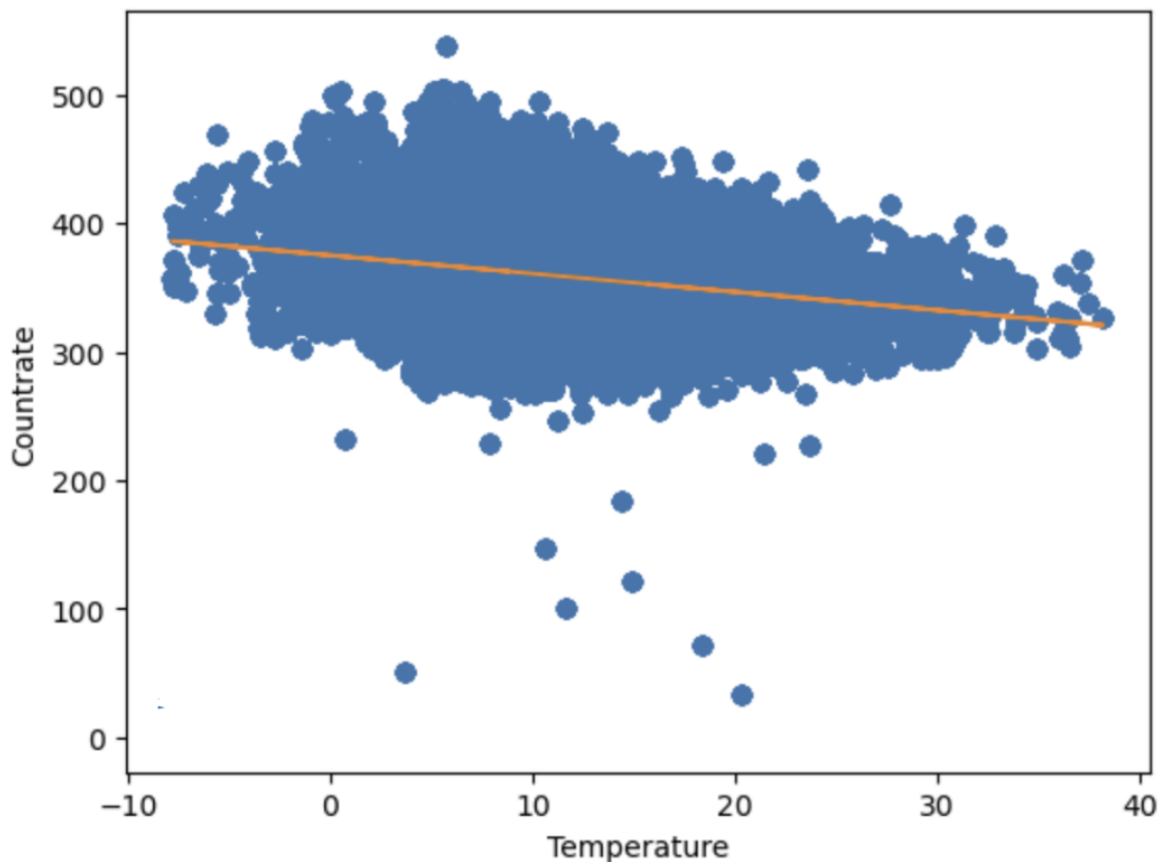
increase again. This indicates that the differences between predicted and observed values are relatively sizable. Hence, variation in the residuals is from systematic bias due to an underlying factor excluded from the current predictor variables, air mass/unit area.

The standard error of  $\sigma/n = 0.097$  suggests that the differences between observed and predicted values are relatively consistent, and the model performs well.

As the graph and standard deviation above indicate the presence of an additional predictor variable. Out of the rest of all information available on the HiSPARC download page, atmospheric temperature is the most likely factor affecting cosmic ray event rate.

Atmospheric temperature is plot against the total count of EAS events to find for a linear correlation.

Figure 6. Scatterplot of linear regression for atmospheric temperature against EAS count rate



$$r = -0.2$$

$$R^2 = 0.04$$

A Pearson correlation coefficient of  $r = -0.2$  indicates a weak negative correlation between atmospheric temperature and cosmic ray events.

An R-squared value of  $R^2 = 0.04$  indicates that only 4% of the variation in the data could be explained by a considerably low atmospheric temperature.

This is not unexpected, as the primary predictor variable, barometric pressure, clarifies most of the variation in the EAS event rate, as previously shown in statistical analysis. To determine if atmospheric temperature makes up for unexplained variation in EAS event rate, analysis of variance (ANOVA) is employed.

The account of ANOVA is determined by the null hypothesis that asserts there is no relationship between EAS rate/steradian and either air mass/unit area or atmospheric temperature denoted by  $H_0$ . In contrast, the alternate hypothesis is a statement that asserts there is a significant relationship between EAS rate/steradian and either air mass/unit area or temperature denoted by  $H_1$ .

$H_0: \beta_1 = \beta_2 = \beta_3 = 0$ , where  $\beta_1$  is the intercept,  $\beta_2$  is air mass/unit area, and  $\beta_3$  is atmospheric temperature

$H_1$ : At least one of  $\beta_1$ ,  $\beta_2$  or  $\beta_3$  is not equal to 0.

Results:

F-statistic: 67732.84

p-value: 0.0

As  $p\text{-value} < 0.05$ , there is a significant difference between the means of the intercept, air mass/unit area and atmospheric temperature; thus, the null hypothesis  $H_0$  is rejected with a high degree of confidence in favour of the alternate hypothesis  $H_1$ . It is concluded that there is a significant relationship between EAS count rate against barometric pressure and atmospheric temperature.

As the F-statistic 67732.84 is very large, this further supports the alternate hypothesis. Although 67732.84 is larger than the expected value, considering the current sample size of the data (2 years worth), only two predictor variables, and that it is known from previous statistical

analysis that there is a high correlation between air mass/unit area and EAS rate/steradian, it would not be considered anomalous.

In order to determine if both  $\beta_2$  and  $\beta_3$  have a significant relationship with  $\beta_1$ , the predictor variable atmospheric temperature is isolated, and ANOVA is independently done between atmospheric temperature and the original EAS count rate.

The account of ANOVA is determined by the null hypothesis that asserts there is no difference in the means of total EAS rate/hour for different atmospheric temperature levels by  $H_0$ . In contrast, the alternate hypothesis is a statement that asserts there is a significant difference in the means of total EAS rate/hour for different levels of atmospheric temperature, denoted by  $H_1$ .

$H_0: \mu_1 = \mu_2 = \mu_3 = \dots = \mu_k$ , where  $\mu_n$  is the population mean of total EAS rate/hour for the nth level of atmospheric temperature.

$H_1$ : At least one pair of  $(\mu_i, \mu_j)$  is significantly different, where  $i$  and  $j$  represent different atmospheric temperature levels.

Results:

F-statistic: 5620.44

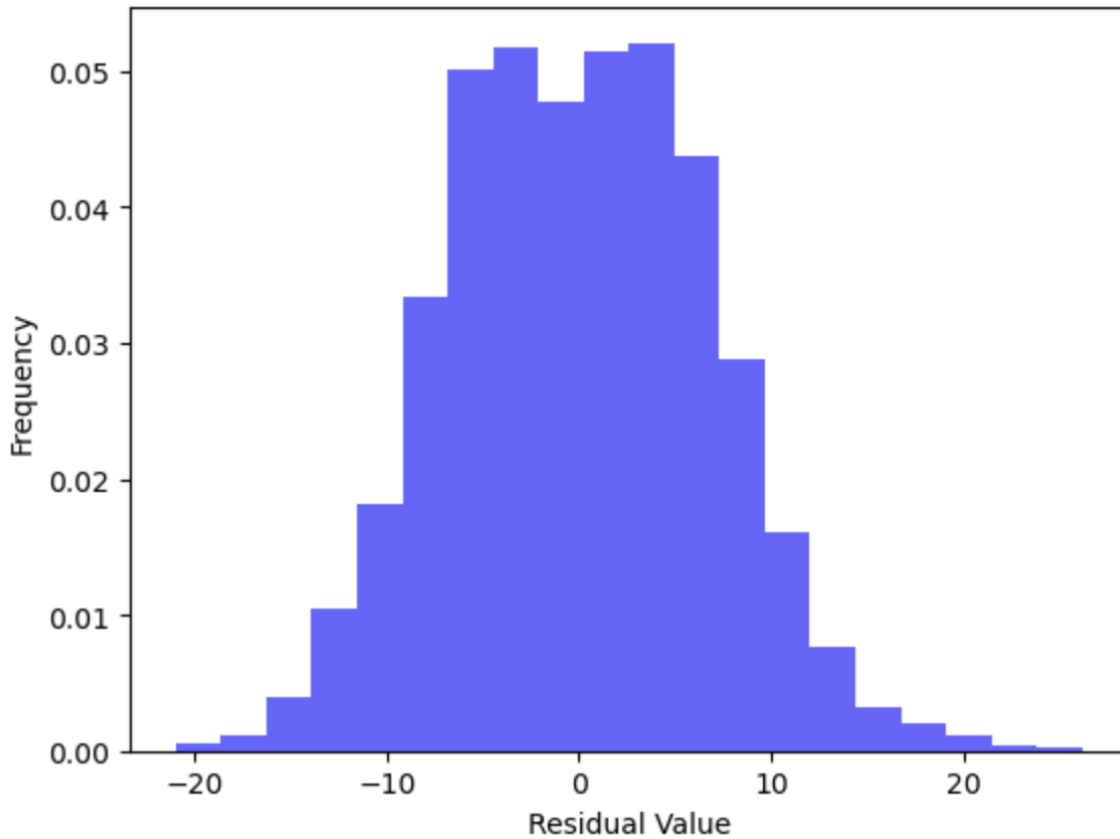
P-value: 0.0

As  $p\text{-value} < 0.05$ , there is a significant difference between the means of total EAS rate/hour for the nth level of atmospheric temperature; thus, the null hypothesis  $H_0$  is rejected with a high degree of confidence in favour of the alternate hypothesis  $H_1$ . It can be concluded that there is a significant relationship between EAS count rate and atmospheric temperature. As the F-statistic 5620.44 is very large, this further supports the alternate hypothesis. Although 5620.44 is larger than the expected value, considering the current sample size of the data (2 years worth), only one predictor variable, and that it is known from previous ANOVA analysis that there is a high correlation between air mass/unit area along with atmospheric temperature against EAS rate/steradian, it would not be considered anomalous.

Hence, analysis with ANOVA strongly indicates that the EAS event rate strongly correlates with atmospheric temperature and could be the reason for EAS rate/steradian variation against air mass/unit area.

In this case, pressure and atmospheric temperature-corrected residuals are found by calculating the residuals from the air mass/unit area and EAS rate/steradian plot against atmospheric temperature.

Figure 7. Histogram plot for pressure and atmospheric temperature corrected residuals



$$\sigma = 6.74$$

$$\sigma/n = 0.018$$

The histogram follows a form closer to standard distribution, indicating that the differences between predicted and observed values are likely random. The standard deviation is a relatively low value of  $\sigma = 6.74$  compared to the previous value of  $\sigma = 35.32$ , after accounting for atmospheric temperature as a secondary predictor variable. The low standard deviation implies



that any remaining variation in the data is most likely due to fundamental randomness. Hence, it would appear that there are no other underlying factors that cause significant variation in the EAS rate.

The standard error of  $\sigma/n = 0.018$  suggests that the differences between observed and predicted values are relatively consistent, and the model performs well. It is significantly smaller than the standard error of  $\sigma/n = 0.097$ , indicating the estimate is closer to more representative of the pressure and atmospheric temperature-corrected residuals.

## Conclusions

The results of this study demonstrate a statistically significant association between barometric pressure and cosmic ray event rate with  $r = -0.71$ , particularly a nonlinear relationship in which EAS event/steradian rapidly decreases as air mass/unit area increases with  $\rho = -0.88$ ,  $\tau = -0.71$ . When a histogram from the Poisson distribution is plotted, the plot generally follows a standard distribution with a few observations that deviate from the general pattern. The standard deviation of  $\sigma = 35.32$  indicates that variation in data may be influenced by an underlying factor rather than just randomness.

This leads to introduction of atmospheric temperature as a confounding variable to identify and analyse causes for variation in the data. Plotting a scatterplot for atmospheric temperature against EAS count-rate/hour yields a weak statistical association with  $r = -0.2$ , though this is plausible given the previously shown strong dependence of EAS rate on barometric pressure.

Conducting one-way ANOVA with predictor variables air mass/unit area and atmospheric temperature with response variable EAS rate/steradian indicates a strong relationship between the variables with F-statistic = 67732.84, p-value = 0.0, supporting the atmospheric temperature as an underlying factor contributing to changes in EAS rate. Furthermore, a one-way ANOVA with only atmospheric temperature and EAS rate confirms a significant association between them, with F-statistic = 5620.44 and p-value = 0.0. Creating a histogram from the Poisson distribution produces a plot even more closely associated with the standard distribution. The standard distribution is significantly smaller at  $\sigma = 6.74$ .

Overall, the study findings support the conclusion that barometric pressure is the primary determinant of variations in cosmic ray event rates, with atmospheric temperature playing a role minor role in variation it.

### **Data Availability Statement**

Cosmic ray events, zenith, and atmospheric temperature data were obtained from the HiSPARC website (<https://data.hisparc.nl/data/download/> (accessed on 03/01/2023) )

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# **To What Extent Does the Karuk Tribe’s Traditional Ecological Knowledge Surrounding Fire Exclusion, and Water Sustainability Prove More Effective than Modern Mass-Agriculture Techniques within California? By Mitali Srinath**

## **Abstract**

The mission of the Karuk tribe— a native Californian tribe— is to promote the welfare of the Karuk people through the preservation of Tribal customs and traditions. A majority of these traditions circulate around indigenous agricultural techniques and the implementation of these techniques into modern agricultural practices, especially with the increased demand for agronomy and the rising problems surrounding climate change.

In my research paper, I will primarily focus on secondary data analysis of historical recounts of indigenous techniques and additionally will be providing insights from the local Karuk community. With my research, I hope to explore the complications in modern farming techniques and how indigenous management could be used to solve dilemmas, for example Californian wildfires and fire exclusion. My research will contribute to the restoration of Indigenous practices— which will further retain their cultural heritage— and agriculturists by introducing helpful farming techniques that could benefit their crops.

## **Introduction**

When early fall temperatures hit a high of 100 degrees in our bone-dry Californian landscape, harvesters get to work. With a lack of direct market access, harvesters operate at a deficit and rely on farmers’ markets— that they travel hours for— to make a minimal margin of profit. Coffee drinkers may enjoy the fruition of their labor, however farmers are forced to hand-pick coffee for less than minimum wage, which shows the worry and cycle of debt that cripples farmworker communities. The efficiency and sustainability of modern mass-agriculture and farm management has been widely debated. One commonly held belief within the American public is that “farming in the United States has no peer... it is apparently advanced, modern, and progressive.”<sup>1</sup> Yet instead, modern farming has demonstrated a high level of inefficiency primarily due to the reliance on human effort and labor and use of unhealthy agricultural

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<sup>1</sup> Theodore W. Schultz, "How Efficient Is American Agriculture?," *Journal of Farm Economics* 29, no. 3 (August 1947): <https://www.jstor.org/stable/1232905>.

techniques. Therefore, researchers and agriculturalists have questioned what methods they can introduce into modern agriculture with the intent of increasing efficiency and progressivism: indigenous methodologies. Even though many agriculturists claim that mass agriculture is more effective and satisfies a larger demand of the American population, I personally believe that indigenous farming techniques of fire exclusion and water sustainability— as successfully demonstrated by the Californian Karuk tribe— both introduce environmentally friendly farming techniques to agriculturalists and contribute to the restoration of indigenous practices.

## **Context**

The Karuk Tribe is an ancient indigenous tribe settled within California, infamous for their water sustainability and fire management. The Karuk Tribe is a federally recognized self-governed tribe. The mission of the Karuk Tribe— “to promote the general welfare of all Karuk people...restore and preserve Tribal traditions, customs, language, and ancestral rights”<sup>2</sup>— speaks to their belief that they are inherently connected to this Californian land and have a right over it as its nurturers. The Karuk tribe’s origins in agriculture began with cultural traditions of hunting, gathering, fishing, and growing tobacco plants. Even cultural ceremonies— the Brush Dance, Jump Dance, and Pikyavish ceremonies— were practiced in order to ‘heal and fix’ the environment.<sup>3</sup> We can suggest that the Karuk Tribe has always focused on sustainability in the Californian landscape, yet their culture and traditions surrounding agriculture have not merged into the unhealthy and contemporary mass agricultural complex.

Pivoting to the obvious question at hand, why is mass agriculture unsustainable? Many sustainable agriculturists and researchers focus on the exponentially growing problem of climate change.<sup>4</sup> Industrialized farming, which produces greenhouse gas emissions, has cost the environment approximately \$3 trillion since the early 2000s. The basis of the fertilizer industry extracts and combines nitrogen from the air with hydrogen, used to produce ammonia which is known as modern fertilizer. The fertilization process accounts for about 1-2 percent of the

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<sup>2</sup> Karuk Tribe Official Website, last modified 2015, accessed January 29, 2023, <https://www.karuk.us/>.

<sup>3</sup> Karuk Tribe Official Website.

<sup>4</sup> "10 Things You Should Know about Industrial Farming," UNEP Environment Programme, last modified July 20, 2020, accessed January 29, 2023, <https://www.unep.org/news-and-stories/story/10-things-you-should-know-about-industrial-farming>.

world's total energy supply which equates to 1.5 percent of the total global carbon emissions.<sup>5</sup> Industrial farming emits methane and nitrous oxide, a chemical known to be up to 300 times more damaging than carbon dioxide. Additionally, U.S. factory farm animals produce an estimated 885 billion pounds of manure every year— which is completely unregulated by the government— and releases methane and endotoxins which are connected to lung disease, spread human pathogens, and contribute to the ground-level ozone.

I want to highlight the impact of industrial fertilization on farmworkers and their families based on my own personal experience. Working for Santa Cruz's "Center for Farmworker Families" association, I helped contribute to the Oaxacan community shed: a pop-up food and resource stand held every month for various farmworker families to visit when they cannot afford to purchase with their wages. Many Oaxacan community members live in rural towns within Central California, enduring racism, and low income problems. Their worries extended to health complications: mercury poisoning and thyroid conditions from hazardous fertilizers and pesticides. As a translator, I worked to advocate for them by sourcing more local food banks and donations from pharmacies. I saw about 50 different individuals, out of the 200 families a month, facing thyroid issues, lung cancer, pesticide poisoning, major skin irritation, and other health issues due to the acute toxicity and exposure from mass produced pesticides. David Bellinger's academic paper, "Farmers' Exposure to Pesticides: Toxicity Types and Ways of Prevention," demonstrates how "pesticides... may cause serious illness, severe injury, or sometimes even death."<sup>6</sup> How are we supposed to protect farmworkers— especially those who lack language access and sufficient means of income— from facing these deathly conditions?

## **Counterargument**

Before delving into how to solve the problems of mass agriculture, I want to mention the counterargument: why contemporary agriculture is the best concept to mitigate the growing demand of food in the United States. Robert Paarlberg's article in the *Wall Street Journal*—"The Environmental Upside of Modern Farming"— comments that "modern farming is better because it uses low-impact, 'precision' techniques that require less land, less energy and fewer chemicals

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<sup>5</sup> *Factory Farm Nation: 2020 Edition*, [Page 4-8], April 2020, accessed January 29, 2023, [https://foodandwaterwatch.org/wp-content/uploads/2021/03/ib\\_2004\\_updfacfarmmaps-web2.pdf](https://foodandwaterwatch.org/wp-content/uploads/2021/03/ib_2004_updfacfarmmaps-web2.pdf).

<sup>6</sup> 1. Christos A. Damalas, *Farmers' Exposure to Pesticides: Toxicity Types and Ways of Prevention*, January 8, 2016, accessed January 29, 2023, <https://doi.org/10.3390/toxics4010001>.



for every bushel produced”<sup>7</sup> in comparison to traditional farming methods of the 1930s. Since the 1980s, irrigation water use has fallen by 46%, greenhouse gas emissions by 31%, and general energy use by 46%.<sup>8</sup> Interestingly, plant-based imitation meals— such as the famous ‘Impossible Burger’— have decreased the pound of production of beef, including 19% less feed, 30% fewer animals, and 33% less land being used compared to the 1970s.<sup>9</sup> Paarlberg argues that he does agree older farming technologies are archaic and lack enough support for modern food demands. Yet, low-impact, precise farming, and animal product substitutes may make global food production more sustainable.

### **Indigenous Farming Techniques: An Overview**

Indigenous agricultural practices adopted by native tribes are known to depend on traditional knowledge surrounding the preservation of “ecosystem, biodiversity, and ...[the maintenance of] sustainable food and human health.”<sup>10</sup> Even though farmers may possess a vast amount of general agricultural knowledge, indigenous knowledge surrounding rural development and nature conservation can contribute to “maintaining [the] ecosystem of [a] particular area which leads to sustainable use of biodiversity conservation.”<sup>11</sup>

Focusing on the Karuk tribe, the Klamath region focuses primarily on the Klamath river and its surrounding mountains and forests— the Northern area of California and part of Oregon. According to Sara Kimberly’s— student from the University of Oregon — dissertation, she states how, “the ikxaréeyav (spirit people) inhabited this land. At a turning point in creation, some of the ikxaréeyav transformed into the humans, plants, animals, and geologic features, and they gave the people the original teachings on how to live, adapt and sustain future generations in this place. These teachings have been passed down through the stories and ceremonies to their

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<sup>7</sup> Robert Paarlberg, "The Environmental Upside of Modern Farming," *The Wall Street Journal*, =accessed January 29, 2023,

<https://www.wsj.com/articles/the-environmental-upside-of-modern-farming-11612534962>.

<sup>8</sup> Betsy Hickman, ed., *Environmental and Socioeconomic Indicators for Measuring Outcomes of On-Farm Agricultural Production in the United States*, report no. 3 (n.p., 2016), [http://fieldtomarket.org/media/2016/12/Field-to-Market\\_2016-National-Indicators-Report.pdf](http://fieldtomarket.org/media/2016/12/Field-to-Market_2016-National-Indicators-Report.pdf).

<sup>9</sup> Hickman, *Environmental and Socioeconomic*.

<sup>10</sup> Reeta Goel, Ravindra Soni, and Deep Chandra Suyal, *Microbiological Advancements for Higher Altitude Agro-Ecosystems and Sustainability* (Singapore: Springer Singapore, 2020), [Page 91-112].

<sup>11</sup> Goel, Soni, and Suyal, *Microbiological Advancements*, [Page 91-112].

living descendants who comprise the membership of the Karuk Tribe today.”<sup>12</sup> The Karuk people have remained steadfast in their commitment to their land and the resources the land provides us: also known as the eco-cultural revitalization efforts. The health of the Karuk tribe as a whole and the landscape are inextricably connected. Therefore, colonial ecological violence— such as human violence and cultural and economic harms— deeply impact both the Karuk people and Californian land.

### **Restoration of Indigenous Practices: Why is this important?**

Why is the restoration of indigenous practices so important? The recovery of indigenous knowledge is integral to the maintenance of cultural heritage and identity. This concept springs from colonialism, which seeks to methodically eradicate and redevelop ways of seeing and interacting with the world.

Colonial encounters have historically been known to impact indigenous agriculture because tribes lose “their sovereign control over the means of agricultural production and crop production.”<sup>13</sup> As seen in Brandon Katzung’s publication, “Oppression and Dispossession out of Fields of Plenty: Colonialism and Indigenous Agricultural Transformation,” many historical occurrences back up this pattern. Katzung alludes to the agricultural transformation in the Roman Gaul— in the aftermath of the Roman colonization— as the types of crops being produced and the degree they were produced exponentially increased. The average Gallic farmer who “was the master of his own farm and prioritized his agricultural produce for his family unit, was robbed of agency by processes of colonialism.”<sup>14</sup>

The Gallic-Roman agricultural situation can be paralleled to European colonization in the Americas. European colonization increased the settlement of European farmers which brought a discouragement of traditional indigenous agricultural practices, food, and cooking.<sup>15</sup> The force of ethnocentrism spread throughout the country, causing knowledge and land to be taken from indigenous communities without permission: this is best described as exploitation and abuse,

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<sup>12</sup> . Sara K. Kimberly, "Restoring What? and for Whom? Listening to Karuk Ecocultural Revitalization Practitioners and Uncovering Settler Logics in Ecological Restoration" (PhD diss., University of Oregon, 2022), [Page 14-28], ProQuest 5000.

<sup>13</sup> Brandon R. Katzung Hokanson, "Oppression and Dispossession out of Fields of Plenty: Colonialism and Indigenous Agricultural Transformation" (PhD diss., Gettysburg College, 2020).

<sup>14</sup> Katzung Hokanson, "Oppression and Dispossession," [Page 17].

<sup>15</sup> Diana Robson, "A Brief History of Indigenous Agriculture," *Manitoba Museum Botany* (blog), entry posted February 18, 2020, accessed January 30, 2023, <https://manitobamuseum.ca/archives/34785>.

with the use only for colonial interests. Angela Wilson's article, "Indigenous Knowledge Recovery is Indigenous Empowerment," describes how fifty-two Havasupai Nation members filed a \$25 million suit against ASU, the board of Regents, and ASU professors for "allegedly using four hundred Havasupai blood samples for studies beyond their stated purpose."<sup>16</sup> This example reminds us, "that as Indigenous Peoples we have a long way to go before we are liberated from the bondage colonialism has created."<sup>17</sup>

### **Fire management and Pest management:**

The Karuk people have established a strong economic connection with the tradition of fire practice. For example, an important food source is "Xunyêp (Tanoak) acorns found on trees and shrubs, which are native to the Klamath region (Lake 2019; Norgaard 2019). Fire ensures the prosperity of the Tanoak by promoting germination; Tanoak sprouts back very quickly after a fire (Cheney, 2011)."<sup>18</sup> With fire management, fire ensures the prosperity of the food source through the promotion of germination. Additionally, the creation of fires reduces the possibility of harmful resources from falling into the rivers and polluting water sources. With prescribed fires, the Karuk tribe can conveniently mitigate destructive fires in the Californian dry season.

Additionally, the function of fire in the Karuk people's agricultural practices goes beyond just food, water, and habitat preservation, proving instrumental in their pest management techniques. Similar to traditional fire management methods, the Karuk tribe uses fire to mitigate pests instead of harmful pesticides. Historic Karuk techniques of "burning would destroy ticks, fleas, lice, insect pests, and harmful fungal poisons which live in ground surfaces."<sup>19</sup> Low intensity fires are known to release mineral nutrients from ash, increasing nitrogen-fixing bacteria levels in the soil, and the fires can also raise the pH of the soil and productivity of the crops.

Even though there may be government policies suppressing the allowance of fire mitigation, the positive effect of fire management is evident, especially seen through the Klamath

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<sup>16</sup> Waziyatawin Angela Wilson, "Introduction: Indigenous Knowledge Recovery Is Indigenous Empowerment," *American Indian Quarterly* 28, no. 3/4: JSTOR.

<sup>17</sup> Wilson, "Introduction: Indigenous."

<sup>18</sup> Micheli Oliver, "Reclaiming Fire: Fire Management as a Form of Autonomy and Self-Determination for the Karuk Tribe of California" (PhD diss., University of Colorado Boulder, 2019), [Page 12], file:///Users/mitali\_srinath/Downloads/reclaimingFireFireManagementAsAFormOfAutonomyAndSelfD.pdf

<sup>19</sup> *Karuk Tribe Department of Natural Resources Eco-Cultural Resources Management Plan*, accessed January 30, 2023, [https://www.karuk.us/images/docs/dnr/ECRMP\\_6-15-10\\_doc.pdf](https://www.karuk.us/images/docs/dnr/ECRMP_6-15-10_doc.pdf).

National Forest. The journal of *Proceedings of the National Academy of Sciences* demonstrates how the Karuk tribe's technique of fire mitigation has played a significant role in "maintaining the forest structure and biodiversity, even during periods of climate variability."<sup>20</sup> The Klamath forest biomass and density — a general forest habitat in the Sierra Nevada—are approximately twice as much as they were before. If we implement these mitigation techniques into modern agriculturism, the germination and holistic nature behind crop management can develop dramatically.

### **Water management:**

The Karuk Tribe has maintained a Water Pollution Control Program, focusing on water quality conditions in the Klamath River. With the goal of assessing water quality conditions and its major tributaries, the tribe has "entered into cooperative agreements with both the U.S. Geological Survey and the U.S. Fish and Wildlife."<sup>21</sup> The Karuk Tribe's resources and strategies of "site-specific geomorphic mapping, surveying, prescription design and preparation of work order specifications for the implementation of identified project areas,"<sup>22</sup> are known to address the issue of water sanitation. These investigations are also referred to as the Klamath Basin Water Quality Investigations.

Additionally, improved watersheds and fisheries are viewed a significant component within water management. The Karuk Watershed Restoration protects the habitat of anadromous fish through the decrease of sedimentation which is caused by road networks. The Karuk typically use GIS to map the location of plants and animals that are culturally utilized, increasing general awareness of what areas within the landscape may need attentiveness.

Crop irrigation methods are currently used worldwide as agriculture strongly relies on irrigation. The overuse of water in agriculture is evident as "with about 24% of global land area suffering from severe water scarcity and 35% of the global population living in areas affected by water storage, economic development often occurs at the cost of the overexploitation of water

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<sup>20</sup> Kara Manke, "How Indigenous Burning Shaped the Forests of the Klamath Mountains for a Millennium," Phys.org, last modified March 15, 2022, accessed January 30, 2023, <https://phys.org/news/2022-03-indigenous-forests-klamath-mountains-millennium.html>.

<sup>21</sup> "Watershed Restoration Division," Karuk.us, accessed January 30, 2023, <https://www.karuk.us/images/docs/dnr/watershed.php>.

<sup>22</sup> "Watershed Restoration," Karuk.us.

resources.”<sup>23</sup> Irrigated areas actually only account for 40% of global food production. Irrigation agriculturing can be seen as unsustainable because “they deplete environmental flows and/or groundwater stocks.”<sup>24</sup> Local water resources are generally unrenovable— such as ground water— and sustainable irrigation is needed to ensure three points: water stocks are not depleted, there are no losses of aquatic habitat, and irrigation does not cause any other forms of environmental damage.

By adopting indigenous water mitigation methods, a culture of sustainable irrigation can be developed and have a healthier impact on the general surrounding environment.

## **Conclusion**

Overall, even though mass agricultural techniques are widely known as more efficient and effective, I determined that indigenous techniques from the Karuk tribe— specializing in fire, pest, and water management— are both more sustainable and equally as efficient. Additionally, indigenous agricultural methods contribute to the restoration of indigenous practices that counter agriculturally directed colonialism.

I first decided to outline the general origins and history behind the Karuk tribe and then demonstrated the unsustainability and negative impact— the extreme expense, lack of water sustainability, impact on the health of farmworkers— of modern mass agriculture. Subsequently, I outlined a possible counterargument that presents mass agriculture as the most efficient form of agricultural techniques. I consequently introduced the general significance of indigenous culture, which includes indigenous farming techniques, and how colonialism has prevented us from accepting indigenous culture. Lastly, I chose to focus on the indigenous techniques of water management and fire management, which include pest management as well. With water management, the Karuk tribe used advanced map tracking techniques and the increase of watersheds and fisheries to support the specific species of plants and fish. Whereas with fire management, the creation of manageable fires increases soil germination and decreases the need for pesticides.

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<sup>23</sup> Eros Borsato, "Weak and Strong Sustainability of Irrigation: A Framework for Irrigation Practices Under Limited Water Availability," *Frontiers* 4 (February 2020):

<https://www.frontiersin.org/articles/10.3389/fsufs.2020.00017/full>.

<sup>24</sup> Borsato, "Weak and Strong."

I personally hope that the discussion of indigenous farming techniques impacts a wide portion of the US population. On a day to day basis, we do not consider where our food comes from, how it is made, who it affects, and how it may impact the future of basic resources. We accept that mass agriculture can be ‘sustainable’ and is ‘at its peak’, even though can be harmful to the earth and human resources. We need to find and accept alternate techniques of agriculturism, even if they may seem unorthodox.

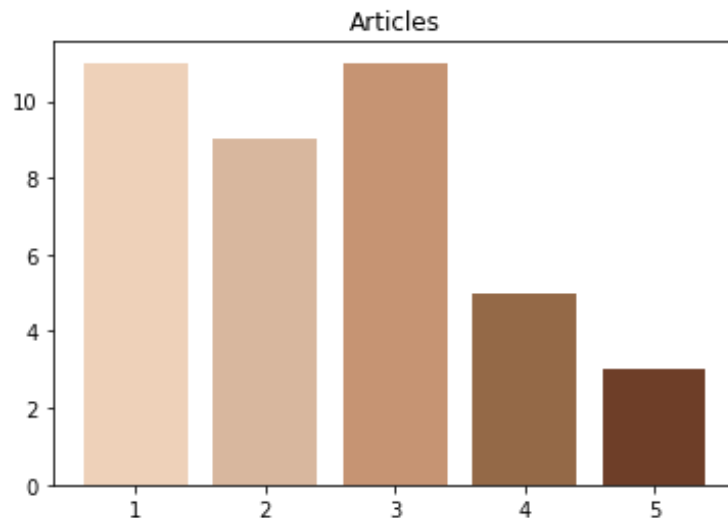
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## Colorism In Media By Kate Proujansky

You have probably seen magazines in your local drugstore, nail, or hair salon. The beauty magazine, *Allure*, has sold millions of magazines. Yet, there is a significantly smaller number of deep skin tone representations in the photos that go along with the articles. The amount of both racism and colorism is drastic. Colorism is defined as “prejudice or discrimination against individuals with a dark skin tone, typically among people of the same ethnic or racial group.” (Oxford Languages) Unfortunately, most of it happens without the perpetrator being aware of it.

Colorism is everywhere whether we see it or not. Although it might not always be intentional, it definitely can be. The author of the article “Fighting the ‘coded gaze’ ” explained that the software she was using had a challenging time detecting her face until she put on a white mask. (Buolamwini) Some Artificial Intelligence technology is biased and discriminatory towards people with darker skin if it is not perfected before the public begins to use it. I chose to collect data from *Allure* because I felt that compared to most of the other beauty/fashion magazines, *Allure* had a lot of diversity. To collect the data, I chose 6 images that went along with the articles (most images had multiple people). Then, I took 3 points from each model’s face (cheek, forehead, and chin) in an RGB website that gave us their RGB values for each point and put them all into clusters (1, 2, 3, 4, 5 - light, light-medium, medium, medium-deep, deep) in a bar graph based on the values.



Numerical data in *Allure*, created by Kate Proujansky

This is a bar graph of the different skin tone clusters in *Allure* magazine. There is barely any deep skin tone representation while the majority of representation is in lighter skin tones. Because the bulk of the representation is in light and medium skin tones, it tells me that there is most likely discrimination against medium-deep and deep skinned models in this magazine.

My takeaway from this data is that in articles, there is a significantly smaller number of deep skin tone representation than there is light skin tone representation. As you can see in the bar graph, light, light-medium, and medium skin tones are the most represented in articles, while medium-deep and deep were the least represented. Light and medium each had 11 points that fit into their cluster while deep had only 3 points.

There are many ways that this data collection could have been biased. I chose the images from *Allure* I wanted to use, so I might have subconsciously skipped over ones that did not fit into my original hypothesis. I also cannot control the lighting of the photo which might have had glares or shadows that could make someone look lighter or darker than they actually are. If I were to do this again, I would have used every single model from the magazine no matter the lighting. I would also make sure to take the same points from each face to keep my research as unbiased as possible.



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# **How Do Age and Biological sex Influence Vaccine Responses and Public Health Guidelines? By Samiya Guru**

## **Abstract**

Vaccines are biological substances that are used to protect against many viruses. Vaccinations play an important role in public health and society because they prevent the spread of infectious and even deadly diseases. There are many factors that can influence vaccine responses. In this research review, I will be discussing two universal factors that play a role in vaccine efficacy—age and biological sex. Specifically, I will cover how these topics influence public health policies and side effects. By gaining a better understanding of how age and biological sex affect vaccination, we can improve overall vaccine effectiveness and reach herd immunity.

## **Introduction**

Vaccines are essential to maintain a functioning, healthy community. Vaccines are biological agents that are usually injected through a small needle into an intramuscular part of your body to promote immunity against viral infections. They mimic viral infections by presenting an aspect of the virus to your immune system that is not infectious. This enables your immune system to create a response that can be leveraged during a real exposure to that virus. One major way the immune system responds to vaccines is by producing antibodies that interact with viral antigens to prevent or combat infection (1). Some of the antibodies produced by vaccines are Immunoglobulin G, which is the most common, and sometimes Immunoglobulin A. In this way, vaccines train your body to protect you from future viral infections. Therefore, vaccines behave as a first line of defense that plays a role in immune regulation.

Variolation is a historic method of vaccination where patients were deliberately infected with mild forms of viral or bacterial pathogens. This started in China and India in the 1500s. Both countries had discoveries that contributed to the evolution of vaccines. Doctors in China found that smallpox could be weakened by placing it in the sun. Doctors in India found that transferring pus from a pustule of a person infected with a virus, to a healthy person, provided protection from contracting that viral infection. With this information in mind, Edward Jenner, a scientist in England, developed the first official vaccine against smallpox disease in 1796. Jenner

had taken material from a cowpox sore, a blister from the infectious disease called cowpox disease, on a milkmaid in England and then injected it into James Phipp's arm, the son of Edward Jenner's gardener (2). A few months after he was inoculated with the cowpox sore, Jenner exposed him to the variola virus several times and he never developed smallpox. This allowed for the first vaccine to be created with cowpox, then later switched to vaccinia virus to provide immunity against smallpox disease. The research about smallpox contributed to the creation of all of the vaccines we have today (3).

Vaccines have since become a topic of public health. Today, mandated vaccine schedules are required for children that participate in the U.S. public school system. The schedule was developed starting with the smallpox vaccine in the early 1950s, and is still evolving to this day. There are 32 mandated vaccines in the vaccination schedule from ages 0-18 (4). Newborns all the way to senior citizens need vaccinations to keep the community from spreading deadly viruses. This is important because if we do this, we can reach herd immunity, meaning a large part of the community will be immune to a disease, allowing our communities to be better protected. Vaccination is relevant to all ages and studies have found that age affects vaccine side effects, severity, and efficacy.

Another factor that affects vaccination is biological sex. Biological sex is the reproductive traits you are born with. This can be female, male, or intersex depending on chromosomes, organs, and other traits. Males and females have different hormones and genetics. Females produce estrogen and men produce testosterone from different organs. The sex chromosomes between males and females are also different. Males have a XY chromosome, while females just have two X chromosomes. Studies have demonstrated that females have greater inflammatory, antiviral, and stronger adaptive immune systems compared to men. This is thought to be because estrogen activates the immune system in the female body (5).

### **Vaccines confer immune protection against viral and bacterial pathogens**

Vaccines imitate an infection by allowing your body to create antibodies from the weakened virus. Some immune cells that are responsible for fighting the weakened virus, and diseases in general, are T-lymphocytes, B-lymphocytes, and macrophages. These ensure your body knows how to fight the bacterial infection or virus in the future. After getting a vaccine, you might experience symptoms like a fever, chills, etc. Minor symptoms are normal, as the

body is building up immunity. We might experience side effects because our bodies recognize something as being foreign and want to “attack” it. Some vaccines require multiple doses to ensure the immunity remains the same and it does not fade after a while. For example, it is recommended that we receive two doses for the COVID-19 vaccine and later we need boosters. Additionally, since multiple strains of influenza arise every year, the influenza vaccine is reformulated to combat whichever strain is predicted to be the most present. We also have two different vaccination schedules; one ranges all the way from birth to 18, and the other is 19+. Each schedule has specific immunizations to take in a certain time frame to make sure you are protected against the virus. We get vaccinated so we are protected from many of the diseases and viruses always circulating in the air. Everywhere you go, you are being exposed to new stimuluses and new diseases (6). These vaccines help your immune system combat illness to protect your body.

### **Biological sex affects vaccine responses, uptake, and attitudes towards vaccination**

At Oregon Health and Science University (OHSU), they found that women have stronger immune systems than men. This can be from hormones, genetics, or even the environment (7). Hormones are chemical messengers in the body that help with metabolism, growth, sexual reproduction and function, and mood. Women produce estrogen and men produce testosterone hormones. The hormone estrogen in women has been found to stimulate the immune system to drive stronger immune responses. This connection and system provides stronger immunity towards viruses and bacteria. Differences in vaccine responses against COVID-19 vaccination for women and men have been recorded (8). Early on in the pandemic, scientists reported that men were dying at rates as high as twice that of women (9). This could be a result of differences in immune responses between men and women. Women’s stronger immune system may have played a favorable role in protection.

Biological sex also appears to play a role in vaccination outcomes, specifically, severe symptoms and side effects. During the COVID-19 pandemic, several different types of vaccines were available and we found that different vaccines were associated with different rare side effects for females and males. For example, in a recent study by the Centers for Disease Control and Prevention (CDC), they found that the Moderna COVID-19 vaccine is associated with a rare blood-clotting side effect for females. This was prominent in females and less common for

males. This is from the higher estrogen levels in the female body. Males did not experience this because their estrogen levels are lower than females. When COVID-19 was first discovered in China, estrogen was being injected into males in order to help their immune systems fight infection (10). Interestingly, the CDC found that males are more likely to develop myocarditis and pericarditis in response to Moderna and Pfizer COVID-19 vaccines. Myocarditis is inflammation of the heart muscle and pericarditis is the swelling and irritation of the thin tissue surrounding the heart. In males, among ages 5-11, 12.6-17.6 cases out of 100,000 were found to have either myocarditis or pericarditis. At this age, women were found to have 5.4-10.8 cases out of 100,000 people. As age increased, the severity and number of cases increased in males and stayed the same in females (11).

Research shows that men have a higher intention to vaccinate than women do. Studies on the COVID-19 vaccination included 58.3% of men to get vaccinated or have intentions on getting vaccinated (12). This may be because men have been shown to be more dominant in the workforce, allowing them to have greater access to vaccines and take more initiative to get vaccinated. Although men are more dominant in the workforce, many women have filled certain positions. For example, in the United States, 86% of nurses are women (13). Interestingly, COVID-19 vaccination rates were low among nurses (57%) in the United States despite having priority access to vaccines at the onset of the pandemic (14). Nurses who were hesitant to get the COVID-19 vaccine said they are unsure about the long-term effects and had mistrust about the vaccine trials, development, and approval. Nursing is a female dominant profession and thus, led to the low vaccination rates. This comes to show that biological sex and misinformation can impact if you get a vaccine or not (15).

### **Vaccine responses and requirements evolve with aging**

When getting the vaccine administered, infants and young children tend to cry, throw their hands in the air, and sometimes try to move away. Before the age of one, it is important that we receive 16-18 vaccines; this does not include multiple doses. Some side effects infants have from receiving vaccines are pain, headaches, and fevers. In adults, common side effects tend to be chills, pain, headaches, muscle or joint aches, and fatigue. Although it is challenging to administer vaccinations to children, it is important to have immunity against those 18 viruses or bacteria early in life (16). Researchers found that getting certain vaccines, like the Hepatitis B

vaccine, have better long term effects when administered earlier. In every state, public schools have different vaccine mandates. When children go to school, they are exposed to more viruses and diseases than they ever have been before. Children are also prone to touching everything they see and putting their hands in their mouths. This transmits the virus or bacteria from their hand into their mouth, and their immune system has to fight against it. The most prominent vaccines children across the country need to get are those against polio, measles, mumps, tetanus, and rubella diseases (17).

As you age, your immune system weakens. This is from the reduced production of B and T-cells in our bone marrow and diminished function of fully matured lymphocytes. This delays the response to foreign viruses in our body, slowing down the antibodies and antigens trying to fight off the virus, and we get sick. This process of reduced B and T-cells in our bone marrow starts around age 60 and continues to degenerate as we age (18).

During the COVID-19 pandemic, older people had more of a struggle with handling and overcoming the virus. They were more likely to catch the virus when exposed to it because of their weakened immune systems. When the vaccines were released, elderly were able to have it administered first, as they were the most susceptible. According to the Commonwealth Fund, about 97% of the elderly and older adults were vaccinated against COVID-19 in the United Kingdom in 2021. In the US, only 19% of adults age 65 and older had gotten the COVID-19 vaccine in 2021 (19). This study also showed that the COVID-19 virus killed about 800,000 people from 2020-2022 in the United States (20). During the 2020-2021 flu season, 20,342 people in the United States died from the influenza virus. About 11,945 of those people were ages 65 and up. Elderly people get the same flu shot as the rest of the population, but they get a higher dose. We can protect the elderly population from a lot of viruses by encouraging vaccination in our community, cleaning and disinfecting our belongings frequently, and encouraging those who are sick to stay home (21).

These statistics show how important it is for both older people and younger children to get vaccinated for as many pathogens as possible. Infants who are nursed or breast fed have immune systems called passive immunity because the immunity from their mother is passed on to the child. This only protects the child for a few weeks and in these weeks, the child is still not fully protected against the viruses (22). Infants who are repeatedly getting introduced to new environments and stimuli, as well as older adults with weaker immune systems are more likely to

get sick. For the majority of your lifetime, you are getting vaccinated at least annually. According to the CDC, the vaccination schedule was made to help show us when and how many vaccinations we get (23).

## **Conclusions**

In this report, we demonstrated that widespread vaccination administration prevents the spread of diseases. Biological sex and age are important factors influencing side effects, vaccine uptake attitudes, symptoms, and more. Biological sex can impact our ability to respond to a vaccine and plays a part in if we are able or want to get a vaccine. Additionally, newborns and the elderly community are especially vulnerable to disease, so it is important to understand how your age might affect how well you react to vaccinations. These two factors are important to consider before getting a vaccine. Vaccination is a building block of public health. By deciding to get vaccinated, you are not only protecting yourself, but you are protecting those around you by building an extra layer of immunity that helps to prevent the spread of infection and severe disease. They allow your body to produce an immune response, minimizing disease severity. Vaccination is the best practice to protect our bodies from diseases, and important aspects like age and biological sex are certainly factors that can contribute to outcomes.

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## **Colorism in Magazines and How it Affects us By Savannah Minor**

"The anti-Blackness started with the idea that the Blacker you are, the less human you are,"- Dr, Degruy. People often do not talk about Colorism, hell there are a lot of people who do not even know what it is. They especially do not talk about the effect it can have on people of color. People are made to feel unimportant because their skin is darker. They get paid less, discriminate against more and a lot of time are not considered beautiful. We need to talk and acknowledge the difference that colorism can make. Especially in Magazines and social media you see how lighter skin tones are more popularized compared to deep skin tones that are overlooked.

Colorism has always been a thing, people favor lighter or medium skin tones over deep skin tones since forever. One example of open Colorism from the past is the brown paper bag test. The paper bag test was used in sororities to determine if someone was "too dark" to join. What they did is they would hold a brown paper bag to the one side of your face and if you were lighter than the bag you would be allowed to join. Though if you were darker then the bag they would reject you. Though it was not just sororities this was a commonly used method to discriminate against darker skinned people it was churches, clubs, and professional organizations. This method started in the early days of slavery and has just recently been stopped.

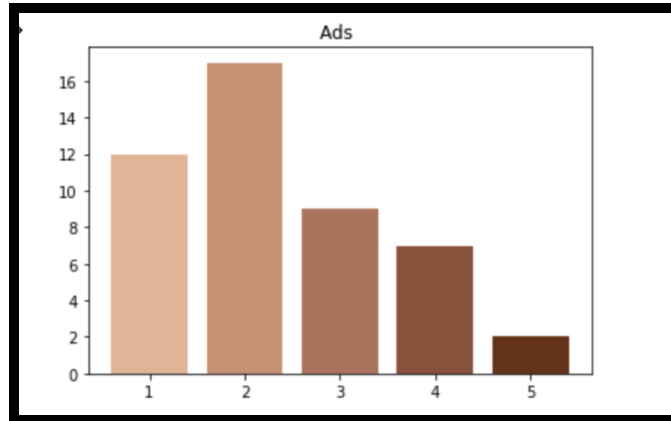
Colorism has been a serious issue for a while except no one recognizes it. So even though now we do not have colorist methods such as the paper bag test, or more like the shadow test does not mean that colorism is not happening everyday. It especially happens in the media. So if the images in magazines are mostly white it gives the idea that that is the ideal race. So it is so important to have diversity in magazines and social media to stop the idea of colorism. That is why my class decided to collect data based on diversity in skin tones. What we did was split into 8 different groups studying 4 different genres of magazines, Fashion, business, social, and sports. My article was an entrepreneur, a business magazine. We looked through the magazines and collected 10-15 pictures of both ads and articles to see the diversity in skin tones. So as you will see below are some graphs and tables from our data.

Percents – Breakdown by Context		
Entrepreneur	Articles	Ads
% Light	30.0%	63.6%
% Light-medium	10.0%	36.4%
% Medium	20%	0.0%
% Medium-Deep	20.0%	0.0%
% Deep	20.0%	0.0%
<b>Total</b>	<b>100.0%</b>	<b>100.0%</b>

Categorical data for Entrepreneur magazine (Minior)

In my article's two way table we used categorical data. You can see the difference in diversity between the ads and the articles. We divided the ads and articles we chose and divided our data into 5 different skin tone categories. As you can see for the ads of my articles there were only two skin tones represented: light and light- medium. Which are almost the same color and only represent light skin tones. While the articles could still have more diversity with light being the biggest category. There is almost a completely even representation in every category. So you can see the change that happens when comparing articles to advertisements. Articles most of the time you can not control who is talked about or is featured considering they are usually not biased. It is chosen based on acholiments and not what image they want to be shown. Of course they can still pick who is in the photo for the ads if there are multiple options. Though this does not happen as often. You see how darker skin tones do not see themselves represented nearly as much. We see that especially in ads.

Ads are all about the image you want to provide for your product. So it says a lot about what people think of darker skin tones if they are not represented. People do not realize the impact this can have on people who have darker skin tones, especially kids growing up. It makes them feel insignificant. Especially with beauty magazines or business magazines. Seeing only light skin tones make people think that I can not be beautiful, or I can not be successful because of the color of their skin. This message will always stick with them and is what we want to show to our future generations.



Numerical data for People magazine ads (Weinstein, miller, Melchor, Nicholas)

This is numerical data modeled in a bar graph from People magazine collected from another group in my class. We collected the bar graphs by finding three RGB values ( which is the combination of how much red, blue and green you need to create a color) from each ad or article. We then put it into a colab to bar graphs so we could see a visual of the representation. We see a similar pattern from my magazine Entrepreneur that the two highest values are light skin tones. Except a difference in People magazine is they do provide darker skin tones representative that are not even close as to what they have for light skin tones. People is a beauty magazine so it is very important to spread the idea that there is not a superior skin color. While looking between the two different data you see the difference between categorical and numerical data. It gives two different perspectives. We are also able to see the data represented both on a table / percents and an actual representation of the colors based on a bar graph. Even though there are two different data sets it gives a better understanding of what we are looking at. Though of course when doing any data collection you have to think about the biases that come with it. For example when collecting our photos we did not use every photo in the magazine and we had to pick 10. Unintentionally or internally you could pick only light skin tones or only dark skin tones. Especially can see bias when looking at categorical data you had control over what category a photo went into. So that could change the data. So it is important to think about that when looking at data.

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## **Shades of Bias: The Problem of Skin Tone Misrepresentation in Advertising and Media By Jesse Turner**

Colorism is racial or ethnic discrimination based on skin color. It prioritizes lighter-skinned people over darker ones (Oxford Language). Magazine portrayals of skin tones have been disputed for years. Some publications have made progress in representing a variety of skin tones, but more has to be done.

Publications have historically promoted lighter skin tones and Eurocentric features as beauty standards. Colorism is the result of an exclusive and constrictive beauty standard that makes many people feel underrepresented and alienated.

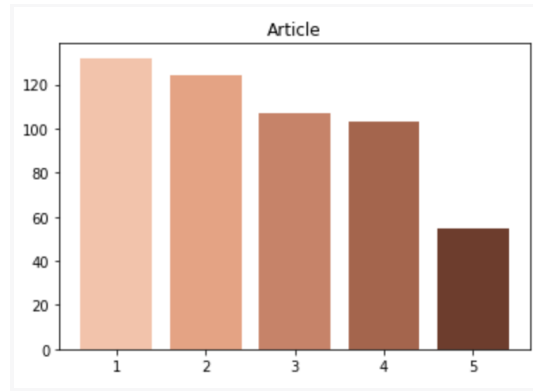
So one might ask, “is colorism actually present in the media (ads and articles)?” While watching videos about colorism, I have learned that there truly is a lack of skin representation in the media. Lack of diversity in the media industry is one of the main causes of colorism. Additionally, since lighter skin tones are thought to appeal to a broader audience, advertisers frequently push for models with those features. However, some magazines have recently made efforts to change this.

In our class, we conducted an experiment to see if colorism actually does exist in some of today's most popular magazines. We selected eight different magazines among four different genres: Sports Illustrated (sports), Sunset Outdoor Living (lifestyle), Vogue (fashion), People (lifestyle), Entrepreneur (business), Essence (fashion), FourFourTwo (sports), and Forbes (business). In the first few days of the experiment, we looked at all of those magazines and took 5-15 screenshots of the people present in both the ads and articles. We defined ads as anything trying to promote a product.

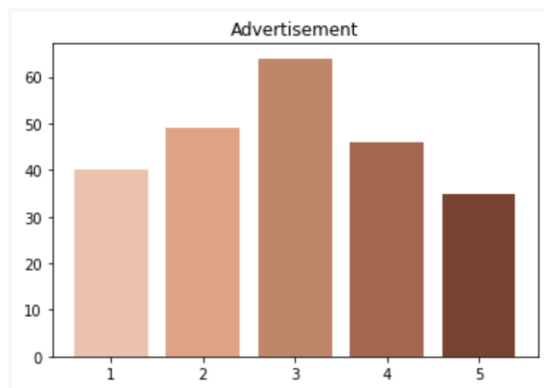
After breaking down our screenshots into two groups, we ran each group through an RGB color picker which gave us the RGB values of every color. “An RGB value is a digital color model used to represent colors on electronic displays, which is based on the intensity of red, green, and blue light. It is represented as a combination of three numerical values, ranging from 0 to 255, that indicate the amount of red, green, and blue light required to create a specific color” (eduCBA). We picked three different points from each screenshot to account for the lighting and shadowing that could affect the outcome.



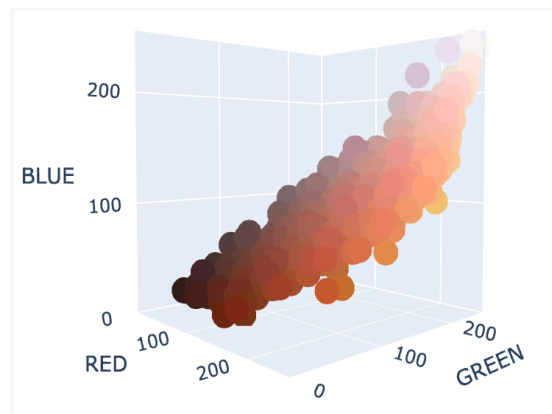
Finally, we ran our RGB values through a code that made a few graphs to make it easy to see which skin tones were most popular. Attached below is the scatter plot and bar graphs we got from the skin colors in both articles and ads.



numerical data for articles, (Turner)



numerical data for advertisements, (Turner)



3d scatter plot numerical data, (Turner)

Interpreting these images is hard to understand so let me try my best to explain it. As seen in these images, articles were made of mostly light skinned tone people but in ads the distribution was mostly even. So in our eight magazines, colorism is more evident in articles. A possible reason why colorism is more evident in articles is because they typically focus on conveying accurate, factual information rather than using models to promote a particular product. For example, a lot of articles are based on politics and the vast majority of politicians are white. However, as seen in the chart above, in ads, about 75% of people fell into the first 2 categories. This clearly shows the uneven distribution of races across magazines considering an even distribution would be 20% in each category or anything around that.

This task taught me that categorical data is more biased than numerical data because it is always prone to human error, whereas our numerical data was more factual. I also recognize that categorical data can be viewed differently and can be difficult, especially when choosing categories for each person since everyone could fit into 2-3 categories. Our experiment may have shown confirmation bias. “Confirmation bias is the tendency to interpret evidence as supporting one's assumptions or hypotheses” (Oxford Languages). If I wanted to believe colorism didn't exist, I might put someone who fits into 2-3 categories in the category that will make the data the most even.

Our numerical and categorical data yielded significantly different outcomes, and I prefer the numerical. Finding RGB numbers on a computer makes skin color more objective. Yet, because all advertising companies utilize editing and lighting, different portions of people's skin show different RGB values, making it impossible to determine their genuine skin tone. Our experiment reveals that colorism exists and that there are numerous ways to combat it.

Our data showed that articles have less of a skin tone variation than ads because articles are normally talking about a politician or a person in power and those people tend to be white. Regardless of colorism being a prominent problem in our society, we can take action to get rid of it. We can call out colorism when we see it in ads and articles and support and encourage those who are impacted by it. Together, we can create a culture where, regardless of skin color, everyone is respected for their inherent beauty and ability to express themselves.

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## Skin Tone Representation and Colorism in Magazines By Analinda Chaple

Colorism is the discrimination against people with a dark skin tone, usually among people of the same ethnic or racial group. Colorism is a huge issue in our world because it lowers a person's self esteem and confidence, but it does more than that. It puts an image to society that people with darker skin are not as attractive, and are not as equal to others with lighter skin tones. Now society believes that that is true, because of colorism.

The harsh and raging storm clouds hover over society, with the idea that “dark skin is not attractive” represented in many magazines. However, the data collected from different types of magazines show how society sticks with this idea that darker skin tones should not be represented in advertisements as much.

Through videos, readings, and class discussions, we have learned that many magazines use brightening products and filters to make the darker skin look lighter in the advertisements. As we collect data on magazine skin tone representations, we learn how this is, unfortunately, very true.

First, my group chose a magazine to analyze based on our interests. The one that looked most interesting and appealing to us, was Sports Illustrated, which was a magazine focused on the NBA. We then took screenshots of 15 images in the articles, and we only took 4 screenshots of advertisements that included skin, because that is all there was. We sorted the skin tones into different categories, as shown below. We compared articles vs. advertisements, so that we could get a better understanding of the skin tone representation.

Sports illustrated	# in Articles	# in Ads	Total	Sports illustrated	% in Articles	% in Ads	Total	Sports illustrated	Articles	Ads
Light	4	1	5	Light	80.0%	20.0%	100.0%	% Light	10.0%	25.0%
Light-medium	4	1	5	Light-medium	80.0%	20.0%	100.0%	% Light-medium	10.0%	25.0%
Medium	9	0	9	Medium	100.0%	0.0%	100%	% Medium	23%	0.0%
Medium-deep	17	1	18	Medium-deep	94.4%	5.6%	100.0%	% Medium-Deep	42.5%	25.0%
Deep	6	1	7	Deep	85.7%	14.3%	100.0%	% Deep	15.0%	25.0%
Total	40	4	44					Total	100.0%	100.0%

Categorical data in Sports Illustrated (Chaple)

<b>Percents – Breakdown by Skin Tone</b>			
<b>Entrepreneur</b>	<b>% in Articles</b>	<b>% in Ads</b>	<b>Total</b>
<b>Light</b>	30.0%	70.0%	100.0%
<b>Light-Medium</b>	20.0%	80.0%	100.0%
<b>Medium</b>	100.0%	0.0%	100.0%
<b>Medium-Deep</b>	100.0%	0.0%	100.0%
<b>Deep</b>	100.0%	0.0%	100.0%

Categorical data in Entrepreneur (Minior, Hlum, and Zeltser)

As shown in the data collected above, Sports Illustrated magazine has a vast majority of people with medium-deep to deep skin tones. However, in articles there were much fewer people with deep skin tones represented in advertisements than articles. According to this data, 94.4% of medium-deep skin tone representation was found in articles, while the other 5.6% was found in ads.

Since this magazine is focused on the NBA, there are more players with deeper skin tones. However, in many magazines such as Entrepreneur, it represents people with lighter skin tones in ads, and deeper skin tones in articles, because they are not always diverse. According to this data, 30% of light skin tones were represented in articles, while the other 70% were represented in ads. However, 100% of medium, medium-deep, and deep skin tones were represented in articles, while 0% were represented in ads.

The data collected from Sports Illustrated magazine is, however, biased because the amount of articles and ads are very different, there were 40 people represented in only 15 images in the articles. There were only 4 advertisements that were shown in the entire magazine with skin showing. This impacted the data collection completely because the data shows that the skin tone representation was lower in ads, making it look like the ads were less diverse, however that is not true. By collecting the same amount of data, with the amount of people, it will show a wider variety of skin tones and a more accurate analysis.

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## **Colorism in Magazines; Why do Magazines About the World not Represent The People in it? By Simone Graves**

People are not inherently bad, it seems as though everyone would like to believe that. But in some ways, discrimination and aggression based on race are impossible to avoid. What makes it worse is that sometimes, a lot of the time actually, people do not even realize what they are doing. They might just avoid someone who looks different from them. Or make the decision to associate with one person who does look like them. And before they know it, there is no diversity surrounding them.

This then brings up the topic of colorism which is widely seen as discrimination based on the shade of one’s skin (effectively the darker you are, the more discriminated against you will be). Because of course, racism is not always white versus black, it has got a scary amount of layers.

For example, in the video “Confessions of a D Girl: Colorism and Global Standards of Beauty”, which I watched in my high school Data Science class, Chika Okoro explains how lighter-skinned people (no matter their race) with natural hair are more likely to get a role in television productions than darker-skinned people with hair extensions (dark-skinned people are at the bottom of the call list–“D girls” as opposed to “A girls”).

After watching the Chika Okoro video, our class worked to figure out the frequency of this sort of accidental (or intentional) exclusion showing up in the media. So, in order to analyze this, we all chose from eight different magazines and selected around 20 images of people in each magazine in order to figure out which skin tones were most likely to show up. And in the travel magazine I analyzed (Conde Nast Traveler), there was a clear preference for highlighting people with lighter skin tones, expressing the colorism in media, whether it is subconscious or not.

Counts			
Conde Nast Traveler	# in Articles	# in Ads	Total
Light	6	19	25
Medium-Light	9	5	14
Medium	4	1	5
Medium-Dark	0	2	2
Dark	1	1	2
<b>Total</b>	<b>20</b>	<b>28</b>	<b>48</b>



This visual represents categorical data of the number of people selected from the magazine and their skin tones in a two-way table. This table also serves the purpose of expressing the differences between the inclusion in advertisements and articles.

Using this visual, it becomes clear that lighter-skinned people are the vast majority in both and are preferred. However, advertisements appear to be somewhat more exclusionary. An example of this is that the advertisements in this magazine have 19 light-skinned people featured and only a singular dark-skinned person. And the visual below expresses how that is over 65% of the total people in the advertisements!

Percents – Breakdown by Context		
Conde Nast Traveler	Articles	Ads
% Light	30.0%	67.9%
% Medium-Light	45.0%	17.9%
% Medium	20.0%	3.6%
% Medium-Dark	0.0%	7.1%
% Dark	5.0%	3.6%
<b>Total</b>	<b>100.0%</b>	<b>100.0%</b>

Categorical data in Conde Nast Traveler, created by Simone Graves

Clearly, in this table comparing the percentages of each skin tone in the magazine, it can be seen that lighter-skinned people are favored. In ads and articles combined, darker-skinned people make up only 3.6% of people in ads and 5% of people in articles (as seen on the second to last row of the table) whereas lighter-skinned people are featured in nearly 68% of ads and 30% of articles. The abundance of lighter-skinned people in this article implies a sort of bias, whether it be subconscious or not, that the media has for light-skinned people. Especially since advertisements, something more universal and not specific to a publication, have a more obvious preference for light-skinned people. This communicates how in general, there is a compulsion to include people who look lighter or even a compulsion to exclude those who do not.

However, despite the implications of colorism and bias that has been addressed, there is still the simple fact that there is bias in this study itself. As a mixed African-American author, I have a somewhat pessimistic outlook on the world, especially when it comes to racism. So, seeing as I selected the magazine, images, and the way to analyze them, I might have skewed the information subconsciously myself.

When selecting images for the study, I might have had a selection bias and been drawn to selecting lighter people in order to validate my pessimistic ideas about the world being stacked against people like me (showing confirmation bias). Or maybe it was the other way around. I could have not realized it, but been desperately searching to include people who looked like me in my selection, explaining why there seem to be a lot of people in the medium-light-skinned category of the table.

Then, when deciding what people/images to assign to which skin tone, I might have misjudged or mislabeled someone as more light or dark in order to prove a point. Also, when collecting the data, we accidentally included too many people in the advertisement category, somewhat skewing the look of the data because of that error (there were 28 images from advertisements selected and only 20 from articles).

Because of this, the research is definitely flawed. But to speak generally, most research is. Human error makes it impossible to not be flawed. However, these flaws should not take away from the importance of the topic and the reality of the situation. And the reality of this situation is that colorism and the distinct preference for lighter people is shocking. I analyzed a travel magazine, something that is specifically created to highlight the world and the people in it, yet not even five darker-skinned people were featured! There simply needs to be a change.

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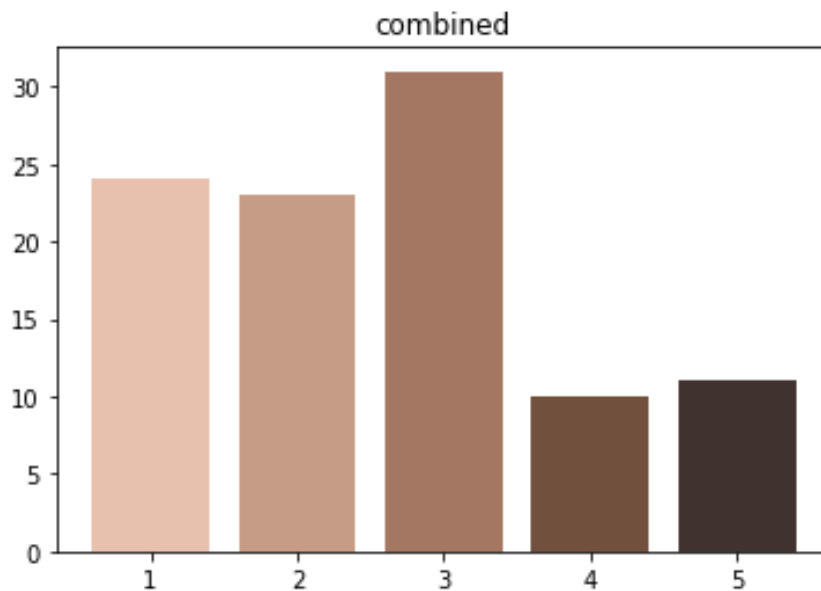
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## Does Vogue Have a Representation Problem? By Samantha Wilcox

Skin tone representation is something that has been lacking in media across the world for hundreds of years. A lack of darker skin tones being represented or praised is known as Colorism which is defined by Oxford Languages as prejudice or discrimination against individuals with a dark skin tone, typically among people of the same ethnic or racial groups. Although this is seen less in media that we consume than it was 60 years ago, the US is still not safe from the systemic misrepresentation of people of darker skin tones, especially in magazines like Vogue.

For some context, in my data science class we did a unit on skin tone representation in media, specifically magazines where our group could choose a magazine from a list of them to study. We collected data from both the ads and articles in the magazine that we chose and put the people in those ads or articles into 5 categories, light, light-medium, medium, medium-dark, and dark. My group chose American Vogue and we found that out of both ads and articles, there was an extremely high representation of lighter skin tones with little representation of darker skin tones.



Amount of people of each skin tone category from both ads and articles in Vogue Magazine

This is the data that we collected from ads and articles combined into one table. When going through the ads and articles, we noticed that there was a fair amount of people of color in the magazine yet almost all of those people of color had lighter skin tones, as seen with the large

amount of medium skin tones on the table. Additionally, in the articles section, we noticed that the people portrayed were either extremely light or extremely dark, also different from what we had expected before.

So what can we conclude from this? Well, after extensive analysis and picking my brain on how medium skin tones could be the overrepresented category, I came to the conclusion that even though Vogue has been moving into an era of more representation of people of color, the people of color that they portray tend to have lighter skin tones than the people actually found in their own ground of identification.

Additionally, I also began to wonder if looking at this categorical data, there could be some errors or bias such as my group and I placing people in the wrong boxes due to confirmation bias or the use of light and shadows affecting the appearance of the people in the magazine. There is always going to be something that is done wrong in an experiment, whether it is bias or human error, something will go wrong. I have realized that if I were to go back and look back at the people we picked from the magazine, maybe I would have put them in a different category or even picked different photos to analyze. Either way, there is always something that will change when we redo an experiment like the one my class did.

So to answer the question in the title, does vogue have a representation problem? My answer would be yes, and although they have improved over the years, there is still work to be done.

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## Colorism in Media: A Dark Truth By Margot Cox

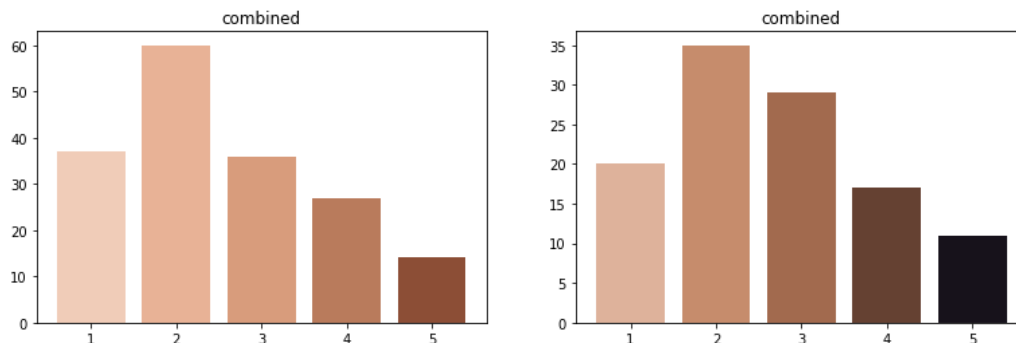
Media is undeniably one of the most powerful forces in the world, it can shape people's thoughts, actions, beliefs and the most minor aspects of life. Yes it can be helpful, but when used in the wrong way, it can do a lot more harm than good. Colorism is an example of some of the harm it can do. Of course companies can be subtle about it but in many media outlets, there is very little representation of dark skin tones.

Colorism is prejudice or discrimination against individuals with a dark skin tone, this happens not only between different races but more predominantly among people of the same ethnic or racial group.

For example, when researching the effects of colorism I read an article from CNN where I learned that in India, light skin tone is something idolized by many people. It is a beauty standard that has contributed to the multi trillion dollar company of skin lightening. Some mothers even take rumored skin lightening products while pregnant with the hope of making their child lighter, and there are a lot of other dangerous practices that go on.

While to some people, colorism might seem like a new concept, to others it is a rooted part of society that has harsh effects on someones mental and physical wellbeing. Which just proves how deeply racism and colorism go into some societies and cultures, it is something that needs to be talked about much more because the affects of it can be dangerous.

These visuals are proof of some of the underlying sources of colorism in society



In both these visuals, you can see a downward slope as the shades get darker. While the light to medium skin tones have a lot of representation, the dark-medium and dark shades come

up in much smaller amounts. While you might notice it while flipping through the magazine, looking at the data shows a trend that proves it may not be an accident.

Counts			
Magazine Name: People	# in Articles	# in Ads	Total
Light	17	8	25
Medium-Light	11	6	17
Medium	2	2	4
Medium-Dark	8	3	11
Dark	2	0	2
<b>Total</b>	<b>40</b>	<b>19</b>	<b>59</b>

Categorical data in People Magazine, created by Margot, Jaydi, Sebastian, and Daniel

The Essence	# in Articles	# in Ads	Total
Light	0	0	0
Medium-Light	2	2	4
Medium	2	5	7
Medium-Dark	5	5	10
Dark	0	2	2
<b>Total</b>	<b>9</b>	<b>14</b>	<b>23</b>

Categorical data in Essence Magazine, created by Eileen, Ross, Lamari

In People magazine, dark skin has the lowest amount of representation, with only two photos containing dark skin, neither of which are from ads. In Essence, it is reversed, only 2 photos show dark skin and they both came from ads. In fact, when I was collecting my data, in all the photos I collected, not one person had dark skin, the photos that represented dark skin were taken by my partner. Maybe medium or medium-dark but I did not see one photo containing a person with dark skin. After collecting and viewing data from both magazines, it is painfully obvious that dark skin has the lowest amount of representation. Looking at both the two way tables and the bar graphs, it is clear the raw data for light skin shows it has the highest amount of representation. This proves that there is little to no representation of darker skin tones in a couple of very influential media outlets, and looking at trends over time it applies to other



companies too. Both these magazines are widely known and sold in many places, CVS, Target, our corner bodegas; places we go into all the time. Meaning they have more influence than other companies, this puts more weight on the type of representation they choose to put in their magazines. The type of photos they actually choose and chose can be damaging because dark skin is so sparsely represented.

Considering all that I've said though, there are issues within our data collection process. Racism is obviously something we all know at least a little bit about, meaning going into this data collection and project, we already had an idea and bias about racism. It could have led to a confirmation bias because we may have gone into this expecting to find some sort of colorism. Our data also could have been susceptible to selection bias because we did not choose a magazine from anywhere, ever; we got it from a magazine library. We also chose only 8 magazines in total, all of which we chose based on our own bias. This can be hard because before we even collected data, our data sources could have been biased. Overall there are multiple possible issues with our data but colorism is not fake or made up. There is evident proof of this in society, there is no denying it's issues and effects. It is a real life issue that needs to be talked about in order for it to dissipate.

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## The Not-So-Inclusive 21st Century Magazines By Lucas Pavan

It is the 21st century. People have gained more rights and the world has become a more inclusive place for everyone- Wait a minute, practically everyone in this magazine is white, I thought while scrolling through magazines, collecting data. I did not think reading magazines was something that only white people did.

The issue that is making marketers seem like they are stuck in the 1950s, regarding race, is colorism. Colorism is discrimination against people with darker skin tones, not just people of a certain race. It is more of a problem within a race, with people wanting lighter skin because that is perceived as beautiful by fashion standards. This has been and still is an issue because people with darker skin can be made to feel like people with lighter skin are better than them, making society a less inclusive place. As a class, we researched the effects of colorism on people. According to an article from Pew Research, 14% more Hispanics with darker skin than lighter skin have said they faced discrimination because of their skin color, proving that it is not just racism causing skin-tone prejudice.

We collected numerical and categorical data by sampling screenshots of people from magazines, then categorized their skin tone and used an RGB color selector to determine what color their skin was.

AGGREGATE	Articles	Ads
% Light	32.7%	62.6%
% Medium Light	15.8%	12.9%
% Medium	14.0%	4.3%
% Medium Deep	18.1%	12.2%
% Deep	19.3%	7.9%
Total	100.0%	100.0%

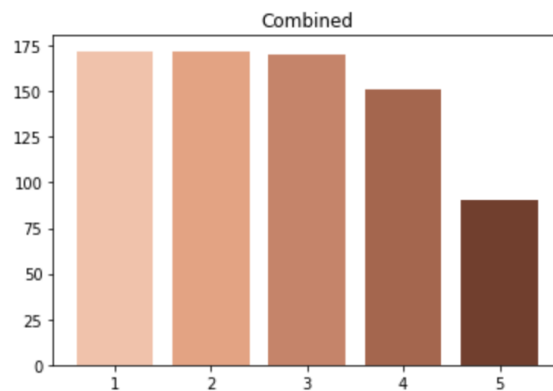
Categorical two-way table of skin tones from several magazines from aggregate class data

In the magazine articles and ads, the majority of people have lighter skin while the percentage of people with darker skin is much more common. The data was collected through screenshots of random people in several magazines, and sorting them into skin tone categories. This may affect accuracy, but it is clear that because the percentages of articles and ads gradually decrease from light skin to deep skin, magazines are targeting lighter-skinned people.



FentyBeauty (50 shades of foundation) used to categorize people into different skin tones.

We used the image above to categorize the people in the magazine images into different skin tones, Light, Light-Medium, Medium, Medium-Deep and Deep. This helped us analyze the skin tone data more efficiently. Although, we sorted them without any computer assistance, so we may have made some errors. The darkest skin tone of one category is very similar to the lightest skin tone in the category below it which could have caused some error while categorizing, causing people to be in one category when they should have been in another.



Numerical bar graph of skin tones from several magazines, articles, and ads combined (Griffin)

The bar graph shows a gradual decrease from light skin to dark skin, darker skinned people appearing much less in magazines. The numerical data were collected from screenshots of people in magazines, then put into an RGB color selector to get the skin color of the person. Both the

two-way table (categorical data) and the bar graph (numerical data) suggest that magazine editors include more light-skinned people in most magazines. The general decline in the bar graph as the skin color darkens shows how deeper skin tones are less prevalent in magazines.

The world has become a much more inclusive place over the last few decades, but with magazines having mostly lighter-skinned people, not everyone is represented. Magazine producers need to up their game in diversity, representing a wider variety of people, making the world a more inclusive place.

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# **Exploring the Public Perceptions and Consequences of the American 2022 Recession By**

## **Anqi Li**

### **Abstract**

Starting from 2022, with two consecutive quarters of negative GDP, the United States has by definition entered a recession. Previous research in this field has already pinned down the basic causes and the history of this recession, yet with the effects of it still unfolding, it's important to understand the U.S. public perception on this topic, in order to better predict its future consequences. Using the method of online survey, this paper will seek to capture the working U.S. citizens' economic identities and their opinion on the existing issues within the American economy, and how they should be remedied. Survey figures are generated for analysis, in which participants will be grouped by their age and income, to better understand their difference in perspectives. The survey results indicate perceptions of lower class, middle class, and upper class American citizens, in regards to their perceptions on inflation, the Federal Reserve Bank, their own spending habits, and the Biden's Administration's response to address the current economic conditions.

### **Introduction**

2022 has proven to be a difficult year for most countries in the world, as economies try to recover from the Covid pandemic with their growth hindered by political conflicts. With its two consecutive quarters of negative GDP growth, and an inflation rate of 7.1% (Ramirez), the U.S. has not been exempted from feeling the negative economic impact. The rising trajectory of the inflation rate could be seen in 2021, as the rebound of demands in markets such as tourism and second-hand cars drove the inflation rate to 4.7% (Whitmore). One year later, energy prices increased significantly as Russia cut off 88% of its gasoline supply to the European Union (British Broadcasting Corporation [BBC]), spreading the inflation in America beyond physical goods and into the service market, reaching the current figure of 7.1%, a new high since the past four decades.

In light of the existing problems in the economy, the Federal Reserve decided to tackle inflation by raising the federal funds rate from 0.08% in 2021 to 4.25-4.5% in December 2022 (Boards of Governors of the Federal Reserve System [FRB]). However, with the high interest



rate, America is currently experiencing recession. Although efforts are being made to mitigate this problem, their outcomes are overall less effective than expected, due the recession is still progressing with its causes and effects not entirely understood. This current economic recession will affect the everyday life of many in the U.S., both positively and negatively. Yet, how are these people affected, their perspectives of the United States economy, and their future decisions based on their demographics are topics not entirely explored by the academic world.

The purpose of this research is to investigate the public understanding of the current economic climate, how they are affected by this inflation, and the future consequences of the 2022 recession in the U.S. economy in order to better understand the public need and further remedy the present issues. Challenging variables to this study include survey participants' limited economic experiences, potential personal biases, and the non-definitive state of the current recession as it's an on-going crisis. This research will add to the work on the phenomenon of economic recessions seen through the lens of American citizens and could further affect the making of upcoming policies as these policies pertain to the preferences of the U.S. citizens. The following questions are formulated to guide this study:

1. To what degree is the U.S. public aware of the current recession and the government's methods of remedying it?
2. How has the recession affected their daily life in consideration of income, spending, investment, and employment status?
3. How will their economic decisions change based on the current economic climate, and how will these decisions affect the economy?

### **Methodological Approach and Research Design**

This research is a survey study employing qualitative methodologies, and the rationale for this method is to gather data from a large participant group with different backgrounds, thus reducing the biases that might exist within the sample, in the meantime also generating statistical trends that could be used in analyzing the current economic climate. This survey produces data on the participants' employment status, spending habits, income level, and opinions on the economy and the U.S. Government. Questions and sub-questions in this survey are grouped into four categories, (a) participants' income level, spending habits, and investment plans, (b) their unemployment status and reason, (c) their knowledge of the current American economy, (d) their

opinion on the economy and the government. All questions are written in English and the participants are expected to be English speakers. Certain questions included in Section C are adapted from Survey of Americans and Economists on the Economy (The Washington Post [WaPo] et al., 1996). For specific survey questions, see Appendix B.

The population of this survey consists of randomly selected working-age U.S. citizens, currently living in the United States, between the age of 18 to 65. The survey was self-administered on the online platform of Survey Monkey. Phase one of the survey consisted of searching and analyzing the common trends between responses. Phase two consisted of finding the relations between the common trends and scrutinizing how these trends will impact the U.S. economy in the future using basic macroeconomic concepts.

### **Participants' Demographic**

Out of the 218 participants, the average age is between 35 to 44, with 95 of them being male, and 121 being female. Most participants, (65.44%) are White Americans, and accounting for professions, the industries with the highest participants' participation rate were education (11.57%), healthcare (10.65%), and retail / wholesale trade (9.72%). As for the participants' regions, they are distributed evenly across America, with most of them from East North Central (20.18%), South Atlantic (16.06%), and the Middle Atlantic (14.68%). Most participants are from the middle class (66.51%), and out of all of them, 69.91% are currently employed with most of them staying employed during the Pandemic (53.70%), and another 13.43% of them were able to find new jobs. However, 10.65% of the participants lost their jobs during this time, with another 15.28% staying unemployed throughout this period.

### **Findings on the Participants' economic status, income level, and investment types**

How do you expect your annual income in 2023 to change compared to 2022?

Answered: 216 Skipped: 2

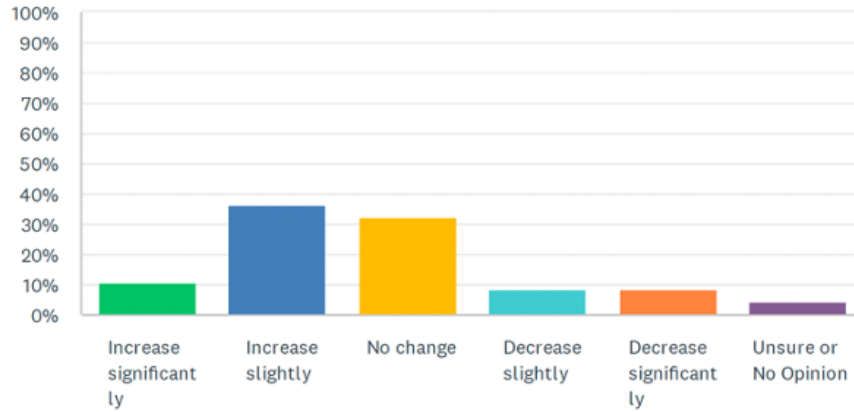


Figure 1. Participants' expectation on the change of their 2023's annual income.

It is seen that most participants expected their income to increase slightly (36.57%) or are anticipating no change (31.94%). With only a small population of the participants expecting their income to increase drastically (10.65%), decrease slightly (8.33%) or decrease significantly (8.33%).

How do you expect your annual spending in 2023 to change compared to 2022?

Answered: 216 Skipped: 2

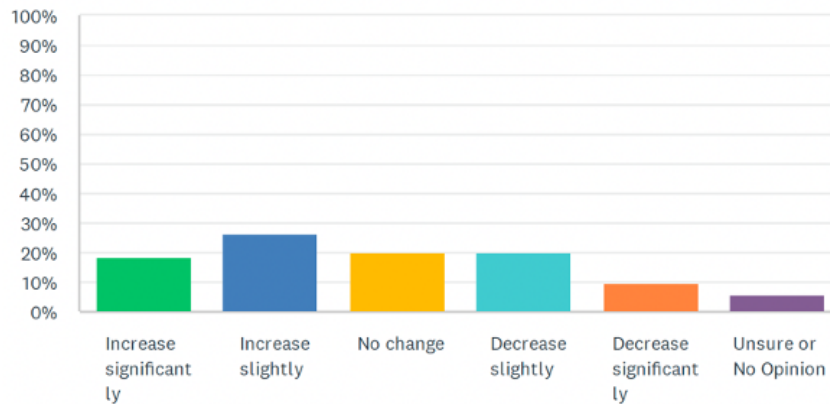


Figure 2. Changes in their 2023 annual spending anticipated by participants.

A large group of participants anticipated either a slight increase (26.39%) or a significant increase (18.52%) in their 2023 annual spending. However, there's also a substantial number of participants that believe their future annual spending is not going to change (19.91%) or is going to decrease slightly (19.91%).

Have you noticed an increase in your utility bills (Electricity, Heating, Water, etc) currently?

Answered: 216 Skipped: 2

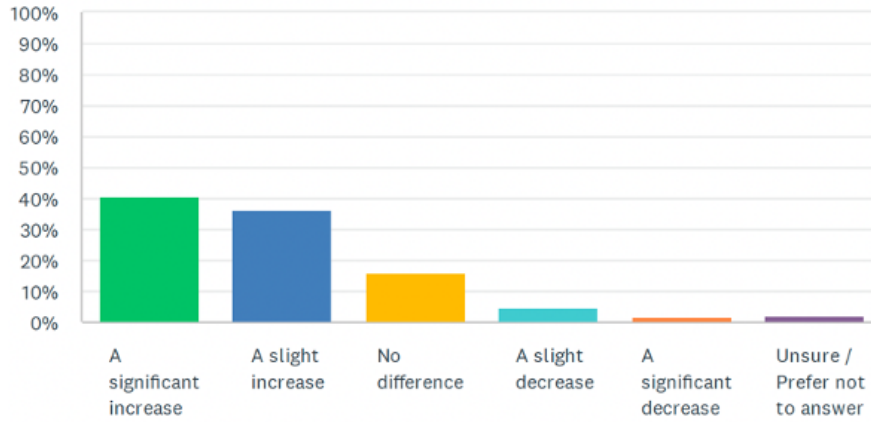


Figure 3. Changes in participants' utility bills year-to-year.

This figure shows a clear trend of a significant increase (40.28%) and slight increase (36.11%) in participants' utility bills, with only 15.74% of the participants not noticing a difference, and 6.02% of the participants feeling a slight decrease or a significant decrease.

How have the changes in expenditures (Utilities, daily necessities, etc) impacted your budgeting / spending habits?

Answered: 216 Skipped: 2

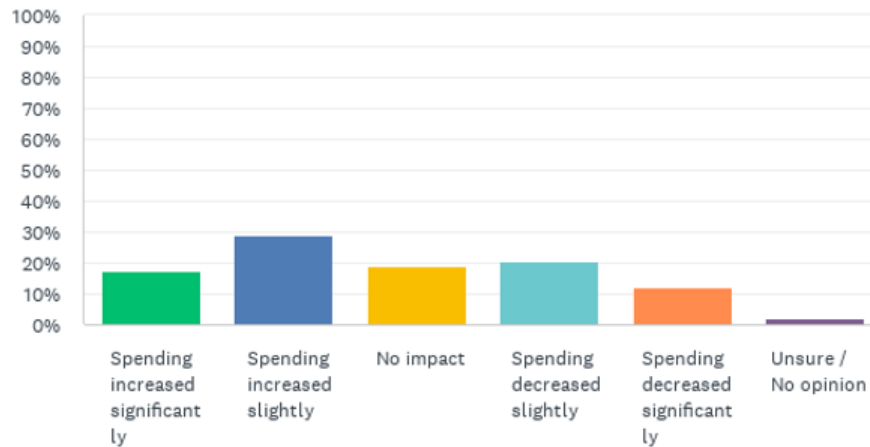


Figure 4. Changes in participants' spending habits

It is seen that a significant number of participants feel that their spending on daily expenditures has increased slightly (28.70%). However, there are also many who felt that their spending has decreased slightly (20.37%) and a slightly smaller percentage of the participants

feeling that the fluctuations of their daily expenditures had no impact on their spending habits (18.98%), followed by 17.59% of the people believing there has been a significant increase.

Q33 Do you plan on making any qualified withdrawals from any of the investments you have selected in 2023? (Please select all that apply.)

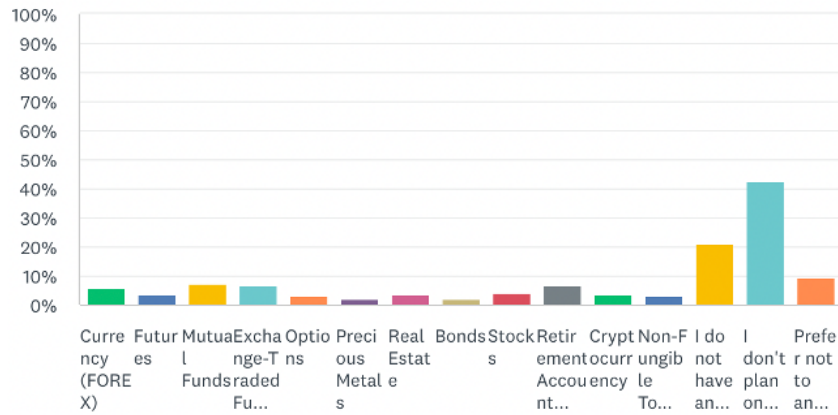


Figure 5. Anticipation on withdrawals of investments participants currently possess in 2023.

42.59% of the participants don't plan on withdrawing any of their economic investments in the upcoming year. However, 14.35% of the participants do reckon on withdrawing from mutual funds and retirement accounts, two of the most popularly held investments by participants. Apart from these two, 6.94% of the participants plan on cashing out from Exchange-Traded Funds (ETFs), and 6.02% are expecting to withdraw currency (FOREX).

Are you planning on making any new investments in the following during 2023? (Select all that apply)

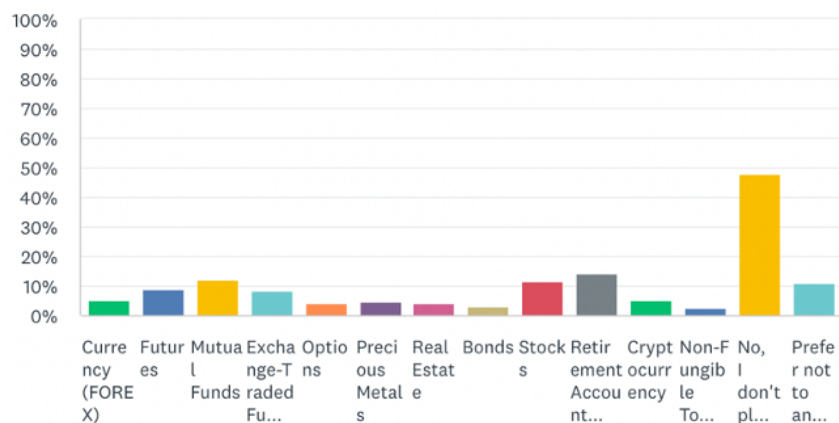


Figure 6. Participants' anticipation on adding new economic investment types in 2023.

Almost half of the participants currently have no interest in adding any new types of economic investments in the upcoming year (48.15%). Yet, despite being the most anticipated

investments to be withdrawn in 2023, retirement account (14.35%), mutual funds (12.04%), and stocks (11.57%) are still ranked the most popular in the participants' future investment plans, with NFTs (2.78%) being one of the least popular.

### Findings on the Participants' unemployment status and reasoning

Q29 If you are currently UNEMPLOYED, and IS actively looking for a job, what is the reason for your unemployment? (Please select all that apply)

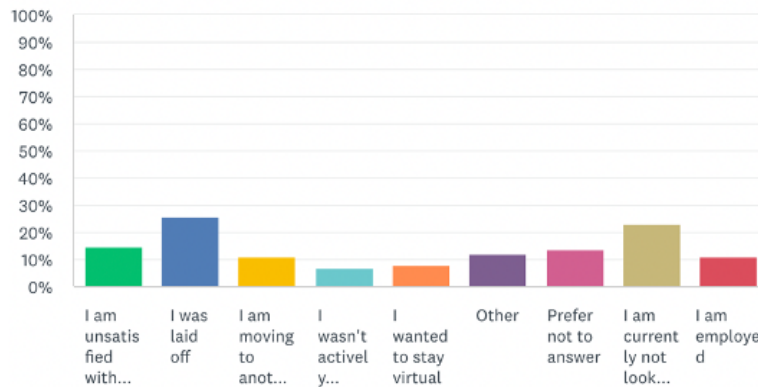


Figure 7. Reasons for the unemployment status of participants actively looking for jobs.

Out of the 39 actual responses, almost half of the participants were laid off (48.72%) by their previous employers, with another 28.21% leaving because they are unsatisfied with the wages and treatments offered to them. Additionally, 20.51% of survey takers were moving away to another location thus being forced to leave their previous jobs, and 23.08% of them are unemployed due to reasons unlisted in the options.

Q30 If you are currently UNEMPLOYED, and NOT actively looking for a job, what is the reason for your decision? (Please select all that apply)

Answered: 76 Skipped: 142

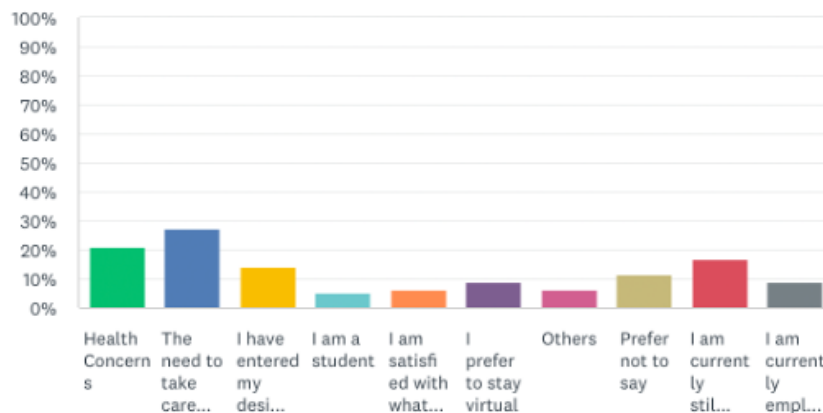


Figure 8. Reasons for the unemployment status of participants not actively looking for jobs.

Of the 73 actual responses, the majority of participants either had the need to take care of their families (28.77%), had health related concerns (21.92%), or had entered their desired retirement age (15.07%) that led to them not being able to stay within the workforce.

**Findings on the participants’ understanding and knowledge of the U.S. economy**

Do you think there is currently an Inflation or a Deflation in the United States?

Answered: 216 Skipped: 2

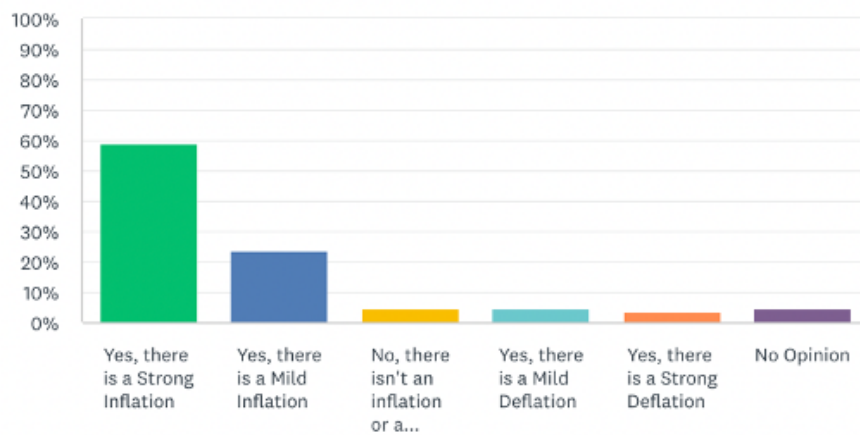
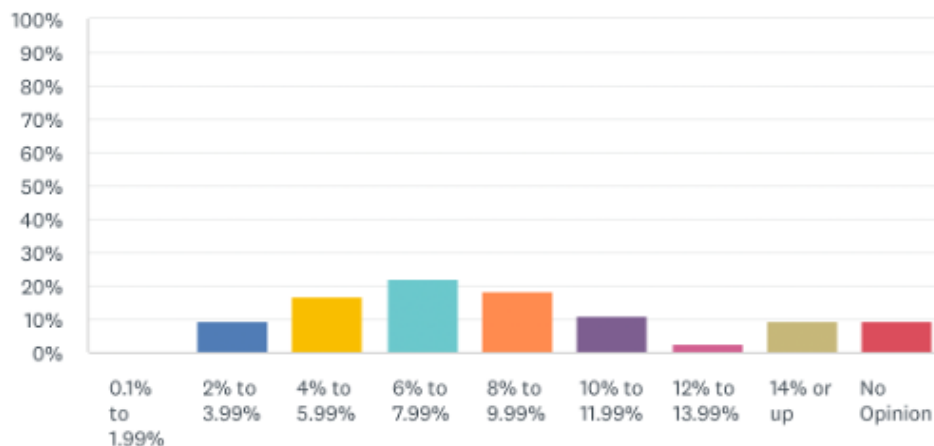


Figure 9. Participants’ awareness of the current U.S. inflation.

The graph above shows a clear trend that most participants believe there’s currently a strong (58.80%) or at least mild inflation (23.61%) in America.

Just your best guess: what percentage is the current U.S. inflation rate? (Please do not search for the answer online)

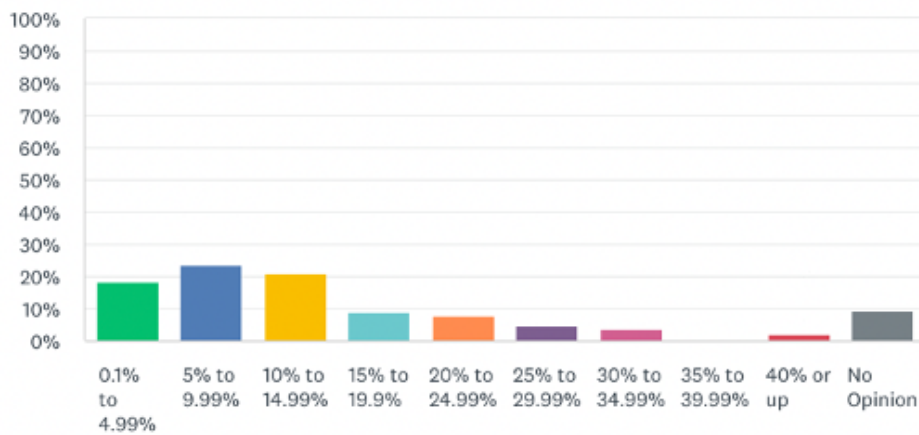
Answered: 216 Skipped: 2



*Figure 10.* Participants’ estimated current U.S. inflation rate.

Of all the answer choices, “6% to 7.99%” was the most selected (22.22%), which also contains the correct answer of the current 7.1% inflation rate. The second and the third most selected were “8% to 9.99%” (18.52%) and “4% to 5.99%” (16.67%), which are just slightly off the correct answer, either by 3% larger or 3% smaller. And of all participants, 9.26% chose “14% or up”, which is double the correct answer.

Q22 Just your best guess: What percentage of Americans are currently unemployed but looking for work? (Please do not search for the answer online)



*Figure 11.* Participants’ estimated current U.S. U-3 unemployment rate.

Unlike *Figure 10*, the option “0.1% to 4.99%” which contains the current U-3 unemployment rate of 3.5% in December 2022, was not the most chosen (18.52%). Most participants believe the unemployment rate is slightly higher, from “5% to 14.99%” (44.91%).



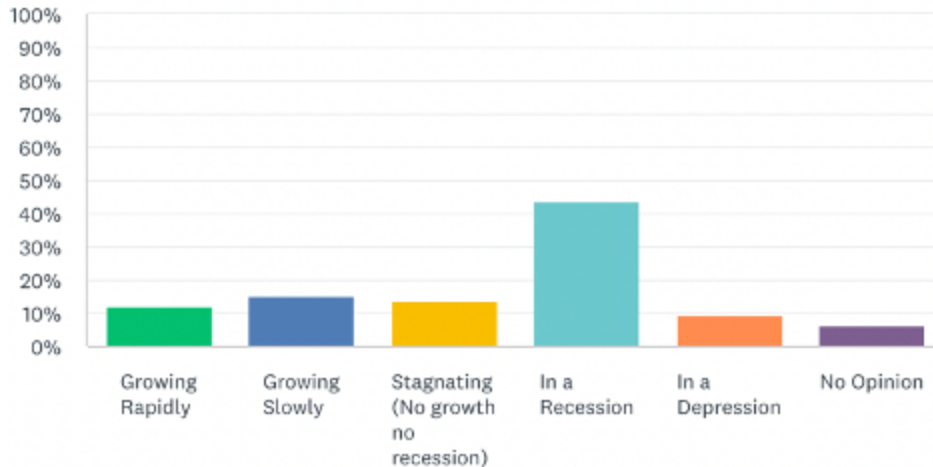


Figure 12. Participants' perceptions on the current American economic situation.

The figure above shows that nearly half of the participants believe that the U.S. economy is currently in a recession (43.52%) along with a small population reckoning that there could even be a depression (9.26%).

Which TWO of these problems do you think are the most important issues the American Economy is facing currently?

Answered: 216 Skipped: 2

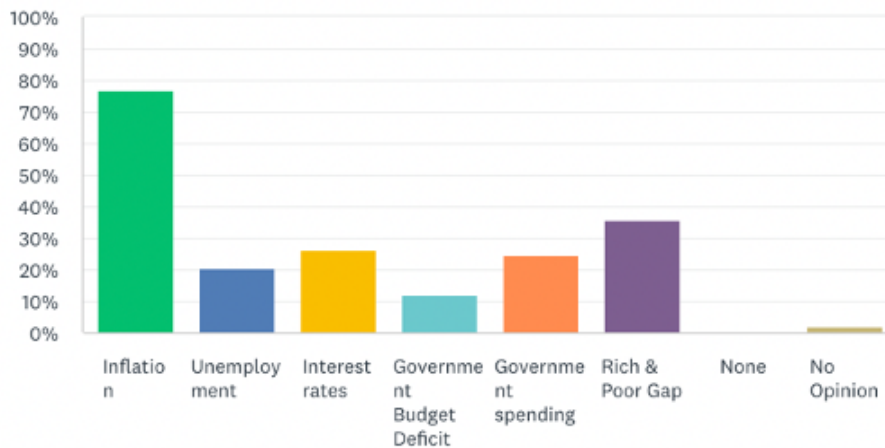


Figure 13. Two major issues that need to be addressed in the U.S. economy.

This is a question that allows the survey takers to choose up to two options, and out of all 424 actual responses, 166 answers believed that one of the most urgent issues that need to be addressed is the current inflation (39.15%), followed by the other most perceived problems being rich & poor gap (18.16%), and interest rates (13.44%).

Thinking about the Interest rate in America currently, do you think it is...

Answered: 216 Skipped: 2

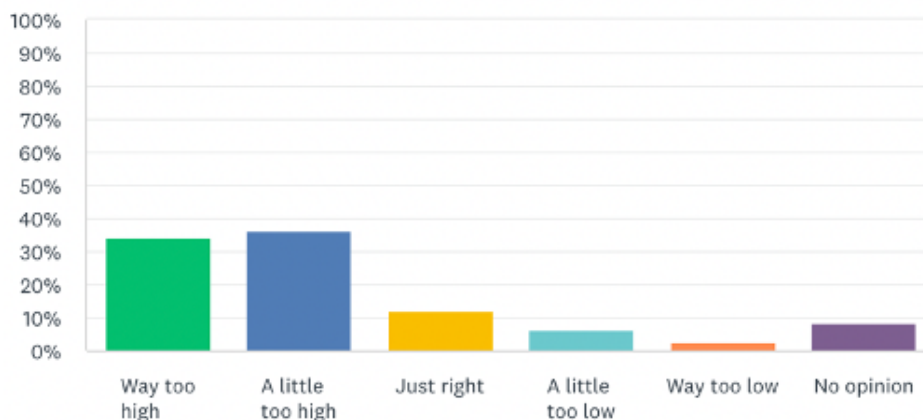


Figure 14. Participants' opinion on the height of the U.S. interest rate.

Although the height of the interest rate is not perceived as one of the most pressing issues within the current U.S. economy, most of the participants under this question still believe that the interest rate is either way too high (34.26%) or a little too high (36.11%).

Thinking about Government spending in the U.S. currently, do you think it is...

Answered: 216 Skipped: 2

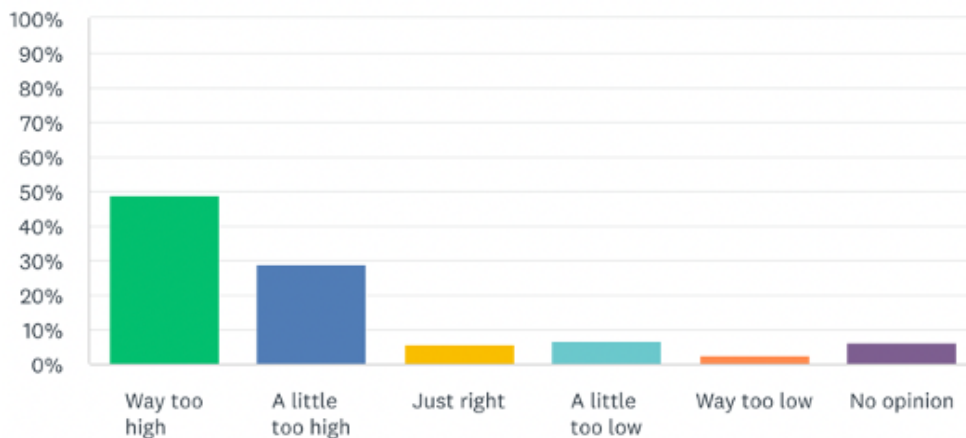


Figure 15. Participants' opinion on the height of the U.S. Government spending.

The responses collected in this question shows a very similar trend compared to Figure 14, with the majority of the participants believing that the government spending is currently way too high (49.07%) or at least a little too high (29.17%).

### About 2022's Inflation, do you think the government is...

Answered: 216 Skipped: 2

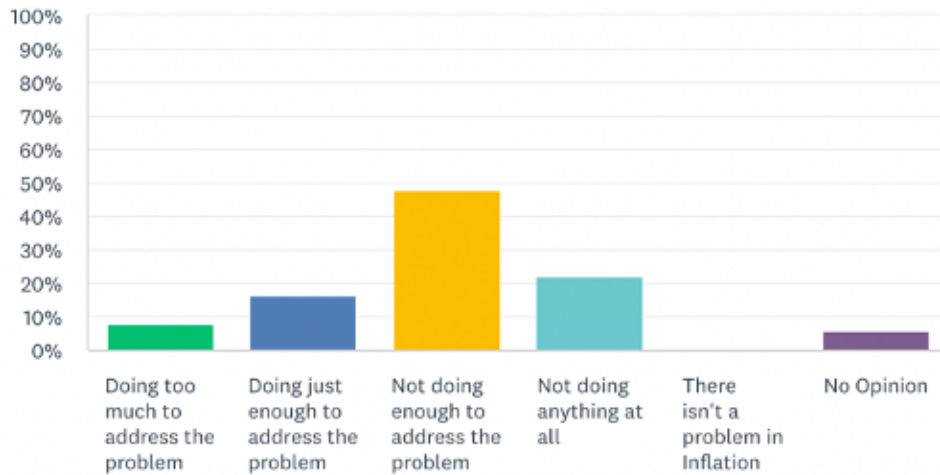


Figure 16. Participants' approval of the government's methods on tackling inflation.

Of all the participants, none believe that inflation isn't a problem, with almost half of the survey takers feeling that the government isn't doing enough to address this issue (48.15%) or that the government is doing nothing at all (22.22%).

### How often does the Federal Reserve do what is in America's best interests?

Answered: 214 Skipped: 4

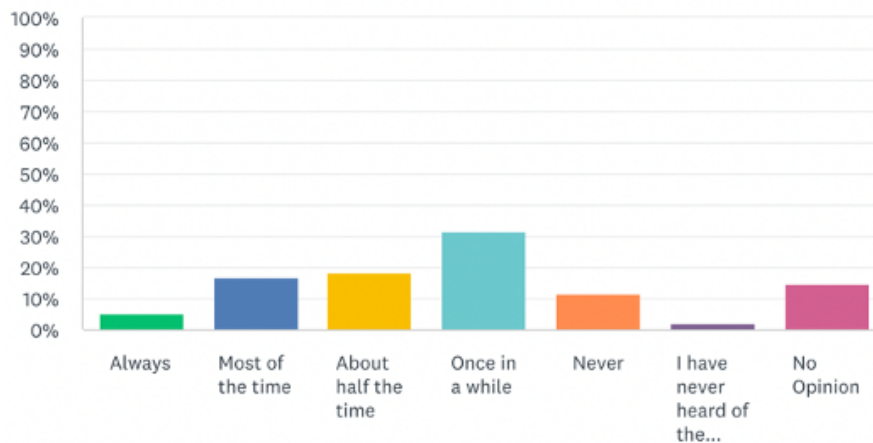
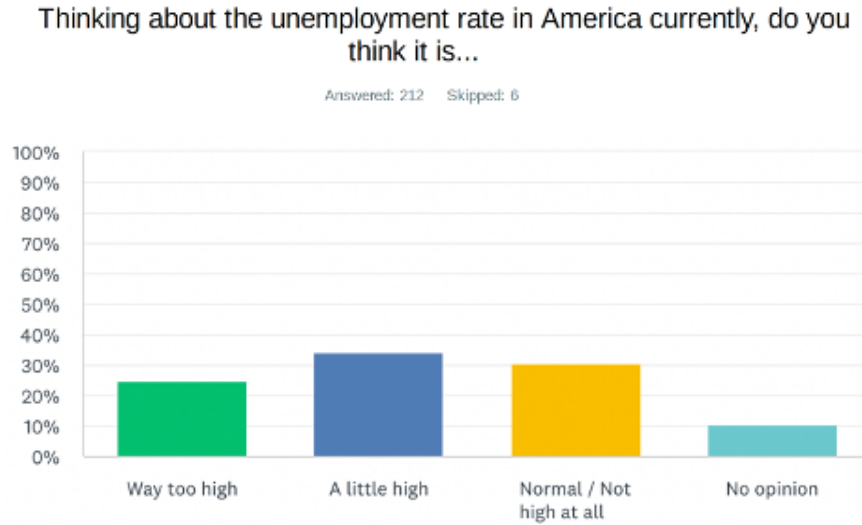


Figure 17. Participants' opinion on the Federal Reserve's methods on solving economic issues.

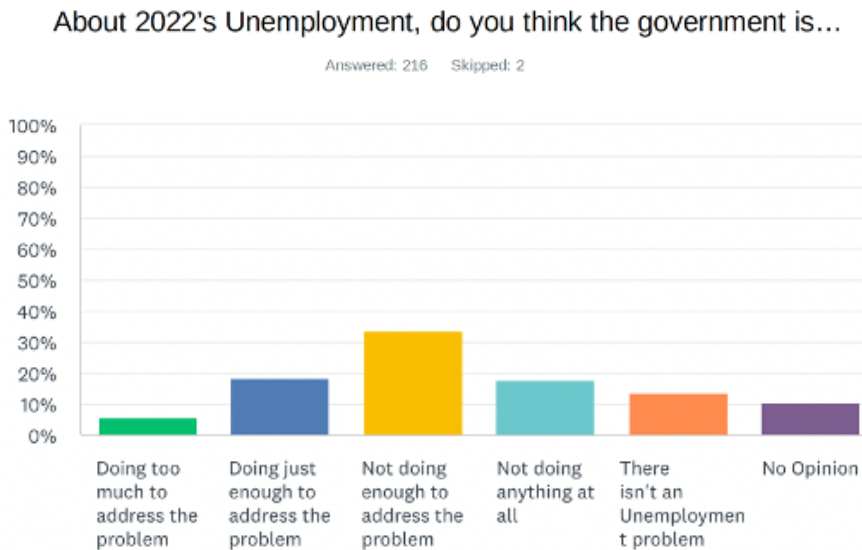
The opinions under this question are mixed, as although a significant number of participants believe the Federal Reserve only does what's best for America's interest once in a while (31.78%), there also a large population of participants that reckon the FRB is much more

trustworthy, with the belief that it does things right about half of the time (18.22%), most of the time (16.82%), or even always (5.14%).



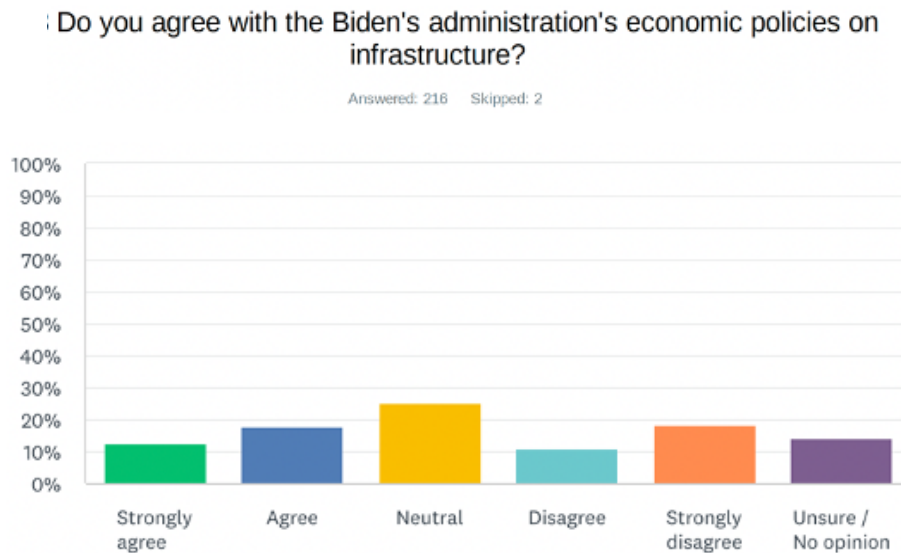
*Figure 18.* Participants’ perceived height of unemployment rate.

33.96% of the participants believe that the current unemployment rate is a little high, with a slightly smaller population reckoning that the rate is normal (30.66%). However, there are also 25.00% of the survey takers that think the unemployment rate in America is currently way too high.



*Figure 19.* Participants’ approval of the government’s methods on tackling unemployment currently.

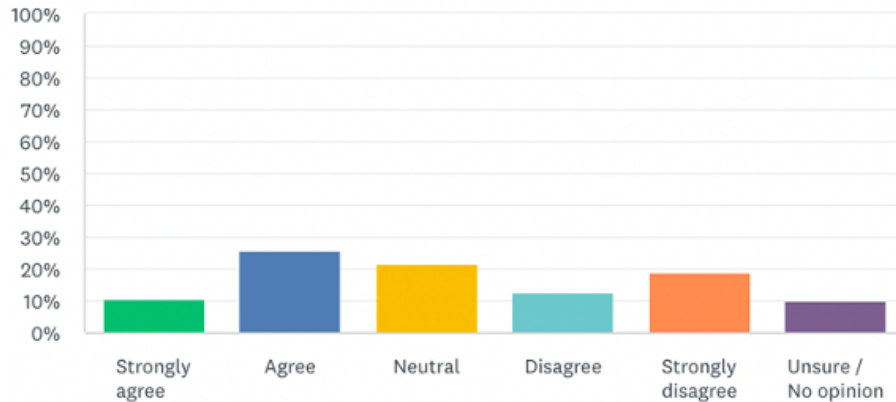
Unlike *Figure 16*, this figure has significantly more people believing that there isn't a problem in unemployment (13.43%). For the rest of the participants, the data collected in this question is distributed somewhat evenly with a large number of survey takers believing that the government is not doing enough to address unemployment (33.80%), and a very close difference between participants reckoning the government is doing just enough to address the problem (18.52%), and participants reckoning the government is doing nothing at all (18.06).



*Figure 20.* Participants' approval on the Biden's Administration's economic policies on infrastructure.

A large group of participants is feeling neutral on the infrastructure plans made by the Biden's Administration (25.46%), with a similar number of survey takers feeling either positive, as 30.56% of them either agree or strongly agree with the policies made, or negative, as 29.63% of them either disagree or strongly disagree with these policies.





*Figure 21.* Participants' approval on the Biden's Administration's five trillion-dollar economic stimulus spending.

The participant opinions under this figure seem more polarized, as less people felt neutral on this topic (21.76%) and more participants are either strongly disagreeing (18.98%) or agreeing (25.83%) with their spending. There's also an increased population who somewhat disagree with the Biden's Administration's economic spending (12.50%) and a decreased population who strongly agree with their actions (10.65%).

## Conclusions and Discussions

The participants are grouped into smaller sets by income level and age. For the income groups, 35 participants belong to the lower class, 145 participants belong to the middle & lower middle class, and 25 participants belong to the upper class. As for the age groups, 73 participants are currently in early adulthood who are between the age of 18 to 34, 52 participants are currently in early middle age who are between the age of 35 to 44, and 93 participants are currently in late middle age who are between the age of 45 to 64.

### Participants' income status and spending habits

For the income groups, an obvious trend could be seen in the data collected: the wealthier the participants are, the more they expect their future income to increase. 40.00% of the lower class participants expect their income to stay the same next year, while only 30.34% of the middle class and 25% of the upper class expect their income to be unchanged. This means that the lower class will be the most susceptible to the rising price level as the recession unfolds, since their income would stay the same while the prices of their daily necessities and utility bills increase

drastically. This is made worse by their tendency to be the most heavily impacted population during economic crises as they usually have smaller savings compared to richer classes and are less flexible when faced with economic difficulties.

The lower class indeed facing a rising price level is confirmed by their awareness of the increase of their utility bills, as 71.41% of the lower class participants recognize such changes. Middle and upper class's economic statuses are also worsened as more than 30% of the middle class and more than 50% of the upper class also recognize an increase in their daily expenditures.

How these impacts affect the participants' economic spending is tangible since participants have made modifications to their spending habits accordingly, especially the lower class. For the upper and middle classes, most participants had their spending habits unchanged. However, for the lower class, the data distribution becomes much more polarized as most participants either increased their spending slightly (34.29%), significantly (17.14%), or had their spending significantly decreased (28.57%), with only 8.57% of the lower class population believing that their spending habits are unchanged.

This is another confirmation that the lower class are less flexible when encountering economic difficulties, as they often have to modify their spending habits based on the fluctuations of the price level. The polarization in the data distribution could be explained by the fact that some lower class families have enough savings and thus could increase their spending accordingly, while other less fortunate families are less resourceful and could only resolve to reduce their expenditures significantly to cope with the rising price level.

A surprise finding here is the lack of spending incentives in the upper class, as 50.00% of them expect their annual expenditure in 2023 to either decrease slightly or significantly. This is especially troublesome since the upper class, which consists of the top 20% of earners, makes up 40% of the U.S. consumer spending (Goodkind). Although the reduction of their future spending could further reduce the current high inflation, it could also lead the economy to sink deeper into recession as the flow of currency slows down, especially since the federal funds rate is already high and the inflation already showing a tendency of reduction. Still, this could be good news to the Biden's Administration's infrastructure plans. President Biden and the Congress have been struggling to keep up with their aim to build highways and networks for U.S. citizens, and the \$550 billion budget has accomplished much less than the bill has promised due to rising raw

material prices and wages (Snyder). If the price level were to decline, then they might get a chance to catch up on the constructions that have been delayed.

The economic flexibility of participants from different class could also be seen in their investment plans, as the lower class, being the least flexible, also have the least amount of participants currently possessing economic investments: 65.71% of the lower class participants don't currently hold any investments, while the same is only true for 20.69% of the middle class and none of the upper class participants. This could be good news for the lower class survey takers as many investment types have suffered severely due to the 2022 recession, including price drops in precious metal and bonds markets, and most of all, the crash of cryptocurrencies.

However, despite the current investment market struggles, they do not discourage middle class and upper class investors to continue their investments, as 52.94% of the middle class participants and 75.00% of the upper class participants indicate that they do not wish to make any qualified withdrawals from their investments in 2023. But that is not to say the investors are encouraged to make more investments either, as 62.86% of the lower class participants, 46.21% of the middle class participants, and 37.5% of the upper class participants, don't plan on adding any new types of investments either in 2023. In the investments that they do plan to add, the most popular are retirement accounts, stocks, and mutual funds. While how the investors are doing in mutual funds and the stock market depend on the specific companies involved, the retirement accounts are not looking good as they continue to lose money due to the recession. Still, their level of struggle isn't nearly as bad as cryptocurrencies, which 12.5% of the upper class participants plan to make withdrawals in 2023. The data indicates that participants seem content in waiting out the current economic situation, with no drastic responses to the market fluctuations at this time.

### **Participants' Unemployment Status and Reasoning**

Accounting for the participants' employment status, it has been discovered that the higher the annual household income participants receive, the likelier they are to be employed. For participants not actively looking for jobs, the reason for their exit of the workforce is different depending on their income class: 42.11% of the lower class unemployed participants are concerned over health-related issues, while only 17.39% of the middle class participants and none of the upper class participants are worried over this issue. Moreover, only 10.53% of the



unemployed lower class participants are concerned over the need to take care of their families, while this is a legitimate issue for 36.93% of the middle class participants and 20.00% of the upper class participants, leading them to quit their jobs. This finding can be explained by the fact that healthcare in America is extremely expensive. During 2020, the healthcare spending per person in the U.S. was \$11,945, over \$4,000 more expensive than other high-income nations (Wager et al.). This could lead to many poor participants not having the economic abilities to pay for their medical treatments and thus would need to avoid getting sick, for example, going to work and catching Covid. In the same sense, because the middle and upper class participants are more flexible in their economic decisions, they could afford one of their family members staying at home to take care of the family, while the other family members work to cover their expenditures.

As for the unemployed participants remaining in the workforce, their reasons for unemployment depend on their economic status as well. 26.32% of the unemployed lower class participants quitted their jobs due to them not being satisfied with their wages and treatments. However, this only happened to 13.64% of the middle class participants and none of the upper class participants. Possible explanation is that although working in education (11.43%), healthcare (8.57%), and food services industries (8.57%) are popular among lower class participants, these industries are all known for providing low wages, few better treatments, and have been struggling to keep workers (U.S. Chamber of Commerce [USCC]).

For the age groups, a major finding here is that a substantial number of late middle-aged participants existed in the workforce due to them retiring early (19.35%). Previous studies have also reported trends in working aged citizens retiring early, and this could significantly worsen the already struggling labor market in America, as companies fail to find workers to fill in job vacancies. Currently there are 10 million jobs available, but there exist only 0.8 job seekers per job (U.S. Bureau of Labor Statistics [BLS]). Workers retiring early would add to the already high job vacancy rate and make the current recession harder to remedy.

### **The Participants' Awareness of the Economic Figures**

Though the recession is affecting all participants of this survey, not all of them are aware of the current U.S. economic situation. Although the lower class participants should be the ones influenced most heavily by the rising inflation, almost half of their responses (42.85%) have an

estimated inflation rate much lower than the actual rate of 7.1%, with only 25.71% of them getting an estimation above the correct level of inflation. While only 24.14% of the middle class participants and 20.84% of the upper class participants have an estimation below the current inflation level, and almost half of the middle class participants (46.21%) and upper class participants (45.84%) obtained an estimation beyond this level. This may indicate that the lower class participants are not fully aware of how inflation impacts the American economy and their daily expenditures.

But the same cannot be said with the estimation of the unemployment rate. It is clear that unlike the estimation for inflation rate, the lower the annual income a participant receives, the higher their perceived unemployment rate is. 79.93% of the lower class participants obtained an estimation above the current U-3 unemployment rate of 3.5%, yet only 72.41% of the middle class participants and 70.84% of the upper class participants perceived a higher-than-current-level unemployment rate.

The difference between the estimation trends in inflation rate and unemployment rate could be explained by the different situation and everyday lives participants from different classes live. For the participants that belong to the lower class, it's relatively easy for them to see how many people around them became unemployed during the recession, and due to many of them being laid off or quitting their jobs, the number should not be too low. However, although they face a rising price level, it could be difficult for them to translate that increase into inflation rates. Thus, it would make sense for them to obtain a high estimation for unemployment rate, but low estimation for inflation rates. And as for the middle and upper class, their being more accurate on the estimation could be caused by their active involvement in economic investments, and thus being more familiar with the current figures in America's economy.

### **Participants' Opinions on the Economy and the Government**

Regardless of income and age, over 40% of all participants believe that America is currently in a recession, and they might not be wrong. By definition, after two consecutive quarters of negative GDP growth, America is already in a recession (LaPonsie & Kerr). However, not all participants agree on what are the most pressing issues and how appropriate are the ways the government uses to remedy this recession.

It is no surprise that over 60% of participants from all income classes believe that one of the most pressing issues that currently exist within the U.S. economy is inflation, and over 30% of the participants also believe that the increasing wealth gap also needs immediate remedy. The wealth gap has always been a problem in America, but is getting much more prominent when combining it with inflation. Since wages for lower income workers don't tend to rise as quickly as for workers with higher incomes, the rising price level would mean that the poor get poorer while the rich stay where they are or get even richer. Another interesting finding is that the numbers of participants that believe unemployment is an urgent issue is much higher in the lower class (28.57%) rather than the middle (19.31%) and upper class (16.67%). Again, this is most likely because the unemployment rate among the lower class participants is the highest and it is also confirmed that 82.36% of the lower class participants believe that the current unemployment rate is too high, while only 54.55% of the middle class participants and 56.52% of the upper class participants believe the unemployment rate higher than normal.

Furthermore, when it comes to judging the government's methods on remedying the unemployment issues, 68.57% of the lower class participants believe that the government is not doing enough or not doing anything at all, with no one reckoning that there isn't such a problem. Yet, only 48.27% of the middle class and 58.34% of the upper class believe in the same, with 15.17% of the middle class and 20.83% of the upper class participants believing that there isn't a problem at all. The implication of this finding could be that a major goal in President Biden's infrastructure bills, to provide more jobs for Americans, could be perceived as unnecessary by a substantial number of U.S. citizens.

As for their opinions on the current interest rates, it's not surprising to see that the majority of the lower class participants believe that it is either way too high (42.86%), or slightly too high (42.86%), while the other two classes have less people that reckon the same, and a small number participants that believe the rate could be a little low, or way too low. This is most likely due to the fact that the lower class are under highest pressure when trying to repay their loans since they earn less, while the middle and upper class could be investing in currencies, thus wishing for higher interest rates to bring higher returns. Yet, although most participants agree that the interest rates are currently too high, it seems like they also believe the government is not doing enough to remedy inflation, as more than 60% of participants from all income classes reckon that the government is either not doing enough or not doing anything at all. This could be

translated into two possible conclusions: 1. The participants believe that raising the federal funds rate is not the best approach the FRB should be using currently, and 2. The participants don't understand the correlation between raising interest rates and lowering inflation. The more likely explanation is that these theories combined are true. It is highly likely that while some participants don't agree with the FRB's methods, others don't even understand the methods it is employing, considering the fact that there are a small number of participants who have never heard of the FRB before (1.87%).

However, unlike perceptions on the current interest rates, when it comes to government spending, the participants' opinions become much more unified, as over 80% of participants from the lower and middle class believe the government is spending too much, while 66.67% of participants from the upper class reckon the same. Yet, it is also surprising to see that although most participants agree that the government expenditures are too high, many of them also agree with Biden's five trillion-dollar economic stimulus spending, with the upper class being one of the most supportive (45.84%). The high level of support could potentially translate into more policies of this kind being made in the future, leading to even higher government spending and further contributing to the rising inflation. However, it is unclear how exactly the situation will evolve considering currently, investors are much more interested in putting their money in currencies due to the high interest rates, and thus whether the reduced flow of money within the economy will cancel out the effects of increased government spending still remains to be seen. Still, that is not to say that there aren't people opposing President Biden's spending bills, as 18.98% of all participants strongly oppose this extra government spending.

The same trend of the upper class participants being the most supportive in Biden's economic policies can also be seen with them supporting his infrastructure bills. However, the rest of the population isn't so enthusiastic, as more than 50% of the lower class participants either feel neutral or have no opinion on this matter, with 21.38% of the middle class strongly opposing these policies. This could mean bad news for the Biden's Administration, since lower class citizens who are unemployed and seeking jobs are one of the biggest targets of the infrastructure bill itself (The White House [WHSE]). With its infrastructure construction already significantly hindered by the rising inflation, it could result badly if Biden's Bipartisan Infrastructure Law doesn't catch the heart of its targeted audiences.

## **Summary**

The research indicates that the American public has different perceptions of the impact of the 2022 recession across lower, middle, and upper economic classes. The results indicate that inflation seems to be the most pressing issue within the economy, and out of all the income groups, the lower class participants are its major victim, with their income, employment status, and spending habits significantly altered, while showing a lack of understanding of the current economic climate compared to the other income groups. Yet, the participants' responses reflect different levels of approval in regards to the way the Federal Reserve is responding to inflation. The consequence of this recession is still unclear as many participants are still waiting to see how the recession will evolve, and definite predictions cannot be made as government policies and participants' spending habits yield different conclusions.

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## Appendix A: Literature Review

### Part One: History of the 2022 recession

America's economy has been experiencing issues ever since the start of the Covid pandemic at the end of 2019. During 2020, the unemployment rate hit its new high since the 2008 Great Depression, reaching 14.7% in April that year (BLS) due to government lockdowns in many states. When lockdowns ended in 2021, demand skyrocketed in markets related to traveling: airfare prices rose 24% and hotel prices rose 10% compared to 2020 (Long et al.). Added with the blooming tourism market with a year-over-year increase of 9.5%, the gasoline prices that year grew 56% (Whitmore), which greatly contributed to the rising inflation, as price increase in raw materials usually lead to more expensively priced final goods. At the end of 2021, the inflation rate has already kicked to 4.7%, 2.7% away from the Federal Reserve's 2% target set in 2022 (FRB). This worsened the already problematic labor situation in America, as wages in many industries were sticky and didn't rise proportionally with the price level. Many workers experienced economic pressure, especially the poor & near poor class, since a large number of them are having difficulties affording their basic necessities and daily needs, such as food, rent, and public transportation (Long et al.). To remedy this problem, in March 2021, the Congress passed President Biden's American Rescue Plan, which added a government spending of 1.9 trillion dollars. What President Biden wanted was to help American citizens afford their daily necessities and health care services. However, what he also accomplished is the worsening of inflation, which continued to push the price level higher, making it even more difficult for Americans in poverty to sustain themselves (Prokop). Not long after, the Federal Reserve decided to tackle inflation by raising its federal funds rate early, from the predetermined 2024 to 2022 (Smart), in hope to reduce the amount of currency circulating in the economy. The bond market reacted quickly to this decision: yields of short-term bonds soared, while yields of long-term bonds, like the 10-year U.S. Treasury, shrank as deflation is expected from the public (Kulahan). Global conflict, foreign political and economic strategy also had an impact on America's economy. However, the forecast of rising federal funds rate didn't stop the progress of inflation effectively, as Russia cut off 88% of its oil supply to the EU (BBC), continuing to raise the energy prices, spreading the inflation beyond the physical goods market and into the service market, ending with the current inflation rate of 7.1% (Rugaber & The Associated Press). Yet, it

couldn't be said that the Federal Reserve is rendered completely useless in fixing the economy, as the inflation rate has already declined from its peak of 9.1% in June 2022 to the current 7.1% in December (Trading Economics)


### **Part Two: Causes and Current Trends of this recession**

In the summer of 2022, with two consecutive quarters of negative GDP, the U.S. has by-definition entered a recession, although it is publicly denied by the U.S. Government and most well-known newspapers, like Forbes (Forbes). Even with high inflation, the labor market is continuing to stagnate: high labor shortages still exist in industries such as education, health care, and food service, as they struggle to retain workers, with the leisure and hospitality industry having a quit rate constantly above 5.4% (USCC). It is suggested by the USCC that these industries have comparatively low wages and bad employee treatments, thus unable to attract workers. Moreover, the labor participation rate still hasn't returned to its pre-Covid era (2019) level, with a 62.1% compared to the previous 63.6% (BLS). The current recession is apparently worsened by another raise of the Federal Funds Rate by 0.5%. High interest rates like this could be one of the causes for the unemployment rate increase in August and November, both rising from 3.5% to 3.7%. Even though the inflation has already been reduced since its peak in June, the Federal Reserve seems determined on raising the federal funds rate even more. Although what's motivating them isn't clear yet, possible explanations could be that Powell is concerned about his public reputation, or America is fighting a proxy war with Russia, or even, the Federal Reserve is trying to make profits for the banks, as itself is owned by various U.S. banks (Strauss). Still, some researchers are not so concerned over the current unemployment rate, as the recent increase of the labor participation rate could also be a cause for the uptick for unemployment, and its rate is showing a trend of reduction in December 2022 (Iacurci).

The current 4.25% to 4.5% interest rate has also greatly influenced the investors, and has caused the bond, gold, and crypto markets to suffer. The Bloomberg U.S. Aggregate, a broad benchmark for the American bond market, has dropped more than 12% in 2022 (Bloomberg). Gold prices have also decreased due investors giving up 'hard money' for the high interest rates banks provide. But out of all markets, the crypto market was the most heavily influenced as Bitcoin prices dropping nearly 65% in 2022 (Duggan & Curry): not only did Binance, the largest global crypto exchange, paused all bitcoin withdraws for a few hours, causing all Bitcoin buyers

to panic, but investors are also unwilling to take on risk-heavy cryptos when putting their money in banks can lead to hefty returns (Kleinman).

### Appendix B: Survey

\* 6. How do you expect your annual income in 2023 to change compared to 2022?  0

- Increase significantly     Increase slightly     No change     Decrease slightly     Decrease significantly
- Unsure or No Opinion

\* 8. How do you expect your annual spending in 2023 to change compared to 2022?  0

- Increase significantly     Increase slightly     No change     Decrease slightly     Decrease significantly
- Unsure or No Opinion

9. Have you noticed an increase in your utility bills (Electricity, Heating, Water, etc) currently?  0

- A significant increase     A slight increase     No difference     A slight decrease     A significant decrease
- Unsure / Prefer not to answer

11. How have the changes in expenditures (Utilities, daily necessities, etc) impacted your budgeting / spending habits? 🗨️ 0

- Spending increased significantly
- Spending increased slightly
- No impact
- Spending decreased slightly
- Spending decreased significantly
- Unsure / No opinion

\* 12. When you think about America's Economy today, do you think it is.... 🗨️ 0

- Growing Rapidly
- Growing Slowly
- Stagnating (No growth no recession)
- In a Recession
- In a Depression
- No Opinion

\* 13. Which TWO of these problems do you think are the most important issues the American Economy is facing currently? 🗨️ 0

- Inflation
- Unemployment
- Interest rates
- Government Budget Deficit
- Government spending
- Rich & Poor Gap
- None
- No Opinion

\* 14. Thinking about the Interest rate in America currently, do you think it is... 🗨️ 0

- Way too high
- A little too high
- Just right
- A little too low
- Way too low
- No opinion

15. Thinking about Government spending in the U.S. currently, do you think it is... 🗨️ 0

- Way too high
- A little too high
- Just right
- A little too low
- Way too low
- No opinion

\* 16. Do you think there is currently an Inflation or a Deflation in the United States? 0

- Yes, there is a Strong Inflation    Yes, there is a Mild Inflation    No, there isn't an inflation or a deflation    Yes, there is a Mild Deflation    Yes, there is a Strong Deflation
- No Opinion

\* 17. About 2022's Inflation, do you think the government is... 0

- Doing too much to address the problem    Doing just enough to address the problem    Not doing enough to address the problem    Not doing anything at all    There isn't a problem in inflation
- No Opinion

\* 18. Just your best guess: what percentage is the current U.S. inflation rate? (Please do not search for the answer online) 0


- 0.1% to 1.99%    2% to 3.99%    4% to 5.99%    6% to 7.99%    8% to 9.99%
- 10% to 11.99%    12% to 13.99%    14% or up    No Opinion

19. How often does the Federal Reserve do what is in America's best interests? 0



- Always    Most of the time    About half the time    Once in a while    Never
- I have never heard of the Federal Reserve before    No Opinion

20. Thinking about the unemployment rate in America currently, do you think it is... 0

- Way too high    A little high    Normal / Not high at all    No opinion

\* 21. About 2022's Unemployment, do you think the government is...  

- Doing too much to address the problem
- Doing just enough to address the problem
- Not doing enough to address the problem
- Not doing anything at all
- There isn't an Unemployment problem
- No Opinion

\* 22. Just your best guess: What percentage of Americans are currently unemployed but looking for work? (Please do not search for the answer online)  

- 0.1% to 4.99%
- 5% to 9.99%
- 10% to 14.99%
- 15% to 19.9%
- 20% to 24.99%
- 25% to 29.99%
- 30% to 34.99%
- 35% to 39.99%
- 40% or up
- No Opinion

\* 23. Do you agree with the Biden's administration's economic policies on infrastructure?  

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

\* 24. Do you agree with the Biden's administration's five trillion dollar economic stimulus spending?  


- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- Unsure / No opinion

\* 25. Are you currently employed?  

- Yes
- No
- Prefer not to say

29. If you are currently UNEMPLOYED, and IS actively looking for a job, what is the reason for your unemployment? (Please select all that apply)  


- |  |   |  |   |   |
|--|---|--|---|---|
| <input type="checkbox"/> I am unsatisfied with the wages or treatments offered to me | <input type="checkbox"/> I was laid off       | <input type="checkbox"/> I am moving to another location, thus unable to continue working in my previous job | <input type="checkbox"/> I wasn't actively looking for a job until recently | <input type="checkbox"/> I wanted to stay virtual |
| <input type="checkbox"/> Other   | <input type="checkbox"/> Prefer not to answer | <input type="checkbox"/> I am currently not looking for a job  | <input type="checkbox"/> I am employed                                      |   |

\* 30. If you are currently UNEMPLOYED, and NOT actively looking for a job, what is the reason for your decision? (Please select all that apply)  


- |   |   |   |   |   |
|---|---|---|---|---|
| <input type="checkbox"/> Health Concerns          | <input type="checkbox"/> The need to take care of your family | <input type="checkbox"/> I have entered my desired retirement age | <input type="checkbox"/> I am a student                         | <input type="checkbox"/> I am satisfied with what I earn from the unemployment benefits |
| <input type="checkbox"/> I prefer to stay virtual | <input type="checkbox"/> Others                               | <input type="checkbox"/> Prefer not to say                        | <input type="checkbox"/> I am currently still looking for a job | <input type="checkbox"/> I am currently employed  |

\* 31. The current U.S. total unemployed people number is 6 million, this number is published by the Bureau of Labor Statistics. Do you think this figure is accurate?  

- Yes, it is accurate       No, it is too high       No, it is too low       No Opinion

\* 33. Do you plan on making any qualified withdrawals from any of the investments you have selected in 2023?  
(Please select all that apply.)  0

- |   |   |   |  |  |
|---|---|---|--|--|
| <input type="checkbox"/> Currency (FOREX) | <input type="checkbox"/> Futures                    | <input type="checkbox"/> Mutual Funds                           | <input type="checkbox"/> Exchange-Traded Funds (ETFs)                      | <input type="checkbox"/> Options                                     |
| <input type="checkbox"/> Precious Metals  | <input type="checkbox"/> Real Estate                | <input type="checkbox"/> Bonds                                  | <input type="checkbox"/> Stocks  | <input type="checkbox"/> Retirement Accounts (e.g., 401k, 403b, IRA) |
| <input type="checkbox"/> Cryptocurrency   | <input type="checkbox"/> Non-Fungible Tokens (NFTs) | <input type="checkbox"/> I do not have any of these investments | <input type="checkbox"/> I don't plan on withdrawing any of my investments | <input type="checkbox"/> Prefer not to answer                        |

\* 34. Are you planning on making any new investments in the following during 2023? (Select all that apply)  
 0

- |   |   |   |   |  |
|---|---|---|---|--|
| <input type="checkbox"/> Currency (FOREX) | <input type="checkbox"/> Futures                    | <input type="checkbox"/> Mutual Funds                               | <input type="checkbox"/> Exchange-Traded Funds (ETFs) | <input type="checkbox"/> Options                                     |
| <input type="checkbox"/> Precious Metals  | <input type="checkbox"/> Real Estate                | <input type="checkbox"/> Bonds                                      | <input type="checkbox"/> Stocks                       | <input type="checkbox"/> Retirement Accounts (e.g., 401k, 403b, IRA) |
| <input type="checkbox"/> Cryptocurrency   | <input type="checkbox"/> Non-Fungible Tokens (NFTs) | <input type="checkbox"/> No, I don't plan on adding any investments | <input type="checkbox"/> Prefer not to answer         |  |



## Compassion in the lens of Buddhism and Christianity By Shikun Yu

### Abstract

This paper explores the concept of compassion in Buddhism and Christianity. While compassion is a virtue present in various religions, it is argued that it sets humanity apart from the inherently selfish animal kingdoms. Buddhism and Christianity both place great emphasis on the value of all life and teach that it is the duty of humanity to show love and compassion to all beings. However, the two religions differ in their interpretations of this tenet, as demonstrated in their literature, traditions, and practices. Through examples from both religions' literatures, this paper aims to compare and contrast their views on compassion and argue that their ultimate manifestation of compassion differs significantly. The paper also provides an overview of Buddhism's core teachings, including the Four Noble Truths and the Eightfold Path, and its emphasis on personal spiritual development and the pursuit of enlightenment.

**Keywords:** compassion, virtue, religions, humanity, animal kingdoms, Buddhism, Christianity, literature, traditions, practices, comparison, contrast, Four Noble Truths, Eightfold Path, personal spiritual development, enlightenment

### Introduction

Compassion, understood as the ability to understand and share the feelings of others, is a virtue that has been practiced and promoted in various religions throughout history. Outside of any religious framework, compassion is arguably what sets humanity apart from the animal kingdoms, which can be argued to be inherently selfish. (Phelps Norm) Religious traditions, too, show the superiority of humanity, yet not all religions demonstrate the fundamentally of compassion to their central messages as much as Buddhism and Christianity, two of the most widespread faiths in the world. In both Buddhism and Christianity, the two religions share a deep respect for the value of all life and teach that it is the duty of humanity to show love and compassion to all beings. Though similar in their centrality of compassion, the two religions ultimately differ in their interpretations of the tenet, which is demonstrated in their literature, traditions, and practices. This paper will serve as an overview of certain elements of compassion throughout both the Buddhist and Christian faiths, utilizing examples from the literatures of both,

in order to compare and contrast the views of the two religious traditions and argue that, despite their initial views, the ultimate manifestation of compassion differs significantly between them. The religion and philosophy of Buddhism was founded in the fifth century BCE by Siddhartha Gautama, also known as the Buddha, in ancient India. The core teachings of Buddhism are the Four Noble Truths and the Eightfold Path. The Four Noble Truths state that life is characterized by suffering, the cause of suffering is desire and attachment, suffering can be overcome, and the way to attain happiness is by following the Eightfold Path. The Eightfold Path consists of right understanding, intention, speech, action, livelihood, effort, mindfulness, and concentration. Evolving from the native religions of ancient India, Buddhism emphasizes personal spiritual development through meditation and mindfulness, and encourages individuals to strive for enlightenment, or Nirvana, which is the ultimate state of peace and liberation from suffering. In Buddhism, compassion is known as Karuna. Compassion, in this context, is the wish for all beings to be free from suffering. It is an active practice that involves understanding the suffering of others and taking action to relieve it. The practice of Karuna is integral to the path of enlightenment in Buddhism. Compassion is considered a key component of the path to enlightenment, as it is believed to lead to the development of wisdom, moral discipline, and spiritual progress. Through the cultivation of compassion, individuals are encouraged to develop empathy, kindness, and a deep sense of connectedness with all living beings. Throughout the faith and philosophy, compassion is not simply seen as a passive feeling or emotion, but an active practice. It involves taking action to alleviate the suffering of others and to promote their well-being. Compassionate action can take many forms, such as offering kindness, generosity, supporting those in need, or advocating for social justice and environmental sustainability. Ultimately, the practice of compassion is seen as a means of breaking down the barriers that separate individuals from each other and fostering a sense of unity and interconnectedness with all of existence.

The Angulimala Sutta is a story from Buddhist scriptures that teaches about the transformative power of compassion. It tells the story of a notorious killer named Angulimala, who had murdered many and wore a necklace made from the fingers of his victims. When the Buddha encountered Angulimala, he did not fear him but instead approached him with compassion and wisdom. The Buddha recognized that Angulimala was suffering and that his violent behavior was a result of this suffering. Through his compassionate teachings, the Buddha

was able to help Angulimala understand the nature of his suffering and how to overcome it. As a result, Angulimala was transformed and became a monk. He renounced violence and dedicated his life to the practice of Buddhist teachings. The story emphasizes the importance of responding to violence and wrongdoing with compassion rather than with fear, anger, or violence. More importantly, this process of self-overcoming through compassion and wisdom is an important aspect of Buddhist teachings.

The Story of Kisa Gotami from the Gotami Sutta also emphasizes similar teachings. Kisa Gotami was a young mother who was grief-stricken by the death of her infant. She went to the Buddha, asking him to bring her son back to life. The Buddha told her that he could not bring her son back to life, but that if she brought him a mustard seed from a household where no one had ever experienced loss, he would help her. Kisa Gotami went from house to house, but was unable to find a household where no one had experienced loss. In the process, she came to realize that suffering is a universal human experience, and her grief began to lift. In Buddhism, the understanding of the nature of suffering and its causes is seen as essential to achieving liberation from suffering. This understanding is often accompanied by the development of compassion and wisdom, which are considered necessary qualities for attaining enlightenment.

Both the faiths of Buddhism and Christianity share the intrinsic belief that compassion is essential in extending beyond personal needs and desires, and that the understanding of and empathizing with others is crucial to both alleviate their suffering and ensure their salvation, respectively. Turning to the Christian system of beliefs, the origins of the religion and its central texts ensure that the approach to compassion, forgiveness, and overall systems of religious traditions differ significantly from those of Buddhism.

Christianity as a religion was founded in the first century CE and is centered around Jesus Christ, who Christians believe to be the son of God. According to their beliefs, Jesus came to Earth to save humanity from their sinful ways and offer eternal life in the form of Heaven through his sacrifice and Crucifixion. Followers of Christianity worship one God in three persons, known as the Holy Trinity, and follow the Bible as the main text for Christian teachings, which contains both the Old and New Testaments. Christianity branched off from the religious traditions of Judaism, whose beliefs center around a just single God through the enforcement of the rules found within the Old Testament. Unlike followers of Judaism, who believed their deity to have codified rules for a specific people to follow, Christianity, through the sacrifice and

Crucifixion of Jesus Christ, thought themselves to have been freed from these ordinances. (Wessel Susan)As a result, turning to a larger community of both Jews and non-Jews, and unlike their more legally-oriented predecessors, Christian beliefs center largely on doctrines of forgiveness, compassion, and love, many of which appear similar to those of Buddhism, at least on the surface.

In Christianity, compassion is rooted in the teachings of Jesus Christ in the New Testament, particularly as written in the Gospels. According to the teachings most central to the Christian faith, followers are called upon to "love your neighbor as yourself" and treat others in the same way they would like to be treated. (Matthew 22:35-40, Mark 12:28-34, Luke 10:27) This quote has evolved into being known as the "Golden Rule," on account of its centrality to both Christianity itself and societies attempting to emulate core Christian values. Compassion is also emphasized in the Gospel of Luke through the Parable of the Good Samaritan; it tells the story of a man who was traveling from Jerusalem to Jericho and was attacked by robbers. He was left half-dead on the road, and several people passed by without helping him, including a priest and a Levite. Finally, a Samaritan, hailing from a group traditionally divided from Jews, came along and showed him compassion, taking care of him and paying for his medical care. (Luke 10:25-37) The parable concludes with Jesus reciting a commandment to go out and do the same as the Samaritan had done, directly tying the acts of the compassionate to all the believers. It shows that Christian compassion involves action, not simply intent or emotions. The Samaritan took concrete steps to provide aid, including bandaging his wounds, taking him to an inn, and paying for his care. Compassion also knows no boundaries. The Samaritan was not from the same religious or ethnic group as the injured man, yet he still showed him kindness and mercy. It shows that compassion is costly. The Samaritan went out of his way to help the injured man, and it cost him time, money, and effort. Christianity teaches that true compassion involves action, selflessness, and a willingness to put others first. By following this principle, Christians can strive to make a positive impact on the world around them.

Through the descriptions and analysis of compassion alone, the differences between Christian and Buddhist beliefs can seem almost negligible. Yet it is once the focus turns from compassion itself to that of forgiveness that the two seem to divide themselves further. The difference between the two terms is also slight. Whereas compassion can be described as the ability to feel and empathize with the suffering of others, taking action to alleviate that suffering,

forgiveness, on the other hand, is the act of letting go of anger or resentment towards someone who has wronged you, which can lead to feelings of peace and healing. While compassion involves an emotional response to the suffering of others, forgiveness is a conscious decision to release negative feelings towards someone who has caused harm.

In Christianity, forgiveness is considered a crucial aspect of compassion, rather than a separate process altogether, emphasizing the importance of forgiving those who have wronged others and showing them love despite their misdeeds. Christians are called upon to forgive others, especially those who have wronged them, as God has forgiven them through the sacrifice of the Crucifixion. The Lord's Prayer, the most widespread prayer in the Christian faith and the only one to have been mentioned in the Gospels themselves, includes the phrase, "forgive us our trespasses, as we forgive those who trespass against us," (Matthew 6:12-14) thus highlighting the central nature of forgiveness throughout the religious tradition. The term "trespass" refers to a wrongdoing or a sin committed against another person. In this context, asking for forgiveness for one's trespasses entails admitting to one's own errors and misdeeds, and seeking absolution from God. This is a gesture of humility and remorse, acknowledging the fact that humans are not infallible and require divine benevolence and compassion. The latter portion of the line, "as we forgive those who trespass against us," highlights the significance of extending forgiveness to others. Similar to how individuals implore God for forgiveness for their own transgressions, they are also encouraged to forgive those who have wronged them. This component of the Christian faith is challenging but essential, as forgiveness can be arduous to grant when one feels hurt or wronged by another person. Nevertheless, by forgiving others, individuals are able to mirror the love and mercy that God embodies.

Throughout Christianity, forgiveness is seen as a means of breaking the imposition and cycle of institutional and personal hatred, violence, and oppression through the promotion of peace and reconciliation. Initially persecuted as a minority religious sect throughout the first three centuries of its existence, Christianity had long fought through its extreme pacifism to secure its independence, security, and systems of beliefs, before ultimately being legalized in the early fourth century. Such examples of pacifism and forgiveness can be seen both in biblical scripture itself and the apocrypha, featuring in the biblical Parable of the Prodigal Son, which tells the story of a wealthy man with two sons. The younger son asked his father for his share of the inheritance, and then he left home and squandered all of his money on a glamorous lifestyle.

Eventually, the younger son found himself destitute and hungry, and he decided to return home to his father, hoping to become a servant in his household. When the father saw his son coming from a distance, he ran to him and embraced him, welcoming him back with open arms. The older son, who had stayed with his father and worked hard for him all those years, was angry and resentful of his brother's return. But the father urged him to forgive his brother and celebrate, noting that he had been lost and was now found. (Luke 15:11–32)

Outside of the biblical canon, depictions of Early Christian martyrs, saints, and holy men and women tell countless stories of unwavering faith and forgiveness in the face of violent imperial and personal discrimination, persecution, and execution, with the core concepts detailing the triumphant nature of overwhelming faith and forgiveness over the harsh crackdowns and impositions of authority. In the same way, the Christian God waits for the non-Christian and unfaithful sinners to realize their inherent sinfulness and repent, asking for forgiveness and fully in their faith as He welcomes them back among his flock of lost sheep. In its development centuries and worlds apart, compassion and forgiveness are also closely related concepts in Buddhism, allowing its followers and adherents to see beyond the immediate harm caused by the actions of a wrongdoer and to recognize the underlying causes of their behavior, which could potentially be rooted in their own pain and suffering, rather than any deliberate ill-will. In Buddhism, the focus of forgiveness, specifically, lies in the understanding and letting go of a believer's own attachments to their anger and resentment, although forgiveness remains an inherent aspect of compassion and understanding. While the process to enshrine peace, joy, and salvation – however that may be defined – for oneself and others is attained through the processes of compassionate acts, the religious traditions of Buddhism and Christianity differ in their approach to forgiveness itself.

In the Buddhist scriptures, the practice of forgiveness is known as Kshanti. Kshanti is the demonstrated practice of patience, endurance, and forbearance in the face of difficult situations and challenging people, be they of Buddhism belief or not. Such adherence to Kshanti requires cultivating the capacity to pardon others despite their wrongdoings, including those who have committed offenses against themselves or society as a whole. The teachings of the Buddhist scriptures emphasize the importance of understanding that all living beings are interconnected, and that the actions of others are often the result of their own suffering, regardless of their intentions or wills. A prime example of preferred actions are demonstrated in the Akkosa Sutta, a

2500 year old discourse in the Pali Canon, also known as the *Insult Sutta* or the *Discourse on Insults*, dealing with the proper practices pertaining to verbal hatred. Within the text, the Buddha is insulted and abused by a man who is suffering from mental illness. Instead of reacting with anger or violence, the Buddha responds with compassion and understanding, recognizing the man's suffering as the cause of his pain and outbursts, offering him teachings on the path to liberation and enlightenment, stating that “If you become angry with me and I do not get insulted, then the anger falls back on you. You are then the only one who becomes unhappy, not me. All you have done is hurt yourself. If you want to stop hurting yourself, you must get rid of your anger and become loving instead.”(Sutta Translation) Despite how this parable may seem, the practice of forgiveness in Buddhism does not center around condoning or excusing harmful behavior. Rather, the relationship between Buddhism and forgiveness promotes understanding the causes of suffering and cultivating compassion and wisdom in response. Forgiveness involves recognizing that all living beings, human or otherwise, are capable of change and growth, and that everyone deserves the opportunity to be free from suffering through the following of Buddhist teachings. This suggests the practice of love and compassion is not only beneficial for others, but more importantly to oneself.

Through a basic analysis of Christian and Buddhist attitudes to both compassion and forgiveness, it is easy to recognize similarities between the two religious traditions, with both forming the foundational cores around their practices. While Christianity and Buddhism share some commonalities when it comes to compassion and forgiveness, however, they approach these concepts differently. In Christianity, compassion is often tied to a belief in a loving, merciful God who extends compassion and forgiveness to all people. In Buddhism, while there may be a recognition of the interconnectedness of all things and a sense of universal compassion, there is not necessarily a belief in a higher power or deity. Additionally, the practices and techniques for cultivating compassion may differ between the two traditions. In Christianity, compassion and forgiveness are considered essential aspects of faith, with Christians expected to follow the examples Jesus had set of showing love and compassion towards others despite external pressures and impositions. Forgiveness is often seen as an act of obedience to God and a way of demonstrating love and mercy towards others, often to a radical degree. Repentance is often linked with forgiveness, as Christians are encouraged to acknowledge their mistakes and commit to changing their behavior. In contrast, Buddhism places a great emphasis on

compassion and considers it central to its teachings. Compassion is often associated with Karuna, the desire to reduce suffering and one of the Four Noble Truths, and is cultivated through meditation and mindfulness practices. Forgiveness is also valued in Buddhism, but it is regarded more as a way to let go of negative emotions and to achieve inner peace than as a moral obligation. Forgiveness is often connected to loving-kindness and is considered a way of cultivating positive emotions while letting go of negative ones, both towards oneself and others, despite the intentions of both. In summary, while both Christianity and Buddhism value compassion and forgiveness, the former places greater emphasis on the importance of forgiveness as an act of obedience and subservience to God through leading by example, while the latter emphasizes the cultivation of compassion as a means to alleviate suffering of both oneself and others, and forgiveness as a way to achieve personal inner peace on the path to enlightenment.

Beyond Enlightenment: Buddhism, Religion, Modernity by Richard Cohen. Routledge 1999. ISBN 0-415-54444-0. p. 33. Bauddha is "a secondary derivative of buddha, in which the vowel's lengthening indicates connection or relation. Things that are bauddha pertain to the buddha, just as things Saiva related to Siva and things Vaisnava belong to Visnu. ... baudda can be both adjectival and nominal; it can be used for doctrines spoken by the buddha, objects enjoyed by him, texts attributed to him, as well as individuals, communities, and societies that offer him reverence or accept ideologies certified through his name. Strictly speaking, Sakya is preferable to bauddha since the latter is not attested at Ajanta. In fact, as a collective noun, bauddha is an outsider's term. The bauddha did not call themselves this in India, though they did sometimes use the word adjectivally (e.g., as a possessive, the buddha's)."



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# **Rivers in Crisis: An Engineering Approach to Removing Pollutants and Garbage with Advanced Water Treatment Systems By Jay Katariya**

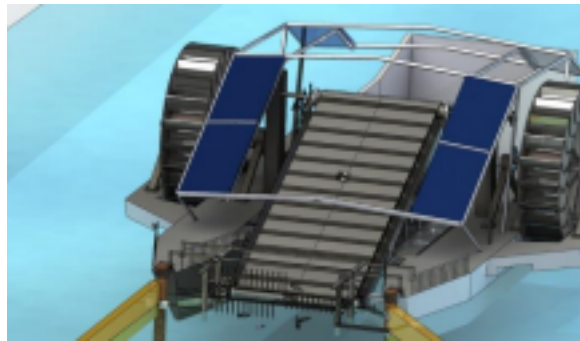
## **Summary**

River pollution is a major global issue that poses a significant threat to the environment and human health. Rivers and other water bodies are affected by pollution from various sources such as untreated sewage, industrial waste, agricultural run-offs, and plastic litter. For example, the Ganges River in India, which is considered the largest river in India and is considered sacred by millions of people, is heavily polluted with untreated sewage and industrial waste. According to a study, over 3,000 million liters of sewage is dumped into the Ganges every day, making it one of the most polluted rivers in the world. In this research paper, we propose a new solution to combat this issue, a machine called as river cleaning machine which will remove floating waste and chemicals from the river using a unique technique. This machine will be boat like structure with a floating conveyor belt which leads upto the boat's garbage collection can. The floating waste will come via this conveyor and can be stored in a storage can. The river cleaning machine is also equipped with a feature to remove chemicals and oils that float on the river surface. It This machine will be designed to operate in different water conditions and can be transported to different locations, it will be able to remove floating waste, plastics, and chemical pollutants, which are the major pollutants of the rivers and revolutionize the way we clean our rivers, help preserve these vital resources for future generations and improve the lives of aquatic species and to all those who depend on river water, basically everyone.

## **Introduction**

According to NRDC, Unsafe water kills more people each year than war and all other forms of violence combined. Meanwhile, our drinkable water sources are finite: Less than 1 percent of the earth's freshwater is actually accessible to us. Without action, the challenges will only increase by 2050, when global demand for freshwater is expected to be one-third greater than it is now. The floating debris and toxic floating chemicals cause maximum damage to the society. According to The Pacific Institute for Studies in Development, Environment, and Security - Every day, 2 million tons of sewage, industrial, and agricultural

waste is released into water all around the world. This is the equivalent of the weight of 6.8 billion people. This debris waste and toxic chemicals must be removed from the water bodies as our drinkable water sources are finite. The world needs machines to clean this mess that has been created. This model of the machine consists of a floating conveyor belt which leads up to the boat's garbage collection can. The floating waste will come via this conveyor and can be stored in a storage can (displayed in **figure 1**). The river cleaning machine is also equipped with a feature to remove chemicals and oils that float on the river surface. This feature is the latest technology of a smart filter with a shape-shifting surface can separate oil and water using gravity alone, an advancement that could be useful in cleaning up environmental oil spills, among other applications, say its University of Michigan developers.



**Figure 1** - The river cleaning machine CAD model

This model of river cleaning machine has made the whole process of river cleaning so efficient with the help of conveyor belt and use of special smart filters for separation of oils/chemicals from water. This model is made keeping the finances in mind. The model can be built at a affordable cost so that the whole world can benefit from this model. This model will be designed to operate in different water conditions and can be transported to different locations, it will be able to remove floating waste, plastics, and chemical pollutants, which are the major pollutants of the rivers and revolutionize the way we clean our rivers, help preserve these vital resources for future generations and improve the lives of aquatic species and to all those who depend on river water, basically everyone.

## **Results**

The aim of this experiment was to evaluate the efficacy of the river cleaning machine model in removing floating debris, plastics, and toxic chemicals from water bodies. The rationale for this experiment was based on the fact that unsafe water kills more people each

year than war and all forms of violence combined, and that the world's drinkable water sources are finite. With the increasing demand for freshwater, it is imperative to take action to preserve these vital resources for future generations. The experiment was conducted by using the river cleaning machine model in a controlled environment with simulated floating waste and chemicals. The machine was equipped with a floating conveyor belt that led to a garbage collection can, and a smart filter with a shape shifting surface to separate oil and water. The results showed that the river cleaning machine was highly effective in removing floating debris and toxic chemicals from the water. The conveyor belt was able to collect the floating waste and store it in the garbage collection can (**Figure 3**), while the smart filter was able to separate the oil and water with high accuracy (**Figure 2**).



**Figure 2** - A new type of filter separates water (blue) from oil (red).



**Figure 3** - Design of the river cleaning machine experiment

In conclusion, the river cleaning machine model showed promising results in removing floating debris, plastics, and toxic chemicals from water bodies. This model, designed to operate in different water conditions and be transported to different locations, has the potential to revolutionize the way we clean our rivers and improve the lives of aquatic species and those who depend on river water. Further research can be conducted to further optimize the design and performance of the river cleaning machine.

## Discussion

The present study aimed to evaluate the efficacy of a river cleaning machine model in removing floating debris, plastics, and toxic chemicals from water bodies. The criticality of this experiment stems from the fact that contaminated water causes more fatalities annually than all forms of violence, including war. Moreover, with the increasing demand for freshwater, it is imperative to preserve this vital resource for future generations. The experiment was carried out in a controlled environment, where the river cleaning machine was deployed to remove floating waste and chemicals. The machine was equipped with a floating conveyor belt that led to a garbage collection can, and a smart filter with a shape-shifting surface for oil and water separation. The results indicated that the river cleaning machine was highly efficient in removing floating debris and toxic chemicals from the water. The conveyor belt effectively collected the floating waste and stored it in the garbage collection can, while the smart filter accurately separated the oil and water. However, the large-scale deployment of this machine presents several challenges. The disposal of the collected waste and harmful oil requires proper chemical processes, such as thermal oxidation or bioremediation, which can be costly. In countries with low-income levels, the cost of producing the machines at scale may be a barrier. Thus, it is vital to find ways to reduce production costs and make this technology more accessible to these communities. In addition, the machine may face difficulties in shallow waters, and restricted locations, and may get damaged by submerged tree stumps. Furthermore, small fragments of weed may remain in the water and spread to other locations, thereby aiding in the dispersal of invasive species.

The pollution of rivers and water bodies is a major concern that needs to be addressed to protect human health and preserve these vital resources for future generations. Clean and healthy rivers not only reduce health risks but also improve the quality of life by promoting recreational activities, such as safe walking and running trails. This, in turn, can attract tourists, boosting both the economy and the well-being of the community. In the future, this project can be improved to sort more categories of waste, and advances such as a conveyor system and the use of solar panels can be integrated to increase efficiency and sustainability. Moreover, modifications to the size and capacity of the machine can make it suitable for use in large rivers and lakes, such as the Ganga, and can be utilized for aquatic weed harvesting and aquatic trash collection.

An example of river revitalization is the Iloilo City in the Philippines, where the main river was successfully revived, and a beautiful Esplanade was built, guided by the principles of unity, strategic planning, and political will. It is our responsibility as individuals to make a difference by reducing our own pollution and supporting initiatives like the river cleaning machine model. In conclusion, the present study has demonstrated the effectiveness of the river cleaning machine model in removing floating debris, plastics, and toxic chemicals from water bodies. However, several challenges need to be addressed for its large-scale deployment, including the disposal of collected waste and reducing production costs. The preservation of our rivers is crucial for protecting human health and preserving these vital resources for future generations.

## **Materials and Methods**

The river cleaning machine is designed as a modified boat, with an open end at the front that elevates the conveyor belt above the river surface by 20-30 centimeters, as illustrated in **Figure 4**. The boat is equipped with a garbage can to collect waste collected by the conveyor belt from the river surface. A separate water can, with a super membrane attached, is also included to segregate oil and chemicals from water. The river cleaning machine is designed as a floating platform with a conveyor belt on one side, as shown in **Figure 4**. The outer body of the machine is made of 316L stainless steel for corrosion resistance in harsh conditions, while the inner body is constructed from 304 stainless steel. The machine features rotating blades at the back to propel it through the water, powered by a 3-Phase AC current motor with IP-65 protection and a worm gearbox. The motion of the rotating blades is shown in **Figure 5**. The conveyor belt is controlled by drive and driven rollers, which move the SS wire mesh belt with gaps to allow water flow. The belt is attached to the garbage bin, as illustrated in **Figure 4**.



**Figure 4** - The AUTO-CAD design of river cleaning machine model



**Figure 5** - The prototype model of rotating blades for river cleaning machine.

### ***Part 2 - Garbage Bin***

The garbage collection bin, which is integral to the functionality of the river cleaning machine, is constructed from durable HDPE plastic material. Its unique design features a rectangular shape that is molded to exact specifications, with a side that opens and closes seamlessly. To further enhance its functionality, the garbage collection bin is equipped with a state-of-the-art hydraulic lifting system that is seamlessly integrated into both the bin and the surface of the boat. This cutting-edge system allows the river cleaning machine to effortlessly remove waste from the bin when it is near the shore, utilizing a smooth and efficient oil-based hydraulic mechanism. The combination of robust materials, advanced design features, and innovative hydraulic technology, makes the garbage collection bin a truly impressive component of the river cleaning machine.

### ***Part 3 - The Membrane and chemicals/oils removal system***

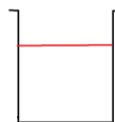
The river cleaning machine also features a specialized HDPE plastic can that is specifically designed to hold a range of chemicals, as indicated in **Figure 6**. This innovative



can is a critical component in the efficient operation of the machine and helps to ensure safe and effective chemical management. Moreover, the river cleaning machine is equipped with a cutting-edge membrane solution that has been developed by researchers to address the challenge of separating oil and water mixtures. The membrane boasts impressive properties, including a coating that enables water molecules to bond with the polymer while oil remains above the filter. This innovative membrane has been tested and proven to efficiently separate oil and water, even in the presence of surfactants and dispersants, such as those that were seen in the Deepwater Horizon oil spill. To ensure optimal performance, the coated filters have been designed to last for over 100 hours of continuous use without clogging, which represents a significant improvement over existing technology. The HDPE plastic can will feature two water line connections, including a motor-powered water line that draws water from the river body, and a pipe for dispersing purified water back into the river. The placement of the membrane within the can is depicted in **Figure 7**.

Chemical	Compatible	Incompatible
Isopropanol	Glass, HDPE, PP, nylon and Teflon (PTFE)	ABS plastic
Acetone	Glass, metal, HDPE, PP, nylon & Teflon (PTFE)	ABS plastic
Methanol	Glass, HDPE, PP & PTFE	ABS plastic & polyurethane
Potassium hydroxide pellets	Stainless steel	Glass, metal & polyurethane
Hydrogen peroxide	Glass & HDPE	
Heptane	HDPE	
Carbon Tetrachloride	HDPE	
Hexane	HDPE	
Ethanol	HDPE and Glass	

**Figure 6** -Compatibility of few chemicals with containers.



**Figure 7** - Membrane Positioning

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## **Sex Toy Shops as Sites of a New, Radical Sex-Education By Shan Su**

### **Abstract**

This paper analyzes how the feeling of shame operates or functions in the beauty industry and the sex toy industry in the contemporary U.S., and how shame affects our behavior as consumers with regard to these two industries, comparatively. In this way, my intervention is to remind people to carefully consider their motivations, or what is guiding their motivations, before buying products and to encourage people not to waste money by focusing on meeting society's narrow beauty standards, but rather to allocate their resources towards what brings pure pleasure and enjoyment to one's body. Better sex education could help bring out this shift by conveying the motif of self-love and teaching about the body and sex scientifically, with an intentional emphasis on cultural values and structures in addition to individual psychology, so people can rethink the relationships to their bodies, to shame, the feeling that is utilized by current cultural values negatively, and de-stigmatize taboos around sex. After we have a thorough understanding of our bodies and how capitalism makes use of the feeling of shame, our decision making in choosing what to buy will be changed and thus may invest more based on the belief to please our bodies instead of meeting the needs of others.

**Keywords:** body, sexuality, sex education, shame, culture, sex toy industry, cosmetic industry, consumer behavior, sex-positivity, body liberation

### **Introduction**

Scene one: The last time I practiced drawing in an art museum, sketching the outline of a nude, ancient Greek sculpture in front of me, I suddenly noticed a boy, aged approximately ten to thirteen years old, smiling and snickering at the genitals of this sculpture. After his parents found him and recognized what was happening, they quickly reproached the boy with embarrassment and escaped from the sculpture as if evading a taboo or evil deed. It was at this moment I started to contemplate the taboo nature of representations of sex and why people feel shameful about these parts of their own bodies.

Scene two: The blinding billboards hanging around the streets near the shopping mall displayed cosmetic advertisements in which models recklessly “show off” their lips, eyes,

mandibles, and cheeks. Like many people, I was immersed in the beauty and splendor of the models' bodies covered with the newly released cosmetic products on sale.

People are crazy about being varnished by products to be viewed as “beautiful” as the models on these billboards, or more recently, on social media, but at the same time, feel abashed with public images or representations of genitalia like in the art museum. Why is this?

These two scenes show two totally different views of the body: people hold open and desired views of the beauty of the face and certain elusive parts of the body while feeling avoidant to nudity and especially to revealed sexual organs. The two behaviors have things in common: they are both driven by shame, but I will argue, through different logics. This paper is going to analyze how shame operates in people's consuming behavior—vis-a-vis a comparative analysis of the beauty industry and sex toy industry in the U.S. People's decision-making and consumer habits with regards to both the cosmetic industry and the sex toy industry are informed by shame, which is a problem that continues to haunt the country. In this paper, I claim that this is a problem due to a complete lack of, or poor-quality sex education. This paper, therefore, advocates for better sex education that challenges sexual shame of all kinds. Adequate sex education can change people's relationships with their bodies and with their consumer habits, in a way that is not informed by shame but by empowerment, thereby affecting both industries. Investing more money in purchases that function as ways of exploring one's sexuality or body will be a better choice than simply squandering money in catering to the tastes of others when it comes to how people consume products between these two industries.

This paper traces back to the source of shame and analyzes the role of shame in affecting people's relationships with the cosmetic and adult toy industries. In addition, the paper points out a vicious cycle that encumbers people from body/sexual liberation. While several studies have already explored the shame of sexuality with respect to beliefs, sexual attitudes, and cultures, there is not yet a detailed analysis of the influence of sexual shame on consumer behavior in relation to the beauty and sex toy industries. Scholars have also created individualized therapeutic programs to reduce sexual shame and help alleviate Female Orgasmic Disorder in America (Pancake), which they believe is the result of shame. However, these studies are limited in that the majority of them only focus on the psychological methods of “correcting” an individual's behavior instead of resolving the rooted problems and creating plans to prevent the problems. In this paper, I propose a more systematic sex education as the solution for addressing

the shameful feeling generated by our bodies. This approach would help create a more inclusive, scientific, and humane world for individuals to be educated. Besides, I expand on some creative ways to conduct sex education at the end of the paper.

## **Shame**

Shame is a self-conscious emotional reaction often associated with unpleasantness, powerlessness, distrust, and exposure under the circumstance of humiliation, embarrassment, and dishonor (Broucek, Tracy). From the psychological perspective, shame is actually a *cognitive skill* that first appears in the early stages of childhood development (Fischer). M. Lewis' (2000) cognitive model offers explanations for the occurrence of shame, which is due to people's failure to meet some standard with respect to cultural norms, social standards, and/or family expectations (Lewis). It arises from the misconnections and failures in human communication and leads to a negative evaluation of the self that causes inner anguish and a sense of worthlessness (Mollon, 2002; Tracy).

American society has long been characterized as a "guilt culture" meaning that moral behavior is elicited by an individual's consciousness and does not require the actual or imagined presence of others (Herpen). However, nowadays, shame culture is pervasive in the United States, and more and more people are becoming sensitive to shame. In the article "The Return of Shame," Andy Crouch distinguishes between the shame culture in Eastern countries and Western social values, and he argues that the omnipresence of social media intensifies the effect of shame culture in Western countries. The advent of the Internet and social media expedites the blurring of private and public boundaries. It creates a stronger connection between everyone and amplifies any subtle emotions such as hostility and exclusion. Shame culture permeates people's lives and directs their behavior. The "face" becomes more important when our life, private and public, is on display on social media all the time. For example, photo editing apps and Instagram filters are designed for you to perfect yourself and avoid anxiety and shame. Social media brings the social environment to even our most private places like the bedroom. We are worried about the information we reveal on the Internet or the comments we receive from our friends and strangers. However, the discourse of sexuality has always been a sensitive topic for both the older and younger generations. Many scholars have already researched the topic of shame. However, most of the existing studies only focus on the psychological analysis of shame at the

level of individual experience without addressing the problem in a broader social context. The absence of scientific and systemic sex education allows people to be more vulnerable to shame and therefore, I claim, sex education needs to be radically reconceived.

In what follows, my focus is specifically on sexual shame--the shame people feel related to sexuality, especially shame of the body. Sexual shame is shame associated with the repressed desire for a shared discourse of sexuality (Mollon, 2005). From an early age, children realize the embarrassment and unspeakable nature related to sexuality from their parents' surrounding reactions towards this topic. Children learn to conceal their desires and explore their curiosities secretly. The consciousness of sexual shame has a long history. From early religious literature, sexuality has been shrouded in the veil of taboo. In the biblical story of Adam and Eve, both were covered with leaves to hide their genitals. The leaf serves as a symbol of shame in sexuality. Adam and Eve realized their nakedness and felt shame for their bodily differences after eating the prohibited fruit and were expelled from the Garden of Eden as punishment. The conscious exploration of sexuality is seen as a sin and a forbidden part of humanity. We hide our sexuality in socialization, hide our desire to talk about sex, and repress our acceptance of the discourse of sex. We constantly solidify the shame and taboo nature of sexuality during these processes. Shame negatively impacts people in terms of both interpersonal relationships and their own mental health. For example, shame has been recognized as an intermediary and moderator in the development of a wide range of mental health issues, such as decreased self-efficacy (Clark). Sexual shame, as shown in scientific research, results in a decrease in sexual pleasure and satisfaction for partners (Shadbolt). It also indirectly affects individuals' views on their bodies and sexuality. When both parents and teachers are shy to talk about sex, the increasingly developed internet becomes the only way for the increasing number of teenagers who are eager to explore sex and sexuality, learn about relationships and their bodies, and shape their identities.

### **Comparative Analysis**

In this section, I will offer a comparative analysis of the beauty industry and the sex toy industry. I will explain how shame operates in these two industries and the impacts it brings on customers.

#### **1. Beauty industry:**

The beauty industry sells a constructed ideal image of beauty that not many people can live up to, intentionally. It relies on provoking the effect of shame on consumers who do not see themselves in this ideal image and therefore purchase beauty products to try to meet it. In this way, the beauty industry capitalizes on shame in order to gain profit. By asking many influencers and stars to promote products or dress in some fashion, brands popularize an idealized image of beauty. In this way, the beauty industry creates a single beauty standard for all people. People internalize this one definition of beauty from advertisements from billboard displays to social media, after viewing them repeatedly. Due to the bandwagon effect, which is the tendency to follow options chosen by the majority (Kiss), more and more people become brainwashed by this singular beauty standard that is determined by the beauty industry. As a result, the majority of people, whose own appearances may deviate from the idealized beauty standard, can experience self-doubt and the desire to change themselves into the ideal impression. The deviation provokes shame in people's minds that drives them to become like the "majority"—the socially constructed beauty standard. Research suggests that the advertisement of body image obviously increases the viewer's anxiety (Monro). People's anxiety is a direct symptom of shame for their appearance. As a result, the negative feelings of shame will lead people to purchase more and more beauty products, and this is how the beauty industry retains its power, charm, and wealth.

Body shame—whether from others or within an individual's mind—can have numerous detrimental effects. One study shows that body-related shame was found to be both positively and significantly related to the regularity of depressive symptoms (Sick). Popular culture and the inundation of targeted advertisements even contribute to the development of mental disorders such as body dysmorphic disorder. Body dysmorphic disorder is a relatively prevalent disorder, especially among women, where individuals become obsessively concerned about any minor flaws in one's physical appearance. The lower sense of self-worthiness and anxiety of shame damages mental health. As a result, people enter a vicious cycle of chasing the beauty constructed by industry brands. They not only lose money but also go astray and are stuck in a quagmire of self-critique. The capitalists that run the beauty industry thus become the major beneficiaries in this homemade trapping game.

## 2. Sex toy industry:

Shame is also intertwined with how most people think about pleasure, which informs their reactions or feelings about the adult sex toy industry. However, this relationship operates in



a totally different way when it comes to the form sexual shame takes. Due to conservative social norms and religious doctrines that continue to pervade culture, especially in the U.S., people feel shameful when they smell any discourse or practices related to sexuality. The adult toy industry, originally aiming to help people better enjoy bodily pleasures, has always been a forbidden zone for the public. Unlike the products in the beauty industry which people advertise on billboards and discuss freely and openly, sex toys, and sexual pleasure, are considered a part of a taboo culture that we can only explore in secret ways. The shame people feel around their sexual organs, or the discourse of sexuality, prohibits them from fully exploring and enjoying their bodies openly or in a way that should be faced with love and respect instead of judgment and embarrassment. Shame stimulates our consumption in the beauty industry but can often prevent the exploration of the body and its pleasure by encouraging people to purchase products that enhance their image rather than enjoying the sensation and learning about our bodies. Sex toys are also seen by some men as a threat to their masculinity because sex toys are propagated as a symbol of women's empowerment and independence. They also can break the heteronormativity of women's dependence on men by introducing a "replacement" that can bring even more pleasure---the replacement can "beat" men in some sense. This threatening effect of sex toys on patriarchal thinking about how the sexes should relate to each other further consolidates its taboo nature.

The products from both industries are used on the shelf. However, *how* these two industries function and sell their products are different. The beauty industry constructs an idealized body image and utilizes people's shame to "force" people to buy products in the name of pleasing themselves by having a more "idealized" body. In contrast, it is people's shame towards the sexual organs, and anything related to sexuality in general that drives people away from exploring sex toys that are essentially designed for pure bodily pleasure. However, shame is used as a stimulus to increase sales by the beauty industry and transfers individuals' attention to whether or not they meet the idealized body image rather than exploring and meditating on the enjoyment of the body. In the sex industry, shame repels people from experiencing the products, which are designed to facilitate their exploration of bodily pleasure, which isn't something to be ashamed of. People gradually lose love for their bodies, which turns out to be the source of negative emotions, especially shame.

## **Intervention**

Despite the increasing body shame culture in the U.S., there is not a comprehensive method that addresses this problem. In order to reduce the negative effects of shame derived from the body and taboos around bodily pleasure, proper sex education is needed as the solution. It can become a force in changing our relationships and attitudes toward our bodies and help alleviate our shame, thereby reorienting our consumer relations with both the beauty and the sex toy industries.

Pornography has long been a substitute for a teacher's role when people cannot receive integrated sex education. However, as is well-researched, pornography can have many harmful effects on its consumers. Learning about sex through pornography is harmful because it is not learning about sex, it is learning a certain, curated image of sex, or sexual relations and the focus on images, as we've seen in the previous section's analysis of the beauty industry, is part of the problem being diagnosed in this paper. Pornography is one trigger that breeds anxiety and sexual shame among many people. Pornography is a product for providing a faster and easier sexual stimulus to the human brain and does not substitute the teacher's role in providing sex education. However, these erotic images, designed not to teach people but to maximize excitement via exaggerated visual images and provocative filming, can spread misleading ideas such as sex positions and genital size. By choosing actors or models with similar features that are used to magnify the stimulation, pornography constructs a singular standard for the relation between sexes. The audiences who search for guidance or simply instant sexual arousal may internalize this standard and compare their own bodies with this exaggerated image of what sex "should" look like. The difference between their bodies and that of the actors may cause doubt for viewers about their own bodies, the "normality" of their bodies, and their gendered disposition, which then causes shame. Toxic masculinity is one byproduct of this artificial standard. Many men are passionate about confirming their dominant place by the size of their genitals. This phenomenon is exacerbated by the exaggerated standard for the body. As a result, pornography establishes an arbitrary body model and unitary requirement for the body.

While there are problems brought about by pornography, current sex education is also inadequate and has many problems in its design and execution. The federal government funds two programs that aim to prevent pregnancy and sexually transmitted infections (STIs): the Title V Sexual Risk Avoidance Education (SRAE) grant program, and the discretionary SRAE grant

program. They emphasize *abstinence* as the method for achieving their goal (Federally Funded Abstinence-Only Programs). However, studies have proved that this method doesn't work and may even have adverse impacts on young people who receive this version of "sex education." Researchers indicate that abstinence-only violates human rights in choosing one's way of life, distorts health information, and lacks medical accuracy, and effectiveness (Ott). A lack of sex education also increases the probability of young people engaging in unsafe sex. Although young students can get information from many sources such as parents, peers, and social media, school is probably the best place for getting a systematic education. Most existing sex education also still centralizes heteronormativity without considering sexual minority groups. Some studies even find out that racism and sexism are involved in the process of sex education. Students of different races and sexes are also disciplined at different levels in school (García). These are all issues that must be addressed with integrated sex education of the future.

Comprehensive sex education should be able to tackle the many problems related to teenagers' health, but more importantly, the rooted problem of shame—people's lack of love and confidence in their bodies. According to the Sexuality Information and Education Council of the United States, a nonprofit organization dedicated to sex education, sex education should include: "developmentally and culturally responsive, science-based, and medically accurate information on a broad set of topics related to sexuality, including human development, relationships, personal skills, sexual health, and society and culture" (Doyle). But most importantly, sex education should be designed based on the motif of self-love and respect for not only us but our surroundings. It should not only diffuse scientific information about bodies using data but also engrain the ideas of diversity, indulgence, and respect to normalizing sexual desire in its various forms. Sex education should encourage people to not only build body positivity and absorb health information in education but also assimilate the idea of respect for the diverse groups of people in the world. We should first love our own bodies and then treat people with love and respect. Sex education can therefore be a good teacher in establishing good ethics and helping people have a correct understanding of each part of the body. Through sex education, people can face their partners again without so much crudeness, ignorance, and shame. In this way, we can enjoy pure body pleasures securely and this would have a massive impact not only on our relationships with ourselves and our sexual partners but on culture more broadly.

## **Implications**

We live in a capitalist world and are consumers of products. How and where we spend and what products we purchase can be up to us. Often, these decisions are informed by our values and our values are constructed by what we're taught. In this paper, I have argued that with more robust, body-positive and sex-positive sex education, it is possible for people to shift their consumption habits, particularly away from the beauty and cosmetic industry, and instead spend their money on products that could lead them to explore their bodies, sexualities, pleasures, and so on. The shift is a result of a reorientation to shame.

As people become more tolerant of the sex toy industry, which affords the opportunity to purchase products relating to sex and pleasure and place more love and focus on bodily exploration and feeling, the body liberation journey can achieve its first success. Besides schools, I want to suggest that an adult sex toy shop itself could be a site for sex education, albeit a very different one from the traditional site of sex education in the classroom. Lately, as the feminist movement gains more mainstream popularity, several feminist sex toy shops have appeared in public views such as Babeland, Good Vibrations, and God for Her. This provides proof that the sex toy industry can be an awesome place for sex education. Some feminists have already had the idea of using sex toys as an educational tool to teach women how to enjoy pleasure. Dell Williams established Eve's Garden in New York City in 1974, the first business in the United States solely dedicated to women's sexual pleasure and health. Feminist businesses have played a significant role in making sex toys more acceptable, especially to parts of America that would never have dreamed of entering an adult store.

From Seattle to New York, Albuquerque to Chicago, and Milwaukee to Boston, a burgeoning network of feminist-identified sex-toy shops exist today. These firms have embraced features of Good Vibrations' educationally focused and quasi-therapeutic approach to selling sex gadgets and discussing sex. Professor Lynn Comella comments on the movement of sex-positive adult shops: "History shows us that women will continue to redefine the sex industry, blurring the boundaries in the process between feminist politics and marketplace culture, activism and commerce, and social change and profitability" (Comella). In the future, with a culture that has a more robust sex education, a sex education that is part and parcel of feminist sex toy shops, the beauty industry and sex toy industry are utilized by people for the pure enjoyment of pleasure

and their own aesthetic, and individuals can move away from shame as the primary driver for product purchases in the beauty industry or cosmetic industry.

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## **Has the Euro Benefited Europe? By Zihao Zeng**

The euro was officially introduced in January 1999. The new common currency was seen as a bold experiment since no other currency union had ever had so many different members. It remained to be seen how well eleven European economies could be integrated with each other and how well a single monetary policy would work for all member nations. What are the main benefits of the common currency, what are some of the key drawbacks and what challenges face the euro going forward?

### **Overview of the Creation of the Euro**

The euro was created so that the members of the European Union would have a common currency instead of individual currencies.

A common currency can provide several key advantages, including:

- it eliminates foreign exchange risk when member countries trade with each other
- it makes investing in other member countries easier
- it is easier for people to work in other member countries
- it is easier to eliminate trade barriers between member countries and have common trade barriers with non-member countries

The main disadvantages are that:

- The member countries no longer have control over their own interest rates and monetary policies
- The member countries are less independent of each other so that they will all have similar interest rates, inflation rates, unemployment rates, trade policies, etc.

On balance, the European countries who joined together to form the European Economic and Monetary Union (EMU) or “eurozone” agreed that the benefits of a common currency would outweigh the costs. Voters in Sweden and Denmark disagreed with this assessment so they are not currently members of the eurozone. Even though there were periods when it appeared that some of the member countries might have to drop out (especially Greece in 2015 when it failed to repay its IMF loans during the Greek debt crisis) the eurozone has actually expanded from its original 11 members to the current 20, with Croatia joining on January 1, 2023. More European



Union members are likely to join the Eurozone in the coming years, including Romania, Poland, Hungary and Bulgaria. Sweden and Denmark have already rejected the euro and are not likely to join in the foreseeable future.

### **Challenges in creating the euro**

Legal issues are a potential problem when creating a monetary union, as the laws of the member countries are not identical to each other. Fortunately, the member countries of the eurozone are required to be part of the European Union, so that the legal challenges were not as great as they could have been, but much legal work was necessary to create a common currency. Integrating the economies of the eurozone members and coordinating monetary and fiscal policies also proved to be a major challenge to the establishment of the euro. This is because the member nations produce and export different types of products, have different labor laws, have different traditions, have experienced different inflation rates and interest rates, etc. so that establishing a single monetary and fiscal policy for all member nations was a substantial challenge.

### **3. Members of the European Union and the Eurozone**

The European Union is a free trade agreement that currently has 27 members. The eurozone refers to the group of 20 countries who use the euro as their common currency. In order to join the eurozone a country must already be a member of the European Union; currently, there are 7 members of the European Union that are not members of the eurozone. As of January 2023, the twenty-seven members of the European Union are: Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden. Of these, Bulgaria, the Czech Republic, Denmark, Hungary, Poland, Romania and Sweden are not members of the eurozone. As a result, these countries continue to use their own currencies. They may decide to join the Eurozone in the future; all European Union countries are eligible to join the Eurozone after meeting several key requirements unless they have negotiated the right to opt out of the eurozone.

The criteria for joining the EMU include:

- 1) Membership in the European Union
- 2) Price stability: a country's inflation rate cannot be more than 1.5 percentage points above the inflation rate in the three lowest-inflation members
- 3) Sustainable public finances: a country's public debt cannot be significantly higher than the other member nations
- 4) Exchange rate stability: a country's currency must be part of the Exchange Rate Mechanism II (ERM) for two years; this means that a prospective member's currency is required to remain very close in value to the euro (within 15%).
- 5) Long-term interest rates: a country's long-term interest rates must not exceed by more than two percentage points the long-term rates of the three member countries with the lowest interest rates in the Eurozone.
- 6) Legal Issues: a country's legal system must be compatible with the Treaty and the Statute of the European System of Central Banks (ESCB) and the European Central Bank (ECB).

Bulgaria is currently not eligible to join the eurozone (EMU) because it is not a member of the Exchange Rate Mechanism (ERM). The Czech Republic is not a member because it only meets two of the requirements for membership.

Denmark is not currently a member of the eurozone even though it meets all of the requirements for membership. This is because Denmark retained the right to maintain its own currency after rejecting the Maastricht Treaty in 1992. Instead of joining the eurozone, Denmark maintains a fixed exchange rate between its currency (the krone) and the euro. This helps ensure that Denmark's interest rates, inflation rate, unemployment rate, etc. are similar to those of the other member countries of the eurozone.

Hungary does not meet all of the requirements for membership in the eurozone; in particular, it has too much public debt and its inflation rate is too high. Poland does not meet all of the requirements, and its laws are not completely compatible with the other members of the eurozone. Romania cannot join until it becomes a member of the Exchange Rate Mechanism (ERM). As with Denmark, Sweden does not use the euro because the public voted to stay out in a referendum that took place in 2003. In addition to the 20 countries who belong to the European Union and use the euro as their currency, there are four countries who are not members of the EU

but use the euro anyway. These are: Andorra, Monaco, San Marino and the Vatican. These countries have signed treaties with the EU to use the euro as their own currencies. They have permission to issue their own coins but do not have any representation at the European Central Bank (ECB), which is the central bank for the entire eurozone. In addition, two countries: Kosovo and Montenegro use the euro as their own currency but do not have any formal treaties with the EU. They cannot issue their own coins and do not have any representation at the ECB. The six countries that use the euro in spite of not being members of the Eurozone are all very small and do most of their trade with Eurozone members. It therefore makes sense to use the euro instead of their own local currency.

#### **4. History of the euro-dollar exchange rate**

When the euro first started trading in January 1999, the exchange rate was \$1.1371/euro. In May 2001, the euro reached its lowest level at \$0.8455/euro during a worldwide recession. The exchange rate rose as high as \$1.5805/euro in March 2008 during the outbreak of the housing crisis in the United States. The euro fell to a low of \$1.1042/euro in October 2016 during the ongoing migrant crisis in Europe. On the date that Brexit became official (January 31, 2020) the euro-dollar exchange rate was \$1.1082/euro. Brexit refers to the departure of Great Britain from the European Union on January 31, 2020. This made Great Britain the first country to withdraw from the European Union since its creation in 1957. Brexit caused a considerable amount of political upheaval in Great Britain and the members of the European Union, causing both the pound and euro to weaken.

The loss of Great Britain as a member of the European Union reduces the benefits of trade among its members as Great Britain is the fifth-largest economy in the world (its GDP in 2022 was \$2.67 trillion). Brexit imposes hardships on British consumers who are likely to pay higher prices for goods imported from the European Union members. Further, Brexit increased tensions between Great Britain and the Eurozone members, which put downward pressure of the pound and the euro. Since the British never adopted the euro and kept the pound as their currency, their withdrawal from the EU had less of an impact on the euro than it might otherwise have had. The euro was highly stable during the Coronavirus pandemic, as virtually all countries were affected by it. In September 2022 the euro fell below \$1 per euro for the first time in 20 years, largely due to the political turmoil resulting from the Russian invasion of the Ukraine, as

well as rapidly rising interest rates in the United States. Political uncertainty has a negative impact on a currency while higher interest rates usually strengthen a currency in the short run. As of January 2023, the euro has rebounded to about \$1.06 per euro.

### **5. What have been the major challenges in the eurozone?**

There have been several crises during the lifetime of the euro; in some cases it was necessary to bail out a member nation to enable it to continue using the euro as its own currency. Some of these crises are: The Greek debt crisis – Greece’s public debt reached extremely high levels after the 2007-2008 financial crisis, with government bond yields soaring in 2015 after Greece defaulted on an IMF loan. This led to doubts that Greece could remain in the Eurozone. Greece needed several external loans to remain afloat during this period, triggering a crisis of confidence in the country’s solvency. During the period 2009-2010, several members of the EMU struggled to pay their debts, including Greece, Italy, Portugal, Ireland, Spain and Cyprus. These crises were resolved with loans and bailouts. The eurozone was also impacted by a migration crisis in 2015 and 2016, in which more than one million refugees from the Middle East entered the member countries. The outbreak of the Coronavirus in 2020 and the Russian invasion of the Ukraine in 2022 were also major challenges to the eurozone.

### **6. Has the eurozone successfully increased trade with the rest of the world?**

Increasing trade was one of the major reasons for creating a common currency as the member nations would no longer have to worry about foreign exchange risk when trading with each other. According to “The Impact of the euro on trade: two decades into monetary union” published by the European Central Bank in 2021, the overriding goal of introducing the euro was to create a single market among the member nations; this required the use of a common currency to reduce transactions costs and eliminate foreign exchange risk. It was expected that the euro would lead to greater openness to trade among the member nations and increase trade among member nations. The paper shows that trade increased among the “first wave” of countries adopting the euro; these are the original eleven members that joined in 1999 (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain.) The average increase in trade among these countries was 5.5% per year from 1995 to 2015.

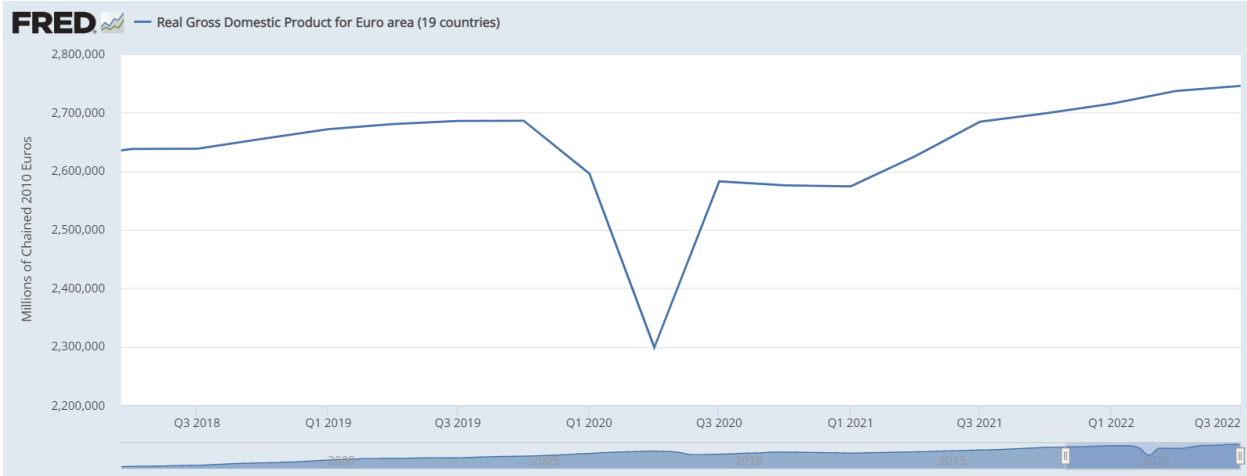
The paper also shows an increase in trade between the first wave and second wave of countries adopting the euro. The second wave countries are: Slovenia, Cyprus, Malta, Slovakia, Estonia, Latvia and Lithuania; these countries joined between 2007 and 2015. Trade between the first and second wave countries increased between 4% and 6% per year after the adoption of the euro. Trade among the second wave countries also increased by average of 5% per year.

**7. What has been the experience with inflation, unemployment, GDP growth, etc. since the creation of the eurozone?**

Before the Covid epidemic, European inflation and unemployment rates had steadily declined, and GDP had risen slowly. In the recovery phase since the epidemic, the unemployment rate has declined, but the inflation is increasing (due to a shortage of labor and goods.) According to “20<sup>th</sup> Anniversary: The Euro as the Cash Currency of Europe”, published by the German government, eurozone inflation averaged 1.7 percent until 2020. This is lower than Germany’s 2.2 percent average inflation rate in the ten years prior to the introduction of the euro. The following graphs illustrate the experience with inflation, unemployment, GDP growth, etc. since the creation of the eurozone.

GDP-FRED (Federal Reserve Economic Data Base)

<https://fred.stlouisfed.org/series/CLVMNACSCAB1GQEA19#>

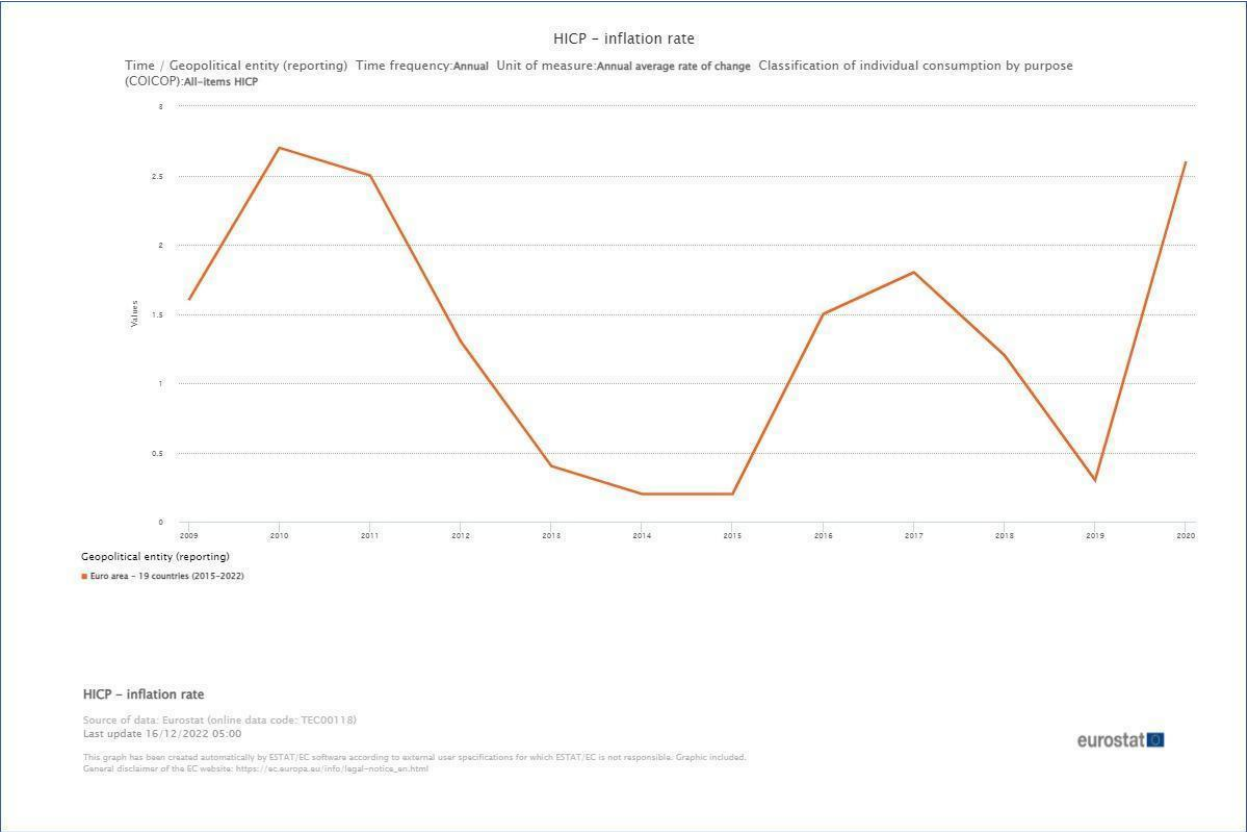


Before the epidemic, the GDP of the euro area showed a slow growth trend. After the outbreak of the epidemic in the fourth quarter of 2019, the GDP fell rapidly and contracted by

about 14% to the lowest point in the second quarter of 2020. At this time point, the outbreak of the epidemic was at its worst, and countries implemented blockade policies to restrict the gathering and movement of people. Most offline enterprises and factories shut down. Moreover, the new German Prime Minister had not yet been elected, and the risk of political uncertainty exacerbated the market's pessimistic expectations of the German economy. In the third quarter of the same year, countries gradually released their policy options to restore the economy, and the data rose month by month. However, in the fourth quarter, the risk of a second outbreak of the epidemic appeared in Europe, and the momentum of economic recovery weakened. In 2021, due to the development of vaccines and the decline in the mortality rate of the epidemic, the data gradually recovered and reached the pre-epidemic levels in the third quarter.

### INFLATION-Eurostat

<https://ec.europa.eu/eurostat/databrowser/view/tec00118/default/line?lang=en>



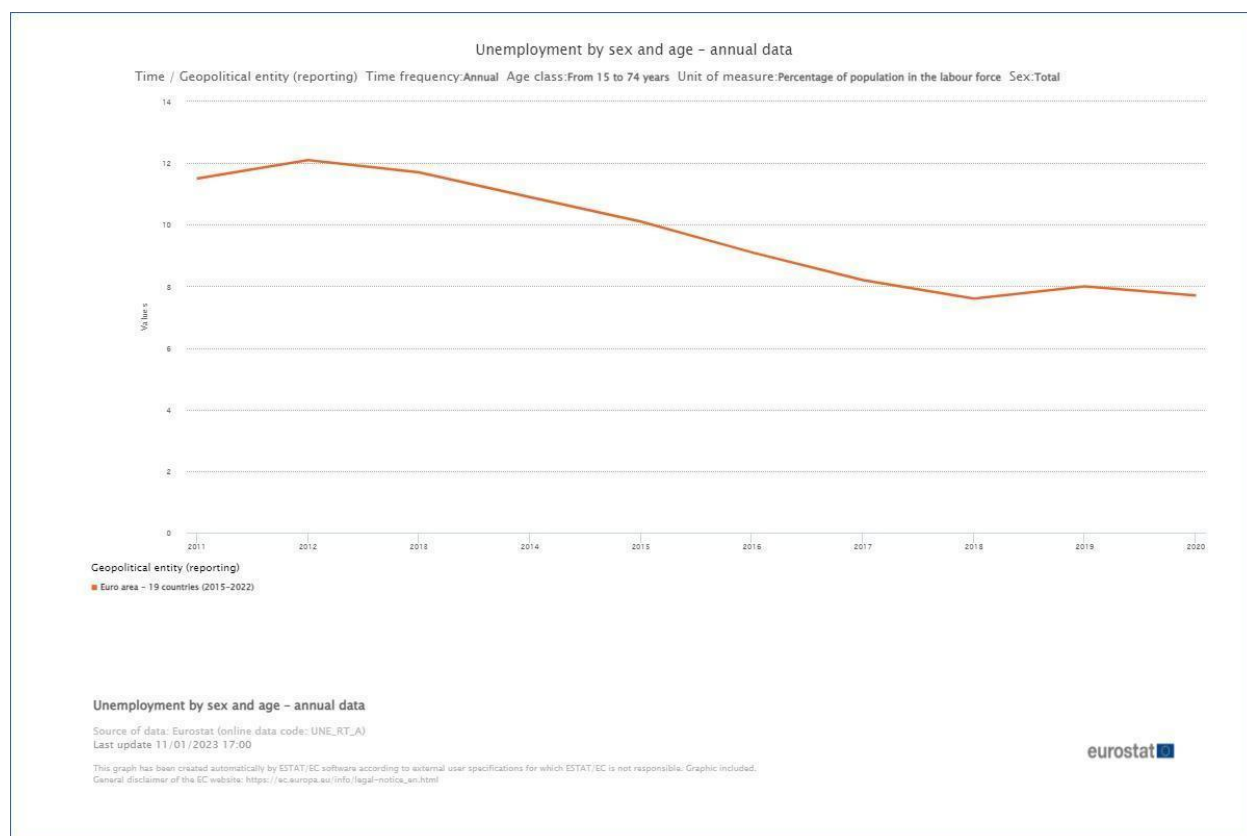
The imbalance between supply and demand in the market led to a decline in oil prices. In 2015, the oil price fell because the cost of shale oil in the United States fell, the geopolitical

crisis in Libya and Iraq, and other traditional oil-producing countries was relieved, and production was gradually resumed. The inflation rate in the euro area increased significantly and reached the highest point of 1.8% in March 2017. The euro area launched a comprehensive quantitative easing monetary policy program, and inflation gradually recovered. With quantitative easing, the central bank acquires financial assets from the banking system in order to increase liquidity and enable banks to continue lending even during a crisis.

In the fourth quarter of 2019, the epidemic broke out, and inflation rose sharply to 8.4%, surpassing the levels reached during the 2008 subprime crisis.

### Unemployment-Eurostat

[https://ec.europa.eu/eurostat/databrowser/view/une\\_rt\\_a/default/line?lang=en](https://ec.europa.eu/eurostat/databrowser/view/une_rt_a/default/line?lang=en)



Before the epidemic, the unemployment rate had been on a downward trend. In 2018, the economic growth of the euro area slowed down, so the unemployment rate rose slightly. After the epidemic outbreak in the fourth quarter of 2019, the euro area implemented a job security plan to protect about 4 million jobs. The unemployment rate was controlled and did not rise

significantly. However, the unemployment rate data lags seriously, and the increase in the unemployment rate after the epidemic may be higher than the data indicate.

## **8. Monetary Policy in the Eurozone**

What are the policy objectives of the European Central Bank and how is monetary policy conducted in the eurozone? The European Central Bank (ECB) is the central bank for the entire eurozone. It is responsible for conducting monetary policy for the eurozone members; it also issues currency and supervises banks. The top priority of the ECB is to maintain price stability, which means that inflation is low (2% or less) stable (not subject to large changes) and predictable (consistent over time.) The European Central Bank recently adopted an inflation target of 2% (during the summer of 2021). Inflation targeting means that if inflation rises above the target, the central bank will raise interest rates to reduce inflation back to its target level. If inflation falls below the target, the central bank may lower rates to strengthen the economy, which would cause inflation to rise back to its target level. With inflation targeting, managing the rate of inflation becomes the top priority of the central bank, regardless of the strength of the economy and the rate of unemployment. 2% is a common target for central banks that use inflation targeting, including the United States. 2% inflation ensures that the money supply can grow quickly enough to accommodate economic growth. It also ensures that inflationary expectations remain low among market participants. For the most part, the ECB has been able to meet its inflation target going back to 2010. During this period inflation has averaged 1.36%, with a low of 0.2% in both 2015 and 2016 and a high of 2.7% in 2011. During this same period, unemployment in the eurozone averaged 9.5%, with a low of 6.5% in 2022 and a high of 12.2% in 2013. Annual GDP growth ranged from -2.8% in 2020 during the height of the COVID pandemic to 5.5% in 2022, with an average of about 1.2%. This shows that unemployment was relatively high and GDP growth was relatively slow during this period, although the impact of the COVID pandemic and the Russian invasion of the Ukraine are at least partially responsible for this poor performance.

## **9. Variables that Affect the Euro**

Some of the key factors that affect the strength of the euro are:



GDP (Gross Domestic Product) – GDP measures the value of all goods and service produced within a country’s borders during a given year; it is often referred to as “national income.” Growth of GDP indicates how strong the economy is; a low or negative growth rate indicates that an economy may be heading toward recession, while strong GDP growth is an indication of rising prosperity. A country’s currency tends to strengthen when it experiences strong GDP growth as the currency becomes more attractive to foreign investors. Inflation – inflation refers to a persistent rise in the cost of goods and services. Higher inflation reduces the strength of a currency as it becomes less attractive to foreign investors and foreign consumers. Holding a foreign currency from a country with a high inflation rate is very risky since it reduces the returns to investing in that country and it also reduces the purchasing power of foreign investors. Unemployment – unemployment is a measure of the proportion of a country’s labor force that does not have jobs. Higher unemployment is a signal of weakness in a country; this reduces the attractiveness of investing in that country, so that its currency tends to weaken. Trade balance – a country’s trade balance refers to the difference between the value of its exports and its imports. A trade surplus means that the country’s exports exceed its imports, which tends to strengthen the country’s currency. A trade deficit means that the country’s imports exceed its exports, which tends to weaken the country’s currency. Political stability – a country with a stable political system is more attractive to investors than a country with a great deal of upheaval. The more stable a country is, the stronger its currency will be.

## **10. Pros and Cons of the Euro**

### Pros

1. it increases the ease with which prices can be compared between countries, which boosts competition between businesses, thereby benefiting consumers
2. price stability; eurozone inflation has consistently been extremely low
3. the euro makes it easier, cheaper and safer for businesses to buy and sell within the euro area and to trade with the rest of the world
4. improved economic stability and growth
5. better integration and therefore more efficient financial markets
6. greater influence in the global economy

7. a tangible sign of a European identity.

The euro has eliminated the costs of exchange rate fluctuations within the euro area. Trade between member nations is conducted in a single currency, which reduces uncertainty and stimulates trade and investment among member nations.

Cons

- 1) Loss of independent control of monetary policy by member nations
- 2) Reduced political independence among member nations

On balance the Eurozone has continued to increase the number of member nations and has not lost any members since the creation of the euro over twenty years ago. This shows that the member nations consider the benefits of membership to outweigh the costs.

## **11. What Explains the Recent Weakness of the Euro?**

The conflict in Ukraine, ongoing energy shortages, the weakness of the US economy and the slowdown of China's economic growth are all major contributors to the euro's recent weakness. The conflict in the Ukraine increases political uncertainty even though the Ukraine is not part of the eurozone. Instability can easily spill across borders, so that investors are nervous about the eurozone's economic prospects. The Ukraine borders on Slovakia, which is a member of the Eurozone.

It also borders on Poland, Hungary and Romania, which are members of the European Union and potential future members of the Eurozone. Further, many European countries obtain much of their energy from Russia, so that a widening of this conflict could lead to severe energy shortages and higher inflation. The recent weakness in the U.S. economy is also a problem for the Eurozone members as it reduces trade with the United States, one of the major markets for European goods. The same holds for China, which is the second largest economy in the world and is another major consumer of European goods.

Another issue that has caused the euro to weaken is that the inflation rate in the Eurozone has risen in recent years, causing the cost of living to increase for European consumers. This has triggered protests in some member nations, leading to political uncertainty and reduced confidence in the euro.

## 12. Forecast of the Euro in 2023

The soaring global inflation and dramatically higher U.S. inflation has led the Federal Reserve to raise interest rates substantially with the federal funds rate jumping from a range of 0.25-0.50% in March 2022 to the current 4.50-4.75%. This has significantly increased the dollar's attractiveness to global investors and has encouraged them to hold dollars instead of euros. As a result, there has been consistent downward pressure on the euro during this period. Since October 2022, the euro has rebounded against the dollar due to rising interest rates in the eurozone; these rate increases are designed to reduce rapidly rising inflation. Higher interest rates tend to strengthen a currency in the short run as this increases the returns to investors. Over a longer period, though, inflation will reduce the strength of a currency due to a loss of purchasing power. As a result, in spite of the temporary rebound of the euro, 2023 is likely to be a difficult one for the euro unless there is a rapid resolution of the Russian-Ukrainian conflict as this war has put upward pressure on energy prices. Further the economies of the U.S. and China appear to be growing more slowly than usual which is likely to put further downward pressure on the euro.

One potential problem for the European Central Bank (ECB) is the persistence of Italy's ongoing debt problems. The ECB was able to purchase much of Italy's government debt in the past few years as part of "quantitative easing" but is unlikely to do so this year as fighting inflation becomes the bank's top priority.

If the ECB continues to raise interest rates and inflation falls as a result, the euro could have a reasonably strong rebound in 2023, but it is likely to fall further based on the uncertainty in the Ukraine and Russia.

### **The Model**

The forecasting model for the euro in 2023 was derived using multiple regression analysis. The dependent variable (Y) is the euro-dollar exchange rate (expressed as dollars per euro). The independent variables (X's) are:

- Eurozone GDP growth
- Eurozone unemployment rate
- Eurozone 10-year government bond yield

- US GDP growth
- US 10-year government bond yield

These variables were chosen due to their strong correlation with the euro-dollar exchange rate.

The data were obtained from FRED – The Federal Reserve Economic Database of the St. Louis Federal Reserve Bank. ([Federal Reserve Economic Data | FRED | St. Louis Fed \(stlouisfed.org\)](https://fred.stlouisfed.org/))

The forecasting model is based on quarterly data from January 1999 to July 2022. January 1999 was chosen as the starting point for the data since the euro was introduced in January 1999. All variables are expressed on an annual basis.

The coefficients from the regression model are given in the following table:

<b>Variable</b>	<b>Coefficient</b>
Intercept	1.9241
Eurozone GDP Growth (%)	-2.6205
Eurozone Unemployment Rate (%)	-4.1179
Eurozone 10-Year Government Bond Yield (%)	24.7638
US GDP Growth (%)	3.5115
US 10-Year Government Bond Yield (%)	-30.8418

Each of these variables is statistically significant at the 1% level. The adjusted R-Square measure for this regression is 0.6798, indicating that the model does a good job explaining the factors that determine the euro-dollar exchange rate.

Since the exchange rate in this study is quoted as dollars per euro, the higher is the exchange rate, the weaker is the dollar and the stronger is the euro. As a result, a variable with a negative coefficient indicates that if the variable increases, the exchange rate falls, indicating a stronger dollar and a weaker euro. A variable with a positive coefficient indicates the opposite. The signs of three of these variables conform to economic theory: Eurozone unemployment, eurozone 10-year government bond yields and U.S. 10-year government bond yields. Eurozone unemployment has a negative coefficient; as Eurozone unemployment rises, the exchange rate will fall, indicating a stronger dollar and weaker euro. The eurozone 10-year government bond yield has a positive coefficient; as Eurozone interest rates rise, the exchange rate will rise, indicating a weaker dollar and stronger euro. The U.S. 10-year government bond yield has a negative coefficient; as U.S. interest rates rise, the exchange rate will fall, indicating a

stronger dollar and weaker euro. The signs of the two remaining variables do not conform to economic theory: Eurozone GDP growth and US GDP growth.

Eurozone GDP growth has a negative coefficient; as Eurozone GDP growth rises, the exchange rate will fall, indicating a stronger dollar and weaker euro. This is a surprising result as stronger GDP growth in the eurozone could be expected to strengthen the euro.

US GDP growth has a positive coefficient; as US GDP growth rises, the exchange rate will rise, indicating a weaker dollar and stronger euro. This is a surprising result as stronger GDP growth in the U.S. could be expected to strengthen the dollar. The coefficients of the U.S. and Eurozone 10-year government bond yields are significantly higher than for the other variables. This shows that interest rates have a much stronger impact on the euro-dollar exchange rate than unemployment and GDP growth. This supports the idea that the strength of a currency in the short run is heavily influenced by the rates of return that investors can achieve by holding a currency. The U.S. and Eurozone inflation rates were excluded from the regression because they were not statistically significant, which is somewhat surprising. It may be that inflation only affects a currency over a longer time frame as the expectations of market participants adjust to changes in inflation. The results of the regression model confirm that over a short period of time, the demand for a currency depends heavily on the expected return that investors can earn by holding bank deposits in that currency. GDP growth, unemployment and inflation can have an impact on exchange rates which is mainly felt over a much longer time frame.

### **The Forecast**

The forecast for the euro-dollar exchange rate in 2023 is based on the assumption that there will be a modest rebound in the U.S. and the Eurozone as the world finally recovers from the COVID crisis. (See Regression Results in the Appendix). Assuming that US GDP growth rises to 3%, while Eurozone GDP growth rises to 2.5%, this could lower Eurozone unemployment to 7%. A reasonable forecast for the government 10-year yield in the Eurozone would be 4% while in the U.S. the yield could rise to 5%. Then the predicted euro-dollar exchange rate for 2023 would be obtained as follows:  $y = 1.9241 - 2.6205 \text{ Eurozone GDP Growth} - 4.1179 \text{ Eurozone Unemployment Rate} + 24.7638 \text{ Eurozone 10-Year Government Bond Yield} + 3.5115 \text{ U.S. GDP growth rate} - 30.8418 \text{ U.S. 10-Year Government Bond Yield}$

Substituting the predicted values of these variables gives:  $y = 1.9241 - 2.6205(0.025) - 4.1179(0.07) + 24.7638(0.04) + 3.5115(0.03) - 30.8418(0.05) = \$1.1241/\text{euro}$

This shows that the euro would strengthen slightly in 2023, continuing the upward trend that it experienced toward the end of 2022 after falling under \$1 per euro in September 2022. This decline has been attributed to the European Central Bank's reluctance to raise interest rates as quickly as the Federal Reserve in the U.S. Since then, the ECB has raised rates rapidly; the ECB's main policy rate, the main refinancing rate, was raised for the first time in eleven years in July 2022, followed by rate increases in September, October and December 2022. During this period the main refinancing rate was increased from 0% to 3%. This was enough to strengthen the euro from its low of September 2022.

If the recovery falters in the Eurozone due to external factors such as the Ukraine-Russia conflict, then the euro could experience a downturn even if its economic performance is relatively strong. Political turmoil can significantly impact the expectations of market participants which in turn can cause a currency to decline despite strong economic fundamentals. A survey of foreign exchange strategists at major U.S. banks in January 2023 showed optimism that the euro would strengthen against the dollar in 2023 based on the expectation that the Federal Reserve would soon slow its aggressive interest rate increases and also expressed confidence in a rebound of the Chinese economy.

<https://www.yahoo.com/now/eur-usd-2023-forecast-per-091247624.html>

### **13. Conclusion**

The euro was created in January 1999 to provide the member nations with a common currency. This has the advantage of eliminating foreign exchange risk among member nations, making it easier for these countries to trade with each other. It also improves the integration of financial and labor markets among member nations, so that investing and working in other member nations is easier. Currently there are 20 members, with more expected to join in the future.

Since the creation of the euro inflation has remained relatively low within the eurozone; unemployment has improved somewhat and trade has steadily increased among the member nations. These were three of the key objectives in the creation of the eurozone.

There has been a significant amount of turmoil within the eurozone countries, including debt crises that nearly led to the exit of some member nations such as Greece. The refusal of Great Britain to join the eurozone, followed by its departure from the European Union (known as “Brexit”) also led to turmoil in the eurozone. Despite these crises, the eurozone has continued to expand from its original 11 members in January 1999 to the current 20 in January 2023. This demonstrates that many European countries recognize the benefits of membership, in spite of the potential drawbacks. In 1999, many market participants were skeptical that such a large currency union could survive, but with the recent 20<sup>th</sup> anniversary of the eurozone in 2019 it appears that the euro will continue to thrive going forward. On balance, it does appear that Europe has benefited from the introduction of the euro.

## **Amphotericin B Binding Inhibits the Nsp15 Endonuclease NendoU of SARS-CoV-2-- A New Idea for COVID-19 Drug Development By Du Lehan, Tang Lingfang**

### **Abstract**

SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2), as a new respiratory coronavirus causing Coronavirus Disease 2019 (COVID-19), has been leading to serious effects worldwide. At present, researchers keep developing drugs for COVID-19 treatment. Nsp15, a uridine-specific endoribonuclease, is a non-structural protein of SARS-CoV-2, which can inhibit the immune response from host cells, and therefore plays a vital role in SARS-CoV-2's life cycle. In this work, we chose Nsp15 as a potential target for developing antiviral medications. After utilizing computer website virtual screening technology to identify potential drugs that can bind to the active sites in Nsp15's functional domain NendoU, we screened several drugs that could inhibit Nsp15, among which Amphotericin B (Amb) shows the highest potency as a candidate COVID-19 drug.

### **Introduction**

Many proteins play key roles in the life cycle of SARS-CoV-2, including structural proteins and nonstructural proteins (Nsp family). SARS-CoV-2 has (+) RNA genome that includes coding genes of nonstructural proteins (Nsps). After it enters host cells, SARS-CoV-2's two open reading frames on its RNA genome, rep1a, and rep1b, will be translated into polyproteins pp1a and pp1a and then are processed into 15 or 16 different types of Nsp proteins by enzymatic processing (Sixto-López & Martínez-Archundia, 2021). The Nsp proteins of SARS-CoV-2 don't constitute new virus particles but play an important role in viral replication and viral assembling process.

Nsp15, one member of Nsp family, is a highly conserved uridine-specific endoribonuclease. Several research proves that Nsp15 is important for SARS-CoV-2 to evade immune response from host cells. Similar phenomena have been observed in viruses such as mouse hepatitis coronavirus (MHV) and porcine endemic diarrhea coronavirus (PEDV) (Deng *et al.*, 2019). The study of Bo Gao *et al.* further explained this mechanism and proposed the Nsp15 working model. Negative RNA and dsRNA are the intermediate form of SARS-CoV-2 RNA that is synthesized from DNA and are finally responsible for direct translation into proteins. The model shows that Nsp15 functions to cleave 5' poly U on negative RNA and dsRNA of SARS-CoV-2, reducing their accumulation that can activate host cells' immune sensor. Thus,



Nsp15 can help to prevent the activation of the host immune response and promote the infection of viruses.

Nsp15 is a hexameric ribonuclease. Nsp15 monomer includes two peptide chains and three domains: the N-terminal domain for oligomerization, the intermediate domain, and the C-terminal catalytic domain with NendoU activity. The C-terminal is the most important catalytic domain in Nsp15 because the most important function of Nsp15 – cleavage of 5' poly U on negative RNA and dsRNA to prevent host immune system activation plays a role mainly through the NendoU domain. The NendoU site is also highly conserved and has fewer genetic mutations. It has the six most conserved key amino residuals in nidoviruses, including His235, His250, Lys290, Thr341, Tyr343, and Ser294 (Pillon *et al.*, 2021).

There are several preliminary research about designing drugs that target Nsp15; for example, the study of Saramago *et al.* concluded that Dutastride, Meprenisone, and Tasosartan have higher inhibitive activity toward Nsp15 through molecule screening, computer modeling, molecular modeling, and molecular experiment. However, further research such as animal and clinical experiments, are needed (Saramago *et al.*, 2022). In conclusion, because of the importance of the NendoU in SARS-CoV-2 life cycle and the highly conserved characteristic of Nsp15 in Nidovirales, targeting the NendoU region, especially the six conserved amino acids of Nsp15 could enable the successful development of drugs that could be widely used in the treatment of other nidoviruses diseases.

## **Method**

### a) Selecting the docking file of Nsp15

After searching the Nsp15 protein three-dimensional structure file by inputting keywords on the PDB website (<https://www.rcsb.org>), 6vww was selected as the working file from all the search results, considering its resolution is 2.20 Å and no exceptional ligand.

### b) Screening of key residues at active sites of Nsp 15

Youngchang Kim *et al.*, using the Crystallization experiments method, pointed out that the six most conserved key amino residuals in NendoU active site are His235, His250, Lys290, Thr341, Tyr343, and Ser294 (Kim *et al.*, 2020).

### c) Virtual screening using the Chemoinfo website

Upload and input 6vww file and the key amino residuals to the website. Screen with six key amino residuals separately.

**Use the docking program PLANTS (reference (12))**

- (\*) Protein structure file in pdb format ([more](#)):  6vww.pdb  
 (option) skip the protonation step and upload your protein structure file in .mol2 format (\*):  未选择任何文件  
 (\*) this file will be the input for PLANTS (can contains water, ions, co-factors... in .mol2 format too) but the protein structure file in pdb format is still required for the display
- (\*) Definition of the binding site around a residue or a ligand in the pdb structure:  
 RESIDUE name (case sensitive)  RESIDUE number  CHAIN (or leave empty)   
 or set coordinates of the center of the binding site: x , y , z
- (\*) Binding site radius   
*rq: water molecules are excluded in this online implementation except if you submit the prepared .mol2 file.*
- (\*) Weight in final score (e.g. 1)

(\*) mandatory fields

Figure. 1 Screening interface of the Chemoinfo website (<https://chemoinfo.ipmc.cnrs.fr>)

## Result

The reference scores provided on the website are based on the ChemPLP function calculation in the PLANTS program, and higher scores indicate higher binding affinity of the targeted protein to the drug. A total of 2012 drugs were calculated and the highest score was obtained by Amb.

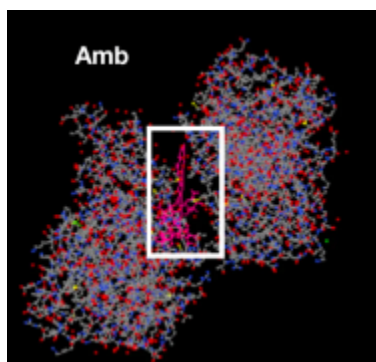


Figure 2. 3D structure of Nsp15 and Amb, showing the binding between them.

a) Amb introduction: Amb, as an antifungal drug isolated from *Streptomyces punctatu*, has broad-spectrum antifungal activity and can treat many kinds of fungal diseases. For example, mucormycosis, aspergillosis, candidiasis, and so on. Also, it can be used to treat life-threatening protozoa infections, such as Leishman disease and primary amoebic meningoencephalitis.

b) Amb's working mechanism: The original target of Amb is a kind of ergosterol, which is a kind of essential lipid compound in the fungal membrane and acts similarly to cholesterol in animal cell membranes. When Amb combines with ergosterol, they will form transmembrane channels through electrostatic repulsion in the fungal membrane, destroying the integrity of the fungal membrane and causing leakage of intracellular components. The targeted fungal cells die finally (AL-Khikani, 2020b)

## **Discussion**

a) The broad antiviral activity of Amb: AL-Khikani's study showed that Amb also has broad antiviral activity. The reason is that many viruses use host cells' membranes to form their own viral envelopes, which therefore contain host cells' components, such as cholesterol, which could be the attacking target of Amb. At present, Amb has been studied in antiviral drug development. For example, in JEV, HIV, and EV71 infection, Amb can interfere with the invasion of these viruses by stopping the entry and the package of viral particles (Konopka *et al.*, 1999; Xu *et al.*, 2016; H. Kim *et al.*, 2004). SARS-CoV-2, as a virus with envelope, therefore, can also be the target of Amb (AL-Khikani, 2020a).

b) Amb's potentiality of treating COVID-19 complications: The infection of SARS-CoV-2 can cause human lungs become fragile. In that condition, fungal infection is easy to happen, such as coronavirus pneumonia-pulmonary aspergillosis (CAPA) (Van Ackerbroeck *et al.*, 2021). Amb,

## **Conclusion**

We performed a virtual screening of drugs that can bind to the active site of nsp15 and block its activity, and analyzed the screening results. We selected the appropriate drugs from the screening results and analyzed the potential possibility of SARS-CoV-2 treatment. Amb is an FDA-approved broad-spectrum antifungal drug with low drug resistance and a long history of use. It shows high potency to treat COVID-19. First, it can be used as an Nsp15 inhibitor, binding to Nsp15 and inhibiting its function. Second, it can be used as an antiviral drug, targeting SARS-CoV-2's envelope to block its entry of host cells. Third, it can be used as an antifungal drug for the treatment of COVID-19 complications-pulmonary aspergillosis (CAPA). It is hoped that investigators could continue to chemically modify Amb and improve its therapeutic potential.

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# **Papillary Thyroid Carcinoma Progression to Aggressive Thyroid Cancers: Uncovering the Biomechanisms of Thyroid Cancer to Explain an Increase in Thyroid Cancer Mortality By Kushal Khare**

## **Abstract**

Papillary Thyroid Carcinoma (PTC) is frequently described as “the good cancer” due to its favorable prognosis and treatability. Whereas now, advanced research regarding aggressive thyroid cancers is indicating an increase in PTC-related mortalities. The objective of this report is to assess and analyze the most common malignancy of the endocrine system and its ability to progress to further dangerous cancers. Even though this progression of PTC is often overlooked, the knowledge understood on the biological and clinical mechanisms of head and neck malignancies is constantly evolving and offers an explanation for a recent increase in PTC-related mortality. By comparing PTC to other well-understood neuroendocrine tumors, this report has mapped this transformational process to synthesize progression-provoking factors through both clinical and molecular approaches.

## **Well-Differentiated vs. Poorly Differentiated Neoplasms**

Thyroid cancer can be classified into two histopathological groups used for neuroendocrine tumors – well-differentiated and poorly-differentiated. These terms are used to “define” different cells and tissues that have acquired structure and function within the human body. In cancer, well-differentiated cancer cells grow at a slower pace, are organized, and pathologically look similar to normal tissue; therefore well-differentiated tumors are referred to as grade I tumors<sup>3</sup>. Although, poorly-differentiated or undifferentiated neoplasms suggest the inability to distinguish where cancer starts and healthy tissue begins. Hence referred to as grade III or IV tumors<sup>4</sup>.

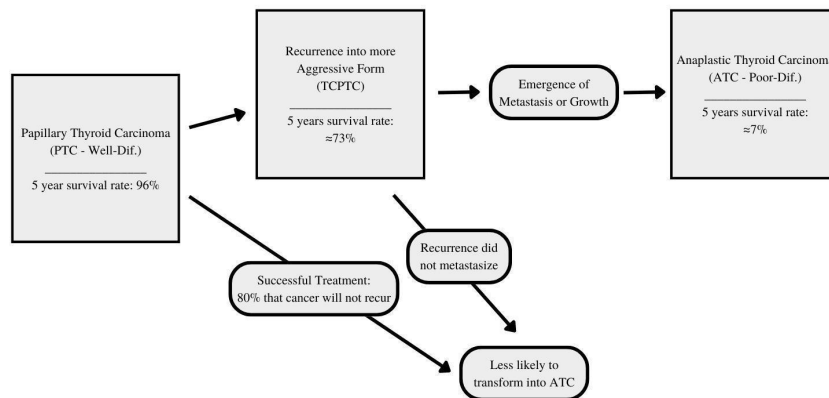
## **Papillary Thyroid Carcinoma vs. Anaplastic Thyroid Carcinoma**

Papillary Thyroid Carcinoma and Follicular Thyroid Carcinoma (FTC) are the most common form of well-differentiated thyroid cancer. PTC most commonly identifies itself as an irregular solid or cystic mass or nodule in the thyroid gland. Although, do not let the “well-differentiated” and “the good cancer” phrases delude the significance of PTC. PTC is a

minimally invasive malignancy and can easily spread to other organs if not identified and surgically managed. Specifically, Tall Cell PTC (TCPTC) has a tendency to spread and invade lymphatics and the neurovasculatures of the neck<sup>5</sup>. Through patient demographics and established knowledge of other neuroendocrine tumors, it can be concluded that the causes of PTC include high levels of radiation exposure and an inherited genetic mutation of the BRAF gene (v-RAF murine sarcoma viral oncogene homolog B1). In recent pediatric cases, there have also been evidential connections between oxidative stress and thyroid dysregulation, although this connection to thyroid cancer still remains unanswered<sup>8</sup>. In opposition to the treatable PTC, Anaplastic Thyroid Carcinoma (ATC) is a poorly-differentiated highly aggressive malignant tumor that demonstrates a lethal behavior. ATC continually ranks itself as one of the deadliest and destructive diseases worldwide and carries a dismal prognosis and a low survival rate. Even though ATC makes up approximately 5% of all thyroid neoplasms, its mortality is close to 100% due to its metastatic attributes. Parallel with PTC, ATC occurs in individuals over age 60 and is more common in females rather than males. However, the exact cause of ATC is currently unknown<sup>10</sup>.

### **Dynamics of Papillary Thyroid Carcinoma's Transformation to Anaplastic Thyroid Carcinoma**

When looking at recent case reports of PTC, age was shown to play a major factor in survival probability, regardless of stage. As established previously, PTC encompasses excellent survival chances, although reoccurrence stands as a prominent issue. Approximately 20% of patients diagnosed with PTC develop the cancer again at some point in their lifetime. The majority of the 20% of individuals who recurrently develop PTC are over 45 years of age<sup>12</sup>. Recurrence of any cancer comes with risks, especially with PTC. When PTC recurs, it often encompasses a more aggressive form of PTC, like TCPTC<sup>(13, 14)</sup>. If PTC recurs, thyroidal cells start to become more genomically unstable, thereby increasing the chances for more aggressive cancers to appear, such as ATC [*Figure 1*].



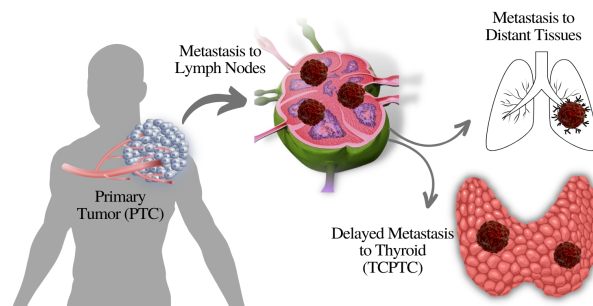
**Fig. 1** | Schematic illustrating transformation from Papillary Thyroid Carcinoma (PTC) to Anaplastic Thyroid Carcinoma (ATC) via a recurrence of an aggressive form of PTC (TCPTC).

### Possible Clinical Treatments

Even though the transformation of ATC from PTC is highly unlikely, this dismissed evolution of PTC can explain the increase of Thyroid Cancer (TC)-Related Death. As of now, there seem to be no concrete denotations that explain certain clinical risk factors for why PTC can progress. Although, researchers have concluded an idea of atypical treatment injunctions that may provoke the progression of PTC to ATC. A population-based trend study conducted at *Bern University Hospital* in Switzerland calculated the effect of the overdiagnosis and overtreatment of thyroid cancer. They observed that approximately 45% to 70% of thyroid cancer cases worldwide are being overtreated<sup>22</sup>. For instance, in the state of Illinois, the rate of thyroidectomies increased by 44% from 1999 to 2009<sup>23</sup>. If a harmless PTC is overtreated, the chance for other regional cancers or lymphatic conditions to appear in the head and neck are possible. Regardless of the physiological impacts overtreating TC may behold, overdiagnosis and overtreatment have been repeatedly associated with potential psychological and behavioral toxicities<sup>24</sup>. Even though we have little idea of what may cause tumor promotion for PTC, we are aware of the factors that are correlated with recurrence. The most prevalent factors include lymph node metastasis, histological variants, and the male sex<sup>26</sup>. Lymph Node Metastasis' (LMN) involvement with PTC has been controversial and continues to evolve in the field of Head of Neck Oncology. As [Figure 2] demonstrates; tainted lymph nodes that have been either



microscopically or clinically inapparent can be undetected and ignored. As LMN's association with PTCs increases, multiple studies have concluded that delayed metastasis through the undetected cancer-tainted lymph nodes is associated with greater recurrence and poorer survival<sup>27</sup>.



**Fig. 2** | *Diagram showing the process of Lymph Node Metastasis (LNM). The primary tumor, which in this case is Papillary Thyroid Carcinoma (PTC) spreads to the nearby neck lymph nodes. Due to the lymphatic system's connection with the rest of the body, the cancer then metastasizes to distant tissues. Or if treatment of the initial PTC was a thyroidectomy (surgical removal of the thyroid gland) without a lymph node dissection, a delayed regional recurrence of PTC can appear via the cancer-tainted lymph node. Note that this is not a definitive response that can cause the recurrence of PTC, although cases such as these are shown to be well-documented and rising in clinical literature.*

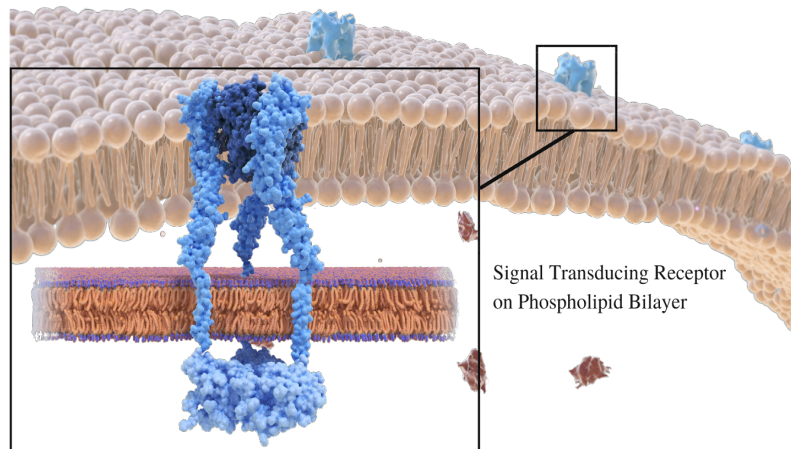
Unlike Lymph Node Metastasis' unproven effect on recurrence, histological variants and the male sex puts forth greater evidence on why recurrence may occur. The term histological variant (HV) refers to "distinctively different histomorphologic phenotypes of a particular neoplasm"<sup>25</sup>. The aggressive histological variants associated with the recurrence of PTC include Diffuse Sclerosing Papillary Thyroid Carcinoma (DSPTC), Tall Cell Papillary Thyroid Carcinoma (TCPTC), Columnar Cell Papillary Thyroid Carcinoma (CCPTC), Solid Papillary Thyroid Carcinoma (SPTC), and Hobnail Papillary Thyroid Carcinoma (HPTC). These more aggressive histological variants present higher levels of cervical and pulmonary metastasis as well as unknown immunohistochemical characteristics that promote cancer recurrence. Given the aggressiveness and unpredictable behavior of these various tumors, clinicians and expert histopathologists do not know the prognostic values of aggressive PTCs. A review performed at

*Moffitt Cancer Center* in Tampa, Florida, uncovered the histological and molecular features found in patients with aggressive variants of PTC. The review compared recurrence rates of more aggressive cancers with patients of conventional PTC with aggressive histological variants of PTC. Through the study at *Moffitt Cancer Center* and research and patient reports around the world, we can conclude that further aggressive histological variants of PTC can increase the chance that aggressive histological variants of PTC can recur after treatment. When further aggressive cancers recur, the chance of the cancer growing emergently and metastasizing into ATC modestly increases. Besides LMN and aggressive histological variants, the male sex shines a light on the significance of identifying sex-related risk factors in PTC. Even though the population that has PTC is dominantly females, the male sex is often associated with some unfavorable clinicopathological characteristics of PTC. This contributes to a worse response to initial therapy or final disease status. A study performed at *Jan Kochanowski University* in Poland retrospectively analyzed 1547 PTC patients (1358 females and 189 males, treated from 1986 to 2018). The study's objective was to verify whether the male sex poses a risk factor for reoccurrence and persistency in PTC. In the study, none of the patients *Jan Kochanowski University* was analyzing had died from PTC or had largely-sized tumors; hence, the study could not examine the effect of sex on death. Despite this, they had come to the conclusion that the male sex can predispose patients with higher reoccurrence levels to more aggressive forms of PTC<sup>28</sup>.

### **Aggressive Papillary Thyroid Carcinoma's Transformation into Anaplastic Thyroid Carcinoma: A Molecular Approach**

Now understanding how conventional PTC can recur into aggressive forms of PTC, we can begin to uncover the reasons why these aggressive forms of PTC (i.e. TCPTC) can emerge into deadly neoplasms like ATC. The model of PTC maturing to ATC is not common, and much research and clinical literature on this topic are not well-recognized. However, we can apply this metastatic model [*Figure 1*] to other neuroendocrine tumors to delineate certain attributes of metastasis in PTC. Cancers, whether common or rare, can spontaneously undergo an emergence of growth or metastasis. In neuroendocrine tumors, this is due to a reduced expression of cell adhesion molecules (CAMs). CAMs are cell surface proteins that mediate the interaction between cells. With limited biochemical knowledge of PTC's cells, endocrine pathologists have

deduced that as a result of reduced expression of cell adhesion molecules, PTC cells are comparatively unrestrained by interactions with other cells and tissue components, contributing to the ability of aggressive forms of PTC to metastasize and emerge into ATC or other fatal neoplasms<sup>29</sup>.



**Fig. 3** | *Figure 3 displays a signal-transducing receptor on the plasma membrane (phospholipid bilayer) of a cell. The majority of cell adhesion molecules (CAMs) are signal-transducing receptors. CAMs are known to mediate the adhesion between cells and the extracellular matrix (ECM), although now, as more research and advancements in cellular physiology develops, CAMs are shown to be much more capable; as demonstrated by a cause for the unregulated proliferation of PTC cells.*

## Discussion

As displayed in *Figure 1*, the mechanisms involved with PTC's transformation encompass high levels of complexity and rely on particulars that isn't subsidized by previous documentation in thyroidology and otolaryngology. However, when plugging this metastatic model *Figure 1* provides to other neuroendocrine tumors, the knowledge identified on PTC grows. Beginning with the conventional PTC, this well-differentiated neoplasm suggests high levels of treatability. Although with the possibility of recurrence in perspective, there comes feasibility for further aggressive genomically unstable cancers to materialize. Even though the causes of this morphological alteration are narrowly supported, current information on other neuroendocrine tumors and cancers can assist in identifying certain risk factors associated with recurrence. If PTC recurs into an aggressive form, for instance, TCPTC, the opportunity for the

aggressive variant to systematize an emergence of growth into a threatening cancer (i.e. ATC) is achievable. By dissecting each step of this transformational process, this report has outlined dismissed clinical and population trends through intricate molecular approaches and histological outlooks.

Comparing the immunological, histological, cellular, and clinical features of cancers that we have a modest understanding of with ones we have a greater comprehension of can be a determining factor in our developments in cancer biology and oncology. Furthermore, case studies and research on specific malignancies like PTC can grant disciplines greater conceptualizations of related conditions, such as thyroid dysfunction, goiter, and thyroiditis. Making studies on this topic principal in the future to benefit our perception of human health.

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## **Preventing the Spread: How the East Coast Can Combat the Spotted Lanternfly Invasion**

### **By Sienna Hargreaves**

Thousands of different invasive species currently exist and wreak havoc on ecosystems. They grow exponentially, multiplying and spreading extensively around the planet. With a multitude of cases in different regions, many ways to handle these alien species have cropped up. While there are many positive solutions, there are also, unfortunately, many solutions with unintentional, detrimental outcomes. With the new invasion of the Spotted Lanternfly on the US east coast, it is clear that a good solution needs to be found. The island US state of Hawaii has a lot of experience with invasive species because many organisms have been brought over accidentally or intentionally, and end up preying on endemic species that have little defenses against outside species. With this experience comes a variety of good and bad results, and ones that the rest of the U.S. can learn from.

#### **Who is the Spotted Lanternfly?**

The Spotted Lanternfly is an invasive species that was found on the east coast of the U.S in 2012. It's generally believed that they came to America on a shipping vessel from China. The Spotted Lanternfly first traveled to Pennsylvania where it has since spread to Connecticut, Delaware, Indiana, Maryland, Massachusetts, Michigan, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Virginia, and West Virginia (*USDA APHIS | Spotted Lanternfly*) (Sightings are updated on this map: [Spotted Lanternfly Interactive Map](#). Spotted Lanternflies are mostly found feeding on fruit and ornamental or woody trees with some footage showing them covering the entire trunk of the tree (*USDA APHIS | Spotted Lanternfly*). While they can fly short distances, these bugs mainly use their powerful hind legs to move around and hitchhike on moving objects/organisms. They can easily be identified by their bright red hind wings and the black-spotted gray wings that lie on top (*SLF Identification and Life Cycle*). The Spotted Lanternfly invasion is proving to be a threat to many crops, fruits, and trees (*USDA*

#### **What Has the Spotted Lanternfly Done?**

While there's not too much news on the damage that the Spotted Lanternfly has done thus far, there is documentation of the damage they've caused to Pennsylvania's vineyards. It's

recorded that these invasive bugs have caused around a 80-90% decrease in yield(*SLF Identification and Life Cycle*). This large decline emphasizes how much we need a solution to this crisis. An economic report predicted that an estimated \$324 million could end up being drained from Pennsylvania's economy annually due to the presence of the Spotted Lanternfly(*SLF Identification and Life Cycle*). Additionally, the Spotted Lanternfly causes leaves on plants to wilt, oozing sap, and the bugs excrete honeydew when they eat, which encourages the growth of mold (*SLF Identification and Life Cycle*). Unfortunately, it's still unclear as to how the Spotted Lanternfly impacts food webs, the functionality of ecosystems, and other indirect effects.

### **What's Being Done to Stop the Spread?**

Currently, there aren't an abundance of known solutions on how to deal with the Spotted Lanternfly. While it has many natural predators back in Asia (Duke), like parasitic wasps, praying mantises, and koi fish, it's not smart to bring in new organisms that could potentially also become invasive (though some of the predators can be found in the US). Doing so would require extensive research in order to make sure that they wouldn't have detrimental effects on the environment/ecosystem. Luckily, there has been evidence found showing different animals, bugs, and even fish eating the Spotted Lanternfly on the east coast (Duke). In addition, both the Pennsylvania Department of Agriculture and the United States Department of Agriculture are taking reports on sightings of it. These reports help keep track of the location of the sightings and how far the Spotted Lanternfly has spread.

With Hawaii's multitude of encounters with invasive species, there are many lessons and possible solutions we can take from them. Analyzing and learning from different places' experiences, and making sure not to repeat any mistakes is crucial to the success of many issues such as invasive species. Not all of them will work for the case of the Spotted Lanternfly but they all contain important takeaways that can help us get closer to extinguishing the threat of the Spotted Lanternfly.

### **What Can We Learn From Hawaii?**

There have been plenty of different invasive insect cases in Hawaii. These pose a very dangerous problem for Hawaii in particular due to the fact that it's very isolated from other parts

of the world, and the endemic species don't have the same kind of exposure and built-up defenses that other species do. One harmful invasive species is the Little Fire Ant. This bug came over to Hawaii due to trade with South and Central America where they originated (Roche) and proved to be a problem for both humans and crops. With its powerful sting, the Little Fire Ant defends itself from possible predators, which, in this case, are humans ("Little Fire Ant"). The ants also damaged crops (and continues to with a predicted \$140 million in damages from 2014 to 2024 (College of Tropical Agricultural and Human Resources)) in different farms and fields, reducing yields ("Little Fire Ant"). One of the reasons this invasive species was able to persist for so long is due to the symbiotic relationship it has forged with different plant pests including: aphids, white flies, and scale insects. The pests secrete sap that the fire ants consume and the ants protect them from their predators and parasites ("Little Fire Ant").

Another significant invasive bug in Hawaii is the Erythrina Gall Wasp. This species was originally from Africa and causes significant damage to Wiliwili (also known as Coral trees) (Tung). Growths in the Wiliwili are caused by the wasps which spread through leaves they infect. These growths are known as galls in tender leaf and stem tissue that cause leaf deformation and decrease in growth ("Erythrina Gall Wasp Treatments | Prevent Gall Wasps | Arborjet"). Severe infestations can cause serious loss of trees and defoliation, and studies found that it caused up to 95% of Wiliwili to die off (Tung).

### **What Solutions Did Hawaii Come Up With?**

Along with all these different invasions in Hawaii came a multitude of different solutions. Some of these solutions were more experimental and didn't provide favorable results, however there have been some successes. One particularly risky solution was the introduction of a wasp called *Eurytoma erithanae* to mitigate the Erythrina Gall Wasp problem previously mentioned. In this specific case, the introduction of this new species went well with it only targeting the larvae of the Gall Wasps (*Coral Tree Pest: Erythrina Gall Wasp*).

However, there are cases that show the need for extensive research and testing before an introduction of another potentially invasive species. This was illuminated by a case in the 1950s where Barn Owls were introduced in order to regulate the rat population in sugarcane fields and Cattle Egrets to get rid of the horn flies on cattle (Gosser). Unfortunately, both of these introductions led to major consequences where birds endemic to Hawaii like the Hawaiian stilt,

Hawaiian moorhen, Hawaiian petrel, and Hawaiian Short-eared Owl were all being preyed on by these invasive species (Gosser). Because the Barn Owl and Cattle Egrets were protected from being hunted by the Migratory Bird Treaty Act (which protects them from harm in regions like Hawaii), the US Fish and Wildlife Service gave permits to certain verified organizations, allowing them to kill both of these invasive species (Gosser).

Another significant solution to an invasive species is the use of AI against Himalayan Ginger. To locate the weed, a drone is sent up above to take pictures of the foliage below (Bernabe). The pictures are then analyzed by AI which detects patterns in the plants below and locates any Himalayan Ginger hidden among it (Bernabe). There's hope that the AI will eventually be able to recognize multiple species at a time. The use of AI to detect invasive species seems to be an extremely successful and efficient solution so far and holds promise in the future as technology advances.

Finally, one other prosperous solution was for the invasive Miconia plant. A key aspect of all issues like invasive species is gaining the awareness of the public. To help with the issue of the invading plant, organizations informed hikers, schools, etc. about the invasive species with details on what it looks like and what to do when you spot one, in the hope that they might help the cause (Neville et al.). When talking about the subject, groups made sure to include the harmful effects the plant has, like effects on the ecosystem and water supply, in order to improve the likelihood at receiving people's aid (Neville et al.). When people are aware of invasive species, they can easily report it, garnering data on where the species has spread to.

### **What Can You Do To Help?**

Hawaii has experienced both successes and failures in its history, but what can we take away from them? Well, I think one of the most important strategies is to make sure the public is informed. With the use of the local residents, locating the invasion and tracking how far it spreads can be made much easier. People should be able to report locations and sightings of any Spotted Lanternflies (currently, you can send in sightings to <https://www.aphis.usda.gov>) and have the information on how to deal with them. Currently, there's a kill on sight order. I think that an introduction of another species to act as a predator for the Spotted Lanternfly could also be a possibility. However, extensive research is definitely needed before new species can be instituted because the chance of another invasive species appearing can be high. Fortunately, it

seems that AI might be a possible solution for the Spotted Lanternfly despite the inconspicuous size of these insects. There's a certain tree called the Tree of Heaven, which is a prominent host for the Spotted Lanternfly. AI technology could potentially be used to locate Trees of Heaven and with them, Spotted Lanternflies. Make sure to spread information to others around you and keep a lookout for any Spotted Lanternflies that may be roaming about!

The invasion of the Spotted Lanternfly, to many, does not seem to affect them, leaving many to have little care for the issues the bug is causing. However, this threat is one that everyone must contribute to combatting, for the effects on the environment and vineyards can impact all of us. The successful containment of the Spotted Lanternfly invasion requires a collective effort of government agencies, local communities, and individual citizens. By working together, we can safeguard our crops, preserve our environment, and protect our economy from the devastating effects of invasive species.

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## **Introduce Experimental Methods for the Quantification of Cell Migration: A Mini Review**

**By Junlin Tao**

### **Abstract**

**Significance:** Cell migration is critical for the development and maintenance of multicellular organisms and is involved in many events in our bodies such as, tissue formation during embryonic development, wound healing, the form of blood vessels and immune responses. The illustration for the mechanisms underlying cell migration will help the scientists to understand the secrets about how living organisms operate.

**Definition of Cell migration:** After receiving chemical and / or mechanical signals, a single cell or a group of cells can start to move in a specific direction regulated by the signals, this process is called single or collective cell migration.

**Process/steps of cell migration:** The cell migration has several steps (Fig. 1). First, the cell receives the signal for migration, then it stretches out its lamellipodia/pseudopodia in front of it and the pseudopod sticks on the ground. After that the cell body shrinks towards the direction that the pseudopod set. Finally, the cell tails leave the ground and move toward the direction of lamellipodia/pseudopodia. Thus, the cell finishes this new step directed by the signal.

**Single-cell migration/ Collective cell migration:** There are two types of cell migration, single cell migration and collective cell migration, depending on cell types and functions. Single cell migration means one cell migrates by itself. For example, leukocytes at most of time move to their destination via the mode of single cell migration. The collective cell migration means many cells migrate as a group. For example, a group of epithelial or mesenchymal cells that are loosely or closely associated only move in specific situations to place, shape, or repair tissue. The critical feature of collective cell migration is the interaction and the coordination between cells which is regulated by the chemical or mechanical signals transmitted in the group of cells. Yet, this coordination and interaction between cells in collective cell migration do not exist in single cell migration wherein the signals are only received by the single cell and not communicated with other cells.

Cell migration plays critical roles in many physiological and pathological processes. With respect to these critical roles of cell migration, scientists leverage various ways to study how the



cell migration starts and proceeds with the regulation of mechanical and chemical signals. For example, scientists can apply genetic and pharmaceutical manipulations to elucidate how these manipulations influence cell migration. In this mini review, we will introduce the experimental methods used for the studies of cell migration, including the assay of wound healing, 3D cellular

### **Experimental Assays Used for the Studies of Cell Migration**

The cells used in the wound healing assay could be cell lines or primary cells that are related to cell migration, such as cancer cells. The cells are cultured in the special tissue culture plates with cell growth media. The in vitro wound healing assay is an experiment that can mimic the in vivo process of cells healing the wound. This popular, technically non-demanding and cheap assay can be used to study migration of cells on 2D surfaces. During the experiment, the cells attached on the plated are cultured to be confluent. Then, a plastic pipette tip is used to scratch off an area of cells from the confluent cell layer to create a wound. Cell migration can subsequently be monitored microscopically, as cells travel from the intact zones into the scratched region.

The disadvantage of this traditional wound healing assay is that the wound regions are introduced in an uncontrolled manner. For example, the size and the shape of the wounds after the mechanical scratching are randomly assigned. Moreover, scratching can damage cells and induce artificial side effects. To tackle these problems, scientists have developed new techniques to optimize the process of wound formation in a well-controlled manner with a defined wound size and shape and without inducing cell damage. For example, before culturing the cell layer, a silicon pillar with designed size and shapes is placed tightly on the cell culture plate to take space wherein cells can not grow into. Then, cells are cultured into confluent. Due the space taken by the silicon pillar a wound would be automatically formed during the cell growth. When removing the silicon pillar, cells start to migrate into the empty region and heal the ‘wound’. Using this silicon pillar stamp method, the wound is generated with a well-controlled shape and size without causing cell damages.

### **Application of Wound Healing Assay**

The wound healing assay can be used in evaluating the impacts of chemical compounds on cell motilities. These chemical compounds and their vehicles are respectively administered on the experimental group and the control group. Then, the speed of cell migration is measured for

both the control and the experimental groups and is used as a metric to assess the impacts of compounds on the cell motilities.

## Summary

Experiments were performed on prostate and normal cell substrates to measure cell migration using experimental drugs for healing cancer wounds. The experimental drugs were used on normal cells as a control group and prostate cancer cell substrates as the impact group. The purpose of the experiments was to determine the amount of the drug needed to heal the wounds and also the speed at which the drugs stopped the growth of the cancer wounds.

The Spheroid Migration Assay utilizes 2D and 3D technology to place multicellular tumor spheroids onto a normal cell substrate. The spheroid form helps mimic typical cancer cells and helps provide more accurate real life conditions for the experiment. The migrating cells attach to the substrate on the plastic surface of a culture dish and expand in a way that mimics tumor spread. The 3D form is especially effective at measuring cell migration because the three dimensional spheroids are able to act like normal tissue. This includes the ability to attach to cells in similar ways and provide oxygen and nutrient statuses. In essence this makes it easy to replicate real life cell migration. The spheroids grow and migrate like tumor cells. The spheroids are distinguished from the control and tracked by applying standard tracking methods. In this case fluorescence is used. The one drawback is migration itself can't be measured. Instead the attachment and spread is used to determine effectiveness.

The spheroids used in the experiment were able to slow the growth of prostate cancer cells in the substrate. This was measured by applying the tumor spheroids to both cancerous and normal substrates and showing how they spread on one or the other. The two types of assays used are haptotaxis and chemotaxis. The haptotaxis assay was looking to see if biological materials put in the holes of the substrate would migrate the spheroids into the substrates. The chemotaxis assay measured whether the concentration of chemicals in the spheroid would affect the movement or signal reception of the substrate. In summation the experiments proved that this technique and the drugs used show promise in stopping the growth of certain cancer cells.

## Trans-well Experiments

During the **Haptotaxis assays** researchers put collagen or fibronectin in the internal layer

of a hole to find the Haptotaxis of some cells, such as epithelial cells, from observing if they are guided to migrate into the hole.( From cell migration experiment. Keyence. Com.cn)

The **Chemotaxis assay** is the change they make and how the concentration of the chemicals affect their movement in the process of cell migration at a particular environment or when they receive some signs.

# **Psychological Differences Between Men and Women in the Domains of Neurobiology, Intelligence, Emotion, and Susceptibility to Mental Disorders By Yuan Lin**

## **Abstract**

In this research essay, I reviewed various past studies and research papers to address whether men and women are psychologically different across four psychological fields of study, namely, neurobiology, intelligence, emotion, and mental disorders. Finally, I conclude that there are significant differences between men and women in these four areas. However, instead of showing which sex is better than the other, the studies and research suggest that women and men actually develop different advantages in different areas based on their various biological mechanisms (nature) and developmental patterns (nurture). This research essay is carried out with the aim that people could view these two sexes fairly and thus be more driven to the pursuing and even the achieving of gender equality in every aspect of society around the globe.

**Keywords:** Social Science, Developmental Psychology, Clinical Psychology, Social Psychology, Cognitive Psychology, Neuroscience and Gender

## **Introduction**

The WHO defines gender as the characteristics, norms, roles, and behaviours that are associated with being a man or a woman; a girl or a boy. This paper will mostly use gender and biological sex interchangeably, as well as primarily discuss it in the dichotomous categories of male and female. Cross-culturally, the majority of nuclear families possess gender norms, where the wife is expected to shoulder household chores and childcare, while the husband works outside and holds the financial power. (Elsworth, 2019) What might be the reason for these ubiquitous gender roles? A number of psychologists believe these differences are innate and immutable and thus due to “nature,” while others believe gender roles are shaped by society and the external world, and thus instead due to “nurture.” In this essay, I will argue that men and women are psychologically different – due to both nature and nurture – by demonstrating gender differences across four domains: neurobiology, intelligence, emotional expression, and susceptibility to mental illness. I will do so by presenting and critically evaluating a wealth of cross-disciplinary and empirical evidence. These disparities are far from trivial, as they have

important implications for making society as equitable and accessible for both genders, rather than geared towards a more masculine psychological profile, as has been the case historically.

## **Research Aim**

The overarching goal of this research essay is to come to a conclusion as to whether there are significant differences between men and women in the domains of neurobiology, intelligence, emotion, and mental disorders. If so, I wish to be able to contribute in concluding if men and women are different through these four areas.

## **Discussion**

### **I. Neurobiological Mechanism and Structures**

Men and women's brains are inherently different in form, function, and rate of maturation. This is suggested by decades of robust research utilising evidence obtained from neuroimaging technologies. One example of a gender disparity relates to rates of neural development, with adolescent girls' brains maturing two years faster than their male counterparts, who take until their early twenties. (Vargas et al., 2006) Neuroimaging studies such as Cahill *et al.*'s (1996) indicate that this faster maturation in females, as judged by neuronal connectivity, occurs in regions such as the amygdala and prefrontal cortex, both of which are areas responsible for controlling impulses and making judgements, (Vargas et al., 2006) respectively.

In terms of brains' connectivity, adolescent boys' brains' connectivity increases as puberty progresses; whereas the reverse is the case for girls, whose connectivity decreases, as connections are "pruned." (Ernst et al., 2019) Hemispheric activation patterns also vary between the genders. An MRI study of 949 people in the United States ranging from the ages 8 to 22 shows that male brains have more intra-hemispheric connectivity, whilst females show more interconnectivity between each hemisphere. (Khazan, 2018) These differential hemispheric activation patterns may contribute to differing approaches to problem-solving across the two genders. Specifically, the greater connectivity within hemispheres in male brains leads to stronger connections between regions responsible for action and perception, suggesting that men's approach to problem solving may be more direct and driven by low-level, sensory information. Meanwhile, the higher interconnectivity between the hemispheres in female brains results in stronger connections between regions responsible for intuition and logic, meaning that

they are more likely to recruit these higher level skills when problem solving. (Khazan, 2018) Furthermore, certain brain structures in men and women differ in size. For example, on average women have larger hippocampus than men, relative to the size of the rest of the brain. This brain region is associated with the formation and encoding of memories. (Cahill et al., 1996) A larger hippocampus may explain why anecdotal evidence suggests that females tend to remember events such as marital fights, which their male counterparts insist have never happened. (Vargas et al., 2006)

It is critical, however, to be mindful that although some gender differences in brain structure and function do exist, research has often been misinterpreted and exaggerated to suggest that differences between men and women's biology are much larger than they are in reality. (Eliot, 2019) Research done by Romanes from 1887 utilised functional and structural differences in male and female brains to posit that female brains are less developed, justifying claims that they are the inferior sex. Research practices like these are an example of "neurosexism," namely "the phenomenon of using neuroscientific practices and results to promote sexist conclusions." (Hoffman, 2016) We now understand that although men's and women's brains have differences in form and function, one gender is not necessarily better than the other given that both form and function affect and benefit individuals of the two genders in various ways.

## **II. Gendered Intelligence: intelligence types and IQ distributions**

Whilst average IQ scores are roughly equivalent in men and women, (Reynolds et al., 2022) decades of research has indicated that men and women may demonstrate differences in more specific categories of intelligence (Punia et al., 2016) and show different IQ score distribution. Research has consistently demonstrated that the distribution of IQ scores for men and women vary significantly: men's IQ scores are more likely to lie on either extreme, whilst those of women are positioned more towards the centre. (Perry, 2022) In other words, the mean IQ scores for men and women are roughly the same, but the range differs.

Previous research suggested that there were greater differences between male and female intelligence. Gardner and colleagues (1999) judged intelligence across eight different factors, finding differentiations between men and women in verbal-linguistic, visual-spatial, mathematical, and bodily-kinaesthetic intelligence. Whilst females scored higher in the first

two, males scored higher in the latter two. There was no strong evidence for gender differences in musical, naturalist, interpersonal and intrapersonal intelligence. (Göğebakan, 2003 & Meneviş et al., 2014)

More up-to-date research demonstrates that differences between male and female intelligence might not be as clearly differentiated as we previously believed. Focusing specifically on linguistic intelligence, women generally score higher in reading capability, (Punia et al., 2016) but differences in other aspects of linguistic intelligence such as writing are equivocal. Findings of differences in mathematical intelligence have been similarly mixed. Although Jeyshankar found evidence for an advantage in males, (2019) a larger scale, cross-country analysis actually found an overall female advantage, although this advantage was smaller in countries with less gender equality. (Stoet et al., 2016)

Historically, these cognitive differences have been attributed to innate, biological features of gender. For example, some say it is due to the different activation patterns of the brains' two hemispheres in men and women. According to Dew, (1996) the left hemisphere is responsible for rational and logical analysis, whilst the right hemisphere supports information integration and synthesis, and relationship recognition for 'big picture thinking.' Rohr et al. (1996) and Walker (2005) observed that women generally use both hemispheres simultaneously although they show more cognitive characteristics from the right hemisphere (verbal), whilst men tend to use their left hemisphere more than their right. However, more recent research has distanced itself from this oversimplification.

Another possible societal explanation for any observed differences in cognitive scores is that although educational equality has largely been achieved in many parts of the world, girls in many developing countries are disproportionately deprived of an education, meaning they have less of an opportunity to develop these skills. In Chad, for example, 78 girls are enrolled in primary school for every 100 boys. (Unknown, 2022) Even in developed countries where education is available to both boys and girls, pervasive social biases relating to scientific and mathematical ability often hinder girls from realising their potential. For example, women's contributions in the field of mathematics have been consistently devalued by society, rendering males more dominant in the field. Research from the past ten years has shown that only 2-12% of prestigious mathematical prizes in the USA are awarded to women. (Moradi et al., 2012) This highlights that although there may not be any innate differences in ability, societal biases

may cause certain differences across different skills.

### **III. Gender Disparities in Emotional Expression**

Another dimension on which men and women show consistent measurable disparities is emotional expression. According to Ablon et al., (2015) there are four basic types of human emotional expression: verbal, behavioural, facial, and physical arousal. Studies have indicated that women are more emotionally expressive, and thus more likely to share their emotions - both positive and negative - predominantly verbally. (Goldshmidt et al., 2000) An early survey by Burke et al. (1976) on 189 married couples substantiates this idea, by demonstrating that women tended to express their emotions more frequently to their male partners. In Fischer et al.'s (2014) study of facial expressions, although women expressed sadness and fear more frequently, men's facial expressions signalled contempt and anger, highlighting a difference in the type of emotions expressed, rather than the frequency of expression. This finding has since been accurately replicated to produce the same result.

Some academics have argued that gender differences in emotional expression can be traced to societal pressures for women to be social and nurturing, partially because of their perceived roles as childcarers, which is a pressure that men face to a lesser extent. (LaFrance et al., 2003; Fischer et al., 2014) Similarly, whilst it is acceptable for women to express "weakness" by crying, this is not in keeping with social expectations of men not being vulnerable. Both social norms and mainstream media teach men to instead express emotions such as anger to hint at their strength and power. Smith (2008) analysed children's televised cartoons and found pervasive gendered character stereotypes: whilst female characters were generally emotional, affectionate, dependent, and domestic, males were more aggressive and dominant. These gender stereotypes are theorised to affect children's beliefs about expected gendered behaviours.

This has significant consequences: in the US, more women are hired to work in careers where caregiving and nurturing qualities are valued, such as teaching or babysitting. For males, consequences show more often in how they deal with negative emotions with anger as opposed to more functional emotional expression. In Australia, 75% of domestic abusers are men (AIHW, 2018), while in the USA, 82% of violent crime (Cross et al., 2010) is perpetrated by men.



An evolutionary perspective offers a complementary explanation, which may explain the origins of these societal pressures. The pressure of finding a mate manifests differently across genders, with expression of aggression being advantageous for males in a way that it is not for females. (Wood et al., 2002) Thus, expression of aggression in males may be positively selected for over evolution, whereas it is not for females.

#### **IV. Differential Susceptibility to Mental Illness**

A final gendered psychological difference lies in susceptibility to mental illness. Whilst, externalising disorders such as conduct and antisocial personality disorder are more common amongst males, internalising disorders such as depression are more prevalent in females (Fusco, 2017). As discussed in the “Neurobiology” section, frontal lobe development, which is important for planning and controlling behaviours (Case, 1992) is delayed in development in males by an average of two years. (Koolschijn, 2013 & Stitches, 2014) Males are thus generally worse at self-regulation and self-control than females, and this has been thought to underlie higher rates of conduct and antisocial personality disorders. In contrast, females are more vulnerable to developing depression. A combination of the female hormonal cycle, pregnancy, and gender role expectations may explain this elevated vulnerability. Firstly, females experience significant hormonal fluctuation, especially during puberty, and during and prior to menstruation, pregnancy, and perimenopause. (Albert, 2015) These hormonal fluctuations are associated with heightened emotionality, which many experience as a lower mood. (Soares et al., 2008) In contrast male hormone cycles are more stable, reducing their risk of depression. (Albert, 2015) Many societal factors relating to gender role expectations can also contribute to increased depression rates among females. Women generally experience lower self-esteem and have a higher tendency to experience body shame, both of which are exacerbated by the media’s expectations of what a woman “should” look like, and result in greater instances of depression. They are also statistically far more likely to experience violence and sexual abuse, both of which increase the risk of depression. (Riecher-Rössler, 2017)

#### **Conclusion**

Ultimately, research suggests that men and women contain significant psychological differences, which are the result of causal factors from both “nature” and “nurture,” as well as

interactions across these two domains. Those of the same gender generally share similar neurobiology, developmental patterns and neurological functioning as well as having similar experiences, social expectations and pressures. This has noteworthy and observable influences on diverse aspects of psychology, ranging from IQ distribution to vulnerability to mental illness. Crucially, it is important that future research moves away from a “deficit interpretation” of either gender, and instead of trying to ascertain whether men or women are “better,” we can focus on how we may facilitate equal opportunities despite gender differences in cognitive profiles. This may allow for the reduction of gender biases across domains like wages and employment, facilitating greater gender equality.

### **Limitations**

In this essay, I reviewed only four sections related to psychology, namely: neurobiology, intelligence, emotional expression, and susceptibility to mental illness. However, there are far more other psychological fields of study that could contribute and affect the result of whether men and women are psychologically different. As a result, I am unable to be conclusive that there are certainly differences between men and women in these four areas, but these conclusions do not necessarily extend to other areas such as physiology or humanistic psychology. Another limitation is that most of the research studies cited have subjects primarily from the United States or western countries; therefore, these conclusions might not necessarily be applied to other cultures such as Asian, South American, or African. Further research is needed to see whether these conclusions extend to those cultures as well. Finally, wealth disparity, educational attainment, and cultural gender expectations are mentioned in the paper, but not thoroughly explored. These sociological factors may also play a role in dictating gender differences between males and females.

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## **South Korea and Japan: Troubled Neighbours Stuck In The Past By Chloe Han**

In January 2019, in the culmination of a public diplomacy campaign led by South Korea's president Moon Jae-In and his administration, the South Korean government officially dissolved the Reconciliation and Healing Foundation. The foundation, established in 2016 as a support system for the women that fell victim to Japanese wartime sex slavery, emerged from a deal that was settled by earlier South Korean president Park Geun-Hye and Japan's late Prime Minister Shinzo Abe (Park 4). The deal rested on two major points: first, that the Japanese government would support the foundation through a monetary donation, and, second, that the Japanese government would also offer an apology to those who were victims of Japanese wartime abuse. The agreement fell through when Japan failed to provide an apology to the victims, which resulted in the South Korean government substituting its own funding in the place of Japan's donation, worsening the rift between the two countries (Kang). The root cause of this tension between the two nations dates back to 1910, when Japan annexed Korea, making it a part of their colonial empire. From then until August 15, 1945, the Japanese forcibly incorporated Koreans into their imperial project, disrupting the lives of millions (Hundt and Bleiker 65). Although the Japanese colonial period over Korea eventually did come to an end, the injustice and torment still remains firmly engraved in the collective memory of all Koreans. It is because of Japan's refusal to take responsibility for their wartime crimes committed against Korea that tensions between the two countries still remain unresolved to this day. The contemporary dispute between the two countries emanates from three areas of concern: the distortion of the history of the era in Japanese textbooks, the question of reparations for "comfort women,"<sup>25</sup> and of compensation for victims of forced labour work.

External pressure from the West was the main factor that drove Japan to attain power over Korea. During the mid-19th century, the influence of Western powers began to seep into East Asia, endangering the independence of countries such as Korea and opened them up to exploitation by the West and their neighbors. In an attempt to avoid being taken advantage of, Japan came to the ultimate decision that obtaining influence over Korea was essential. "In 1876, Japan became the first country, other than China, to establish formal diplomatic ties with Korea." However, it only took a decade before Japanese ambitions and their treatment towards Korea

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<sup>25</sup> The term "comfort women" is a euphemism that the Japanese created to refer to the women who were subjected to sex slavery during World War II (Soh 1226).

became much more threatening (Hundt and Bleiker 65). Due to growing concern regarding Russian influence within East Asia, Japan's minister of war, Yamagata Aritomo, argued that by occupying control over the Korean peninsula, Japan would gain enormous control over East Asia (Allinson 68-69). Consequently, Japan fought two wars for control of Korea—one against China from 1894 to 1895, and the other against Tsarist Russia from 1904 to 1905. The outcome of these two wars resulted in Japan's annexation of Korea in 1910, which lasted for 35 years before coming to an end in 1945 (Hundt and Bleiker 65).

Korea suffered greatly during those years under Japanese colonial rule. One of the main approaches the Japanese administration took in order to maintain power over the Korean people was to eradicate all traces of Korean identity. This meant banning schools from teaching Korean history, culture or language, forcing Koreans to adopt Japanese names and Shintoism as their main religion, therefore indirectly affirming Koreans' fealty to the Japanese emperor. The Korean economy was also forcibly incorporated into the Japanese imperial project, which disturbed the traditional lifestyle that many Koreans led (Hundt and Bleiker 66). By further oppressing Koreans through the elimination of factors that bound them together, Japan successfully held their authority over Korea as they managed to quell any possibilities of rebellion.

Following the end of World War II and the Korean War, Korea divided itself into two halves—the Democratic Republic of Korea, North Korea, and the Republic of Korea, South Korea. South Korea continued to maintain their relationship with Japan and in 1965, South Korea and Japan normalized diplomatic ties with the signing of the Treaty on Basic relations. When it was signed, however, South Korea was in a disadvantageous position as it was in need of financial assistance and did not have the diplomatic authority to negotiate proper terms of reconciliation (Kim et al. 24-25). It was still heavily dependent on Japan in fields such as technology and capital, giving Japan power and control over South Korea (Park 7). Because of this, South Korea was forced to overlook all the unsolved problems between themselves and Japan in order to benefit from the short-term gains of the treaty (Kim et al. 25). As South Korea did not have the proper resources to ensure that the terms and conditions of the treaty were just, it resulted in the neglect of issues from the past, which have remained unaddressed to this day.

An issue that has been discussed time and again is Japan's distortion of history and "how to teach the respective 'facts' to future generations." Japan's modern historical textbooks are



“plagued by national interests,” as displayed by the omission of historical events that paint Japan’s government in a bad light, showing how Japan controls the narrative of how their history is portrayed and refuses to acknowledge and take responsibility for the atrocities and oppressions of their past. South Koreans regularly accuse Japan of “painting a benevolent picture of the past” that fails to recognize the true extent of pain and trauma inflicted on the people of Korea as a result of Japan’s aggression during their annexation (Hundt and Bleiker 62). An effort to improve this disagreement was made when, in March 2002, plans for the production of a joint history textbook between the two countries, and China, was put into action. Just five months after the initial idea was suggested, in August 2002, the first project meeting in Seoul marked the official launch of the trilateral history textbook project. The writing committee responsible for piecing together the history of the three nations was composed of “fifty-three members from the three nations: seventeen from China, thirteen from Japan, and twenty-three from the Republic of Korea” (Wang 106). A large majority of the representatives had their connections to the study of history, whether that be through holding positions as history professors or working as senior researchers for historical research institutes or museums in their respective countries. In addition to that, mixed in among the Japanese and South Korean crowd of scholars, “middle school history teachers, members of nongovernmental organizations, and civic groups” were also present. The joint history textbook began and continued to its final production stage as a nongovernmental project. After “eleven meetings and six revisions,” the final version of the joint history textbook was published in Japan, South Korea, and China in 2005 (Wang 107).

Although this may have seemed like a successful step towards reconciliation for the two nations, the outcome was not ideal. While the production of a joint history textbook was definitely a step in the right direction, the question of how to maintain the utilization of the textbook was where things began to fall apart. When finally published and released in both countries, the textbook was very well received (Wang 116). However, according to information collected by Japanese publishers and bookstores, almost all the textbooks purchased were bought by individual buyers, rather than “bulk orders for classroom use.” Another issue that served as an obstacle is the fact that the Japanese government held ultimate power in deciding which textbooks were allowed to be used in Japanese classrooms. In order to be recognized as a textbook, books are required to undergo a “rigorous process of official approval,” something that is yet to take place in both South Korea and Japan. This ultimately renders the textbook useless

as its main purpose was to be used in classrooms to give students a true look at history through an “unbiased” lens. In addition to that, the textbook has also failed to be used as supplementary text material, as it has “not been required reading for students in either of the countries” (Wang 117). Furthermore, according to the results from a public survey conducted over five years from 2011 to 2015, an average of 36 percent of respondents still believe that history textbook issues are the biggest obstacle to South Korea-Japan relations (Kim et al. 24). Additionally, Japan still actively published and circulated textbooks that omitted the mention of “comfort women” well into the late 2000s, despite having the needed resource at hand (Schneider 116). This goes to show that Japan would choose to protect its sense of national pride instead of owning up to its mistakes and teaching its students history the way it truly is. Finally, there are still ongoing content arguments regarding textbooks that Japan is currently using between the two countries today. As is clearly evident, the joint history textbook, while a good idea in theory, ultimately was not useful in diffusing the tensions and disputes between the two countries regarding historical representations in textbooks.

Another major point of disagreement between the two nations is Japan’s refusal to acknowledge the women who were victimized and used as sex slaves during the Japanese occupation. Japan’s reluctance to further compensate “comfort women” contributes to the widening of the gap between itself and South Korea. The issue of “comfort women” has undoubtedly gained more attention in recent years, as is reflected in the statistics presented in the public survey. In 2011, only 7.5 percent of people thought that the issue of “comfort women” was a source of dispute between South Korea and Japan, and in 2015, that number increased to 19.8 percent. The increased interest in this matter seems to have stemmed from the widely publicized altercations between the South Korean and Japanese governments regarding this issue (Kim et al. 24). On January 17, 1992, Japan’s Prime Minister Kiichi Miyazawa stated that,

“...There was a certain period in the thousands of years of our [Japan’s] company when we [Japanese] were the victimizer and you [South Koreans] were the victim. I would like to once again express a heartfelt remorse and apology for the unbearable suffering and sorrow that you experienced during this period because of our nation's act. Recently the issue of the so-called 'wartime comfort women' is being brought up. I think that incidents like this are seriously heartbreaking, and I am truly sorry” (“Japanese Government Ministry of Foreign Affairs Statements”).

However, many South Koreans argue that Japan's apology lacked sincerity (Kim et al. 26). Despite what Japan's Prime Minister had said in his apology, the Japanese government seemed to think otherwise. According to Hosaka Yuji, a professor at Sejong University in Seoul, "The Japanese government has said that the Korean comfort women were not sexual slaves and were not forced [into sexual slavery] by the Japanese military during World War II. [Ultimately, Japan's stance is that] they ["comfort women"] were voluntary prostitutes" (Kang). Furthermore, in December 1991, "thirty-five members of the Association of Korean Victims filed a lawsuit in Tokyo District Court against the Japanese government for violating their human rights during WWII." Three of the thirty-five women had served as "comfort women." The women demanded five things: "an official apology, compensatory payment to survivors of ¥20 million JPY, approximately \$154,000 USD, each, a thorough investigation of their cases, the revision of Japanese school textbooks identifying this issue as part of the colonial oppression of the Korean people, and the building of a memorial museum" ("Lawsuits Brought against Japan"). In March 2001, however, the Tokyo District Court dismissed the demand for compensation, claiming that "individual victims' claims for damages against Japan were unacceptable under international law" and that the issue had already been settled with the signing of the treaty in 1965. The plaintiffs then turned to appeal to the Tokyo High Court to no avail as the Court concluded, in July 2003, that despite the Japanese government failing to provide protection for the "comfort women," the "[comfort women's] right to demand compensation had expired." This was further supported in November 2004, when the Japanese Supreme Court upheld the decision made by the Tokyo High Court and rejected the women's appeal, forcing the South Korean women to walk away without compensation money or an apology ("Lawsuits Brought against Japan"). The Japanese government continues to refuse the request for another apology and according to a public opinion survey done by Yomiuri Shimbun, one of the top five major newspapers in Japan, "81 percent of Japanese felt that their former prime ministers' apologies were enough to resolve these issues. Only 15 percent stated the opposite" (Kim et al. 26). These statistics clearly show that even a large majority of the Japanese public agree with the government's opinion, sparking tensions between the two sides on a more civil level.

The final issue that has continued to be a source for the tensions between South Korea and Japan is the disagreement concerning the issue of forced labor workers. This matter of discussion has been present in society since the early 2000s. The fight for recompense started

when forced laborers from South Korea gathered together and filed a case to the Japanese Supreme Court, petitioning for compensation from Japanese firms that were responsible for inflicting material and spiritual damage upon them. These laborers ultimately lost the case, and that is when the issue was brought to the South Korean Supreme Court. In 2012, it was determined that the claims sought by the plaintiffs were justifiable (Park 4). However, nothing materialized as a result of that court ruling and it did not have a significant impact on the relationship between Korea and Japan, as the issue was not widely publicized. Nevertheless, the issue opened itself once again on October 30, 2018, where it reappeared as a conflict in the South Korean Supreme Court. This time, however, the Supreme Court saw the case through by delivering a verdict stating that, “Japanese corporations represented by Nippon Steel should compensate former forced Korean laborers mobilized during the colonial period” (Park 4). In response to this statement, the Japanese government did not hesitate to maintain their stance and deny the possibility of compensating victims, as they declared that they believed the issue had been settled when the Treaty on Basic Relations was signed in 1965. The Japanese Government claimed that the treaty stated, “it was the responsibility of the South Korean government to compensate former forced laborers.” However, South Korea argues that “the treaty did not explicitly state that no claims can be made by individuals regarding abuses suffered during Japan’s colonial rule over Korea” (“Lawsuits Brought against Japan”).

In addition to denying the request for an apology, the issue worsened when Japan attempted to register Kyushu and Yamaguchi as World Heritage sites with the United Nations Educational, Scientific and Cultural Organization (UNESCO). The main point of concern that South Korea argued was that both of those sites had a tragic history tied to them, as they were both locations during the Japanese colonial era where the forceful mobilization of Korean workers existed. The one condition that South Korea proposed in order to allow Japan to register the two locations as World Heritage sites was that the Japanese government needed to recognize and record the hardships and trauma that Korean labor workers were forced to endure. Once the Japanese government acknowledged that Korean workers had been subjected to labor at both Kyushu and Yamaguchi, they were entered as World Heritage sites and the issue was submerged once again. The dispute between the two nations continued until June of 2019, when the vice foreign minister of South Korea made a confidential proposal to Japan, suggesting that both South Korea and Japan compensate the forced labor victims. This proposition was received with

mixed receptions from both sides as South Koreans considered it a set-back as it would require South Korean firms to join the compensation process, whereas the Japanese still considered it an issue as Japanese firms were still being asked to compensate the plaintiffs (Park 5). However, in the grand scheme of things, it was actually an action taken that was able to bring the two nations one step closer together. Through the act of a compromise, both parties had agreed to take part of the blame and work together to help those that were negatively affected as a consequence of the actions from the past. Despite this, as of August 18, 2022, neither the South Korean nor the Japanese corporations have put forth any form of payment, making that small step that had been made towards reconciliation useless (Webster).

While some may argue that progress is being made, however, the wounds that have been left untouched for so long are far too deep for the rift between Korea and Japan to close any time soon. The issues from the past that have been carried over into the present are not going to improve or reconcile themselves if they are not unpacked and debated. Although there may be some initial tension and resistance from both parties, the points at issue are only going to escalate and become the next generation's problem if they are not discussed and dealt with now. As is evident from the status quo, carrying over issues from the past into the present does not make them any less significant, nor does it lessen the impact they will have on society if left unattended to. In order for lasting success to be possible, there is a need for both countries to approach these sensitive subjects with an inclusive and open mind, which means respecting differences and being ready to have discussions without allowing past prejudices or biases obscure the core of the matter at hand. By finding new ways to grapple with and interpret history, commonalities will be found and, with time, bonds will strengthen. Despite it being difficult at times, in order for society to continue to advance and move forward, there is a need to look back and acknowledge the past.

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