RGSHW
Academic Journal

Second Edition

Welcome to the second edition of the RGSHW Academic Journal.

My intention for this Academic Journal was to provide my peers with the opportunity to showcase their academic talents, beyond the subject specifications, in a collation of their interesting ideas and insights: this, and more, has been achieved.

For this edition of the RGSHW Academic Journal, the new Year 12s were encouraged to write articles alongside their peers in Year 13. Overall, these articles have made for a great second edition to the Journal.

A special thank you must go out to the Senior Prefects on the Academic Team, who helped me read and format the articles.

I hope you enjoy them.

Robert Bowker.

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Disclaimer: all of the opinions expressed in this journal are those of the individual writers and are not representative of the views of RGS High Wycombe

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STEM (science, technology, engineering, mathematics)

Miscommunication between doctors and managers: the cause and effect on our lives?
Ibrahim Jalisi

'A doctor is someone whose confidence is tempered with humility, empathy, compassion and integrity. They are to ensure that as clinicians, they remember that they act as advocates for the patient and as a result of this have the courage to challenge a system to guarantee that each patient receives the right care. It is through these characteristics that a clinician gains the full trust of a patient.'

This is a quote of what a doctor should be like from Dr Jalisi, a lecturer at the University of Reading, and this ethos relies on the foundation of good communication between doctors and their managers to ensure they run a well-oiled machine capable of caring for their patients.

An example of where this is relevant is in Mid Staffordshire. Poor communication and health care in Mid Staffordshire Foundation NHS Trust between 2005 and 2009 reportedly contributed to the avoidable deaths of many patients, possibly in the hundreds. Many of these errors were due to miscommunication and mistakes in understanding. A quote by Robert Francis QC who wrote an audit on this case says, "This situation was exacerbated by a lack of effective communication across the healthcare system in sharing information and concerns." It is shown that through this case, many errors in communication are more likely to occur where there are distractions and interruptions in the lines of communication. This can be passing information to superiors or through a chain of command. This may lead to ambiguity or duplication in roles as people assume other people's position meaning communication is ineffective. This is very possible between doctors and managers which could lead to a crippling and devastating effect on the lives of patients, preventing doctors from giving world class care.

Throughout the years in the NHS, there has been a changing relationship between clinical doctors and managers. Before the 1980s, the healthcare sector was predominantly dominated by clinicians and doctors in both influence of making decisions and distribution of resources as well as control of daily life running of healthcare establishments. However, the Griffiths Report in 1983 introduced the concept of general management in the NHS with a single person in a managerial position responsible for the organization. They replaced doctors in this respect. Managers were then empowered for both operational and strategic decision making them a different entity to doctors and other professional healthcare professions. This led to a new relationship being forged, between doctors and the managers. This has a historical context that impacts organizations and people nowadays. Furthermore, managers and doctors inhabit different cultural worlds which will always be unlike each other but there is a need for them to both understand each other's different source of power. This can lead to problems and this organizational structure can present challenges for working styles and behaviours resulting in ineffective communication and in worse situations, cases that were mentioned above. A famous quote by Nelson Mandela speaks volumes about the power of communication, "If you talk to a man in a language he understands, that goes to his head. If you talk to him in his language, that goes to his heart."

Could the end of Malaria be near?

Raphael Emecheta

Recently, there have been many theories and ideologies explaining that there could be an end to a very threatening disease called malaria, a disease which was discovered in 1880 by Alphonse Laveran. This comes to a surprise as there was once a notion that the eradication of malaria at a regional level wouldn't be possible, however now there is the potential of eliminating the disease globally.

Malaria is an infectious disease that affects humans and other animals, but is caused by plasmodium spread by mosquitos, causing the person who gets infected to have symptoms such as vomiting and a fever, but can potentially lead to a coma or death.

Malaria affects more than 200 million people a year, and it is a disease in which many younger children are targeted and suffer from.

So, how can malaria be eradicated? There is two main ways to do this and that is through the laboratory technique called 'genome editing' and through prophylaxis (drug treatment).

The biggest way is through the new idea of 'genome editing', which is a technique that requires a group of technologies to allow scientists to modify an organism's DNA. The technology involved allows genetic material to be added, removed or altered in particular locations in the genome. There has been some development in the approaches to gene editing, The CRISPR-Cas9 system has given many scientists hope that malaria can come to an end, due to it being faster, more accurate and more efficient with it also being cheaper than other methods of gene editing.

How CRISPR-Cas9 would work is that as it was modified from bacteria (a genome editing system that is naturally occurring), the bacteria get small parts of DNA from the invading protozoa (plasmodium), to then create CRISPR arrays (DNA segments). What the CRISPR arrays do is that they act like an immune response, allowing the bacteria to remember the protozoa, so if they attack again, the CRISPR arrays produce segments of RNA from the bacteria (involved in the genome editing system) to target the DNA of the protozoa, then the enzyme Cas9 breaks down the bacteria, disabling the protozoa.

This is significant in the case of malaria since malaria is transmitted by the bite of a female Anopheles mosquito. So, with the understanding of molecular mechanisms of sex differentiation in the mosquito *Anopheles gambiae*, such as the discovery of the female and male transcripts known as 'AgdsxF' and 'AgdsxM' and what they comprise of to identify the female Anopheles mosquito, it is more efficient and easier for scientists such as in Imperial College altering the genes.

Furthermore, by blocking the reproduction of the female Anopheles mosquito, you cut more reproducing with the protozoa, and this can be a huge step into the progression of eradicating. If larger lab-based studies were to be put into this, they would need a larger insect population to work with.

There are no ethical issues either, considering the gene modification is not happening to a human, which also gives this ideology in gene editing a massive positive.

The second way to try to reduce malaria is by taking a new drug that has been developed as recently as 2012 called malaria prophylaxis. An individual is permitted to take it as long as the use of it reflects the overall risk to ensure protection when travelling to an endemic region. Or by using suppressive prophylactics such as chloroquine and mefloquine; which are only effective at killing the malaria parasite as soon as it has entered the erythrocytic stage of the parasite's life, so won't have any effect yet in such situation. This indicates that these drugs can be used for prevention as it will help reduce the amount of people being infected with malaria.
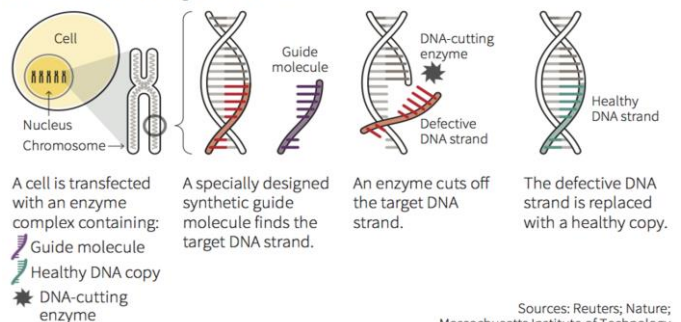
There are some barriers to the eradication of malaria however, and one of them is the access to the most remote areas in which malaria is located. Although effective, vaccines were distributed quite widely. Ensuring that a vaccine for malaria goes to every single child in the areas in which it is the most common is quite perplexing and challenging, as shown to be quite an issue in the elimination of the Poliovirus.

Another barrier to the eradication of malaria is the resistance of the mosquitoes, as the mosquitoes are evolving to become more and more resistant to the drugs and insecticides which are often used to kill them. However, only 2/4 of the human malaria parasite species are currently showing resistance to the antimalarial drugs, and they are the Plasmodium falciparum and the Plasmodium vivax.

The other barrier to the eradication of malaria is the cost of the wipe-out. The price already required annually for the use of the current technologies to be run effectively and efficiently is 4.3 billion pounds, and an extra amount of 1.6 billion pounds would be needed. Furthermore, does the amount of people who obtain malaria justify this amount of money being allocated into it considering the longevity of the disease is 7 to 18 days in most cases? And is malaria as bad as HIV in third world countries, in which potentially has a similar but more difficult to deal with gene problem with the CCR5 – delta 32 mutation? And, lastly, is it worth the large investment considering the economic burden in which malaria brings to these countries?

No matter the opinion you may have to this whole ideology, there is a chance, a massive chance that malaria could be brought to an end.

Is vaping really the solution to smoking?

Shanker Narayan

Tobacco. A world-wide notorious killer. Despite having been caught by a plethora of scientists, we lose **78000** lives each year to this menace. (Tobacco | NHS inform," n.d.)

Smoking is the number one cause of **preventable** disease. This was firstly epidemiologically established by **Bradford Hill** in the 1950s. (Fanu, n.d.). Although there has been a steady decline in smoking following Hill's "annus mirabilis", this has been matched; or even superseded, by a rapid rise in the utilisation of e-cigarettes.

Cigarettes - https://www.independent.co.uk/news/business/news/philip-morris-stop-smoking-quit-comments-tobacco-company-cancer-a7377361.html

Bradford Hill's study into the causative role between smoking and lung cancer - https://lesslikely.com/medicine/smoking-and-lung-cancer/

China was one of the first countries to take up tobacco at the end of the fifteenth century. (Cotton, 2019). In their case, it was taken up as protection against malaria, since doxycycline and other secondary agents were not readily available for staving off haemorrhagic fevers. (Herchline, 2019). Ironically, China was additionally the birthplace of e-cigarettes. E-cigarettes, often referred to colloquially as "tank systems" and "mods" ("Know the Risks: E-cigarettes & Young People | U.S. Surgeon General's Report," n.d.), are the subject of heavy controversy. Although there have been a multitude of studies ("Long-term vaping 'far safer than smoking' says 'landmark' study - NHS," n.d.) depicting usage of e-cigarettes and **nicotine replacement therapy (NRT)** as having fewer long-term effects than smoking, some scientists believe otherwise.

Toxins in tobacco

Nicotiana tabacum - https://www.sarahraven.com/flowers/seeds/annuals/nicotiana-tabacum.htm

Nicotine:

Nicotine - the main culprit of characteristic cigarette satisfaction. Although, several other compounds do contribute to this effect (**acetaldehyde** (ethanal) does so, alongside 5-hydroxymethylfurfural). It is the secondary metabolite produced by *Nicotiana tabacum*. Since it is produced as a defence mechanism for fending off herbivores, surely it is not safe to be consumed by humans. However, caffeine, which is hardly put to shame in the media healthwise, is also produced as a defence mechanism. (Cotton, 2019). Furthermore, nicotine can be fatal to humans when administered in large amounts. For example, in 1932, a florist absorbed so much nicotine via insecticide that he was sent to hospital.
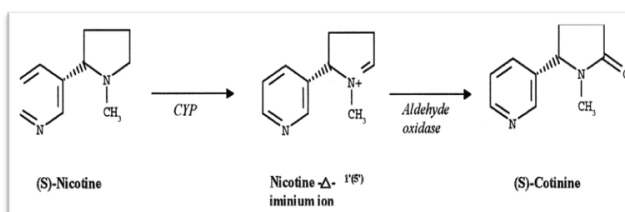
Oxidation of nicotine to cotinine - http://jpet.aspetjournals.org/content/282/3/1608

Nicotine acts as an addictive agent, intercepting the blood-brain barrier and stimulating **dopamine** release. Furthermore, whether nicotine is in the **S or R isomer** form, nicotine is oxidised in the liver to **cotinine**, which has a half-life of around 24-hours. Therefore, nicotine remains in the body for longer than one may think.

Nicotine does not account for the **genotoxic** aspects of smoking. However, the addictive qualities it emanates only becomes an issue when looking through the lens of a "vaper". E-cigarettes are seen to hook younger generations onto nicotine, inevitably leading to re-normalising of tobacco use. (News, n.d.) This is a serious issue, as younger generations

are more prone to health damage by nicotine, which includes mood disorders and lowering of impulse control. The damage could undoubtedly escalate to increased blood pressure due to **narrowed arteries**. Worst case scenario: a **heart attack**. ("How Smoking and Nicotine Damage Your Body | American Heart Association," n.d.).

Tar:
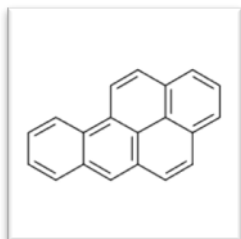
Tobacco tar consists of a myriad of **carcinogenic** molecules such as **benzo[a]pyrene** and nitrosamines (i.e. **N'-nitrosonornicotine (NNN)** – a derivative of nicotine). These damage the DNA of epithelial cells, including those of the lungs, larynx, pharynx and kidneys.

Benzo[a]pyrene - https://www.sigmaaldrich.com/catalog/product/sigma/b1760?lang=en&region=GB

Polycyclic aromatic hydrocarbons (PAHs) are the most nocuous of these molecules. Generally, they tend to inflict cataracts, kidney and liver damage and even cancer. ("Polycyclic Aromatic Hydrocarbons," n.d.).

NNN - https://www.sigmaaldrich.com/catalog/product/sial/75285?lang=en&region=GB

PAHs embark on their carcinogenic journeys once they enter the bloodstream.
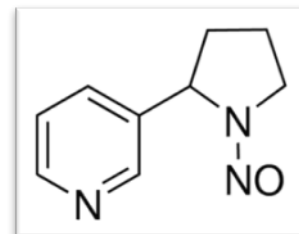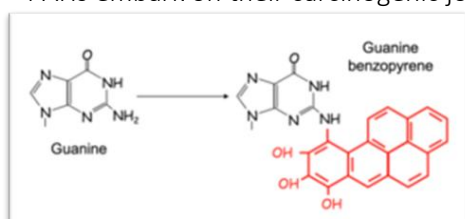
1. **Cytochrome P450** enzymes oxidise PAH to epoxide.
2. **Epoxide** is rapidly **hydrolysed** to a **diol** (Cotton, 2019).
3. The diol undergoes **epoxidation** to form a **diol epoxide**.
4. E.g. **Benzene diol expoxide (BDPE)** reacts principally at **guanine** (and adenine) DNA bases to form an **adduct**, which deactivates cells which suppress tumours. (Cotton, 2019)

Adduct formed - https://en.wikipedia.org/wiki/Benzo(a)pyrene

Cytochrome P450 enzyme - https://www.news-medical.net/life-sciences/What-are-Cytochrome-P450-Enzymes.aspx
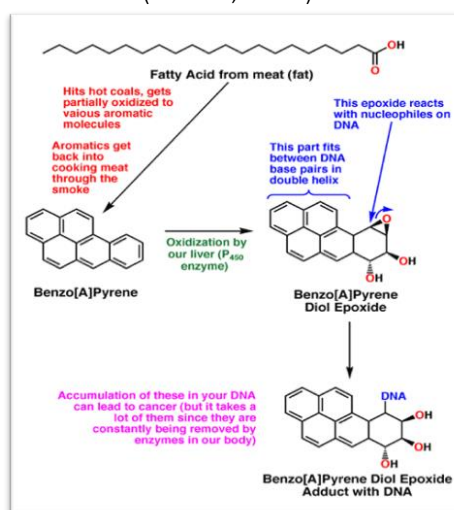
Adduct formation in a different context - http://iverson.cm.utexas.edu/courses/310N/MOTD%20Fl05/MOTDfl02%20copy/Benzpyrene.html

There are many more damaging compounds, many of which are again **mutagenic**. These include:

- **Acetaldehyde** – carcinogenic and facilitates absorption of other toxins into the bronchial tubes. ("What Chemicals Are In Cigarette Smoke?," n.d.)
- **Benzene** – causes acute myeloid leukaemia (AML). ("Benzene and Cancer Risk," n.d.)
- **Carbon monoxide (CO)** - it is both odourless and colourless. It reduces the amount of O_2 carried via haemoglobin around the body in erythrocytes. CO can cause comas, or even death.

According to this article, (Talhout et al., 2011), there are **5000** chemicals in tobacco smoke. At least **98** of these are hazardous. Although e-cigarettes do produce certain toxins such as acetaldehyde and **acrolein**, there are a plethora of toxins which cigarettes produce but "vapes" do not.

E-cigarettes

Benzene ring - http://www.chemspider.com/Chemical-Structure.236.html

1) Oxygen (O₂) and carbon monoxide (CO) are inhaled
2) O₂ and CO enter blood

CO poisoning - https://metrohealth.net/healthwise/carbon-monoxide-poisoning-3/
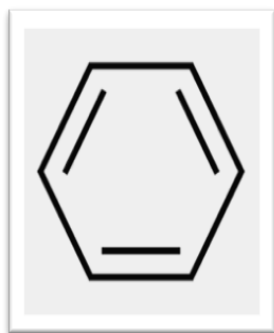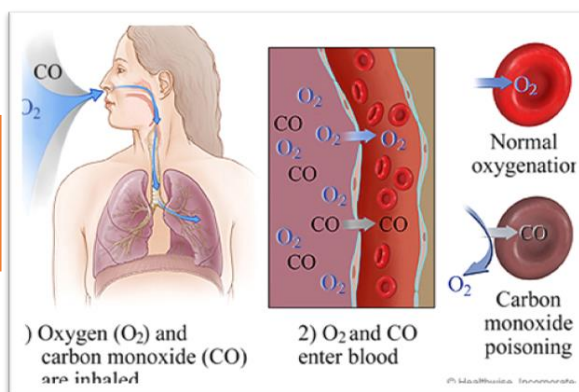
Solvents:

The solvent in an e-cigarette is either **glycerol** (propane-1,2,3-triol) or **propylene glycol** (propane-1,2-diol). These, as they are, cause insignificant harm. However, the heating chamber surge up to **300 degrees Celsius**. Therefore, due to **thermal decomposition**, there is no guarantee that the compounds, which they are broken down into, are just as innocuous.

Three particularly vicious aldehydes are formed from solvent decomposition:

- Decomposition of glycerol forms **acrolein**, **methanal**, **ethanal** and **dihydroxyacetone**.
- Decomposition of propylene glycol forms methanal and ethanal (following

thermal decomposition of glycerol into aldehydes - https://www.sciencedirect.com/science/article/pii/S0273230015301549
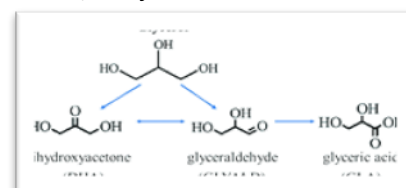
oxidation of propylene glycol to pyruvaldehyde).

thermal decomposition of glycerol into dihydroxyacetone- https://pubs.rsc.org/en/content/articlehtml/2015/cy/c5cy00586h

- Acrolein can cause someone to feel nauseous and lose consciousness. At higher concentrations, it can even bring about death. ("Hazardous Substance Factsheet: Acrolein," n.d.) Furthermore, it is an irritant of the eyes and nasal passages.
- Ethanal is a carcinogen and a **teratogen** (causes malformation of an embryo). ("Hazardous Substance Factsheet: Acetaldehyde," 2010). When inhaled, it can cause pulmonary edema, causing a build-up of fluid in the lungs.
- Methanal (formaldehyde) is a well-known mutagen.
- Dihydroxyacetone is known to have genotoxic properties in spray tans. (Cotton, 2019)

acrolein (propenyl) - https://alchetron.com/Acrolein

acetaldehyde (ethanal) - https://chemistryonline.guru/acetaldehyde-properties-2/

formaldehyde (methanal) - https://twu.edu/health-safety/safety-programs/formaldehyde/

Flavourings (already discussed nicotine when discussing tobacco)

Many adults believe that certain flavours of e-cigarettes should be banned to stave off adolescents from vaping. Many adolescents start vaping as they are attracted to certain flavours.

Monocyte - https://www.verywellhealth.com/what-are-monocytes-2252110
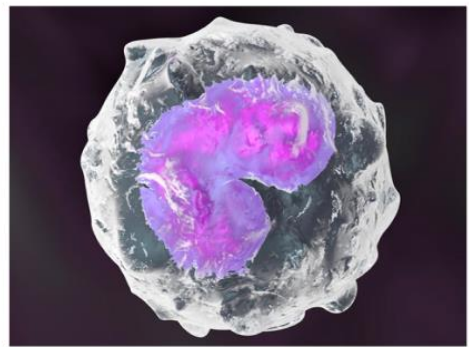
However, there has been an experiment in which it was found that e-cigarette flavours have a pernicious effect on bodily cells. (Sandoiu, 2018). This research, published in "Frontiers of Physiology", examined the effect of e-cigarette vapour on **leukocytes**. What was further found was that some flavours are more noxious than others. The tests were performed on two types of **monocytes**, which are involved in our inflammatory immune response. As expected, **cytotoxicity** tests proved that these e-liquid chemicals increased inflammation and skin damage. This was done via increasing levels of oxidative stress (in which **oxygen radicals** are produced in excess). This depicted how prolonged use could damage DNA, leading to cancer. Furthermore, the study portrayed how **cinnamaldehyde**, **vanillin** and buttery flavours (**diacetyl**) are the most cytotoxic.
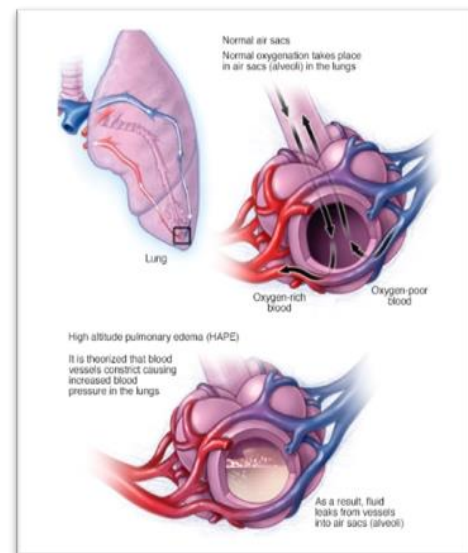
formation of pulmonary edema - https://www.mayoclinic.org/diseases-conditions/pulmonary-edema/symptoms-causes/syc-20377009

This cytotoxicity is due to **carbonyl (C=O)** groups, which are often irritants of the mucosal respiratory tissue. These carbonyl groups occur in both aldehydes (i.e. acrolein), where the C=O group is at the end of the chain, and ketones (diacetyl), where the C=O group is mid-chain. These flavourings, alongside **menthol** and **isoamyl acetate**, may damage the linings of blood vessels and trigger future cardiovascular disease. Furthermore**, 2-methylbutanal** (chocolate flavouring) is decomposed to form methanal (mutagenic) and acrolein (can kill at high concentrations). These myriad examples show how all these flavourings might not be as appetising as first thought.

Metal contaminants

E-cigarettes have higher levels of particulates, including **zinc, silver and nickel**, which are released from the heating element. Fine particles can delve deep into the lungs and remain there, leading to premature death. Furthermore, **cadmium**, a toxic metal, can additionally build up, inevitably leading to respiratory and cardiovascular issues. ("What's in an E-Cigarette? | American Lung Association," n.d.)

A build-up of heavy and toxic metals is a serious threat posed by solely e-cigarettes, perhaps contributing to why e-cigarettes double the risk of bronchitis.
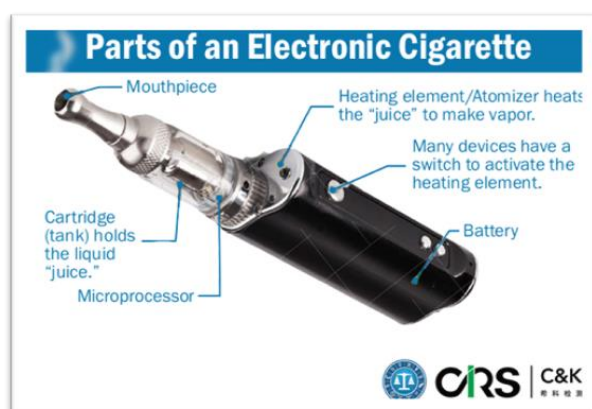
How an e-cigarette functions - http://en.cirs-ck.com/services/electrical-electronic-equipment/electronic-cigarette

Weighing up: is vaping really the solution?

Nicotine is clearly the level ground between cigarettes and e-cigarettes. Both contain significant amounts of it (c. 6mg/ml), which undoubtedly results in hypertension, and even cardiovascular disease, following prolonged use.

However, if we are looking at the argument from a mutagenic view, then neither vaping nor traditional smoking are solutions to nicotine addiction. It may be that tobacco contains more carcinogens (98) than vaping appears to create. However, both vapes, and cigarettes harbour **definite carcinogenic potential**.

E-cigarettes have been around for a relatively minute period. We do not know of any long-term effects.

Only time will tell.

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CAR T-Cells: A new branch of Cancer Immunotherapy
Karthik Sadanand

What are CAR T-Cells?

CAR T-Cell therapy is a branch of immunotherapy which uses a patient's own T cells to target the cancer cells. However, before delving deeper into this topic, it is important we understand what T cells are in the first place.

Figure 1. A description of how T-Cells are extracted and then genetically engineered to make Car T-Cells.

Lymphocytes are a type of white blood cell and they play an important part in fighting off infections and diseases. There are three main types of lymphocytes: B cells, natural killer cells and T cells. T cells get their name from the thymus gland, where they mature, and are very important in the immune response as they can recognise and bind to antigens on any foreign or cancer cells.

However, it can be quite hard for these T-cells to recognise any cancerous cells in the body as the cancer cells have developed the ability to evade the immune system. This is where CAR T-cell therapy comes in.

CAR T-cells have the ability to identify cancerous cells, but they have to be genetically engineered first. Initially, a sample of T cells are taken from a patient's blood in a process known as apheresis. An apheresis machine helps separate the different parts of the blood, thus allowing the extraction of T cells. These T cells are then taken to a laboratory and genetically modified, turning them into CAR T-cells. This means that an artificial Chimeric Antigen Receptor (CAR) is now present on the T Cell, allowing it to detect and bind to a specific antigen that is only present on the cancerous cells. The patient's own immune system can now attack the cancer, hence why it is classified as a type of immunotherapy.

Why is this topic significant?

In the medical world, this topic is quite frankly ground-breaking. So far, the approved CAR T-cell therapies are for adults with advanced large B-cell lymphoma (blood cancer in the lymph nodes) and for children and young adults with acute lymphoblastic leukaemia (cancer that affects white blood cells). CAR T-cell therapy is normally used for patients where the standard treatments have been used but did not respond well or for patients who have relapsed. According to Dr. van Beisen, CAR T-cell therapy has "the ability to eradicate large B-cell lymphoma and childhood acute lymphoblastic leukaemia in patients where nothing else has worked". This would be a very big deal to patients where prospects of survival, after the failure of standard treatments, are grim. The most noteworthy part of this new discovery is that it has a completely new mechanism of action – it's essentially a drug that attacks cancer cells, but also multiplies and remains in the patient, meaning repeated infusions are not necessary. In essence, CAR T-cell therapy has allowed people to go into long term remission, which was previously very difficult to achieve.

My opinion

I believe that this new development in cancer treatment is an example of how far modern medicine has progressed in the last few decades. From the discovery of penicillin in 1928, medicine has advanced rapidly to the extent that now we are able to genetically engineer T lymphocytes to identify and target cancerous cells in the body. The fact that it permits many people to reach long term remission showcases the success of CAR T-cell therapy and this is what makes me believe that this type of treatment is the way forward in Lymphoma and Leukaemia treatment.

The next step in CAR T-cell therapy is to create treatments for adults with cancers such as acute lymphoblastic leukaemia (ALL) as, currently, treatments are only present for children and young adults. It is important that we develop this soon as the three-year survival rate for ALL in adults is only around 25-30%. I'm almost certain that CAR T-cell therapy will soon become a major treatment for the different types of blood cancers and looking at its success over previous years, it seems that it will provide hope to those whose prospects of survival look dire.
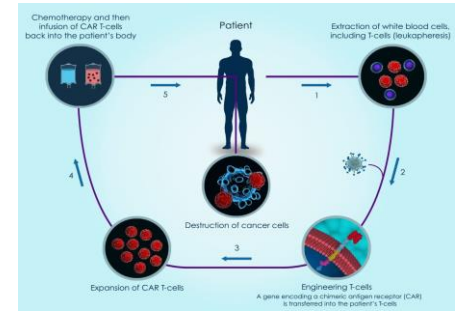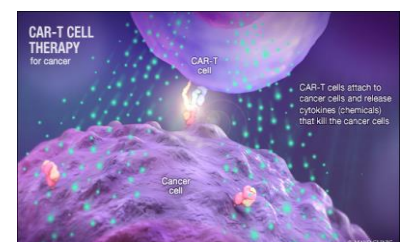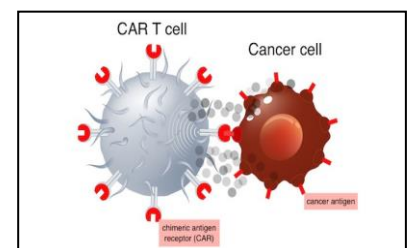
Are we addicted to Prescriptions?
Abhishek Viswanath

For many of us, receiving a prescription has become a normality. With every trip to our GP, we often leave with a small, green piece of paper with a few illegible scrawls and think nothing of it. However, this so-called 'sticky-plaster' approach is the underlying cause of a severe problem that has plagued our society.

According to a report released by the Government in 2017, 17% of the adult population were prescribed antidepressants that year, up by 2% from 2015. Moreover, there was a strong association with the prescribing rates for opioid pain medication and areas of greater deprivation. (Shown by the figure below with the North East being one of the poorest regions of the UK). At first glance, these figures may not seem important, but the length of these prescriptions is shocking. In March 2018, over 50% of those receiving medication had been continuously prescribed for the last year. Moreover, nearly a third had received prescriptions for three years. (**"Dependence on prescription medicines linked to deprivation - GOV.UK," n.d.**)

Opioid analgesics prescribed in 2017
Items prescribed per 1,000 residents, by NHS region

Source: NHS Digital/Openprescribing.net   B B C

The UKAT (UK Addiction Treatment Service) released figures in 2018, which showed that 10% of all patients who checked into UKAT's rehabs were treated for drug addictions, stemming directly from GPs prescriptions. Furthermore, in just three years, admissions have risen by 45%. (**"Did you know 90 days is all it takes to be addicted to prescription opioids?," n.d.**)

Although the best option for many conditions is prescription drugs, patients blindly accept this option without understanding the long-term, damaging effects. A number of patients described the actual problem as the 'withdrawal stage' of their treatment. BBC News released an interview with Fiona French in 2017, describing her personal experience of being diagnosed with myoclonic epilepsy, a condition that causes shock-like jerks of a muscle. She was prescribed the benzodiazepine "Nitrazepam". This sedative drug led to further complications such as depression, cognitive problems, rapid weight loss and shockingly her first attempt at suicide(**"The 'hell' of my prescription drug withdrawal - BBC News," n.d.**). In a separate article by BBC News, various quotes were taken from victims conveying the detrimental effects these prescriptions have had on their lives. Patients have described their ordeal "like a roundabout [which] nobody wants to help you get off" or, their "whole lives have been torn apart", (**"'Growing problem' of addiction to prescription drugs probed - BBC News," n.d.**) or that "they turned me into a zombie".

Despite the apparent long-term mental damage, opioid abuse can have on a patient, the true underlying problem resides in the sole fact that there are not enough effective alternatives available. Professor Helen Stokes-Lampard from the Royal College of General Practitioners commented that the reason for doctors prescribing these medications indicates a "severe lack of alternative options." Therefore, it is my view that the solution to this issue is to invest in other treatment possibilities. CAMs (Complementary and Alternative Medicines) are treatments that are outside of mainstream NHS healthcare. These include options such as Chiropractic treatment, osteopathy, or even merely therapy and recreational activities. The problem is the limited access for those in areas of high deprivation have to these alternative forms of treatment.

One option is for the NHS to increase funding for education programmes to raise awareness for the detrimental effects opioid addiction can have on vulnerable patients and for the alternative options they could pursue. Another option could be to increase funding for these CAMs, allowing them to be available in more areas of need to combat this problem.

The NHS could take notes from the US, which has a similar problem. In April 2018, the NIH (National Institute of Health) announced the launch of the HEAL (Helping to End Addiction Long-term) initiative. In 2019 the NIH awarded $945 million in grants for medical research and the implementation of alternative options to prescription drugs. **("Helping to End Addiction Long-term | NIH HEAL Initiative," n.d.)**They have devoted a significant amount of resources to fix this growing problem, and the NHS should follow suit.

The discussion of this topic is essential in our society due to the lack of awareness of this particular subject. We often hear "Antibiotic resistance" and "obesity" at the forefront of medical issues, but 'prescription addiction' is a far more pressing issue to us, who are not aware of the long-term dangers of their medication. With increased awareness for mental health conditions, this problem will only increase in significance.

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Are Microplastics the new silent killer?

Kunal Nataraj

What are Microplastics?

Microplastics are extremely small pieces of plastic, that are less than 5mm in diameter. They are produced from the breakdown of waste from larger plastic products e.g. plastic bottles.

These small pieces of plastic are very harmful to the environment. As of 2014, there are an estimated minimum of 15 trillion pieces of microplastic in the oceans, which is equal to approximately 93 tonnes. There are two main types of microplastics, which are primary microplastics, and secondary microplastics. Primary microplastics are plastics which are already less than 5mm in diameter, before entering the environment, which include microfibres, from clothing, and microbeads, for example. Secondary microplastics are produced when much larger plastic production degrades in the environment and this includes plastic bags, fishing nets, and plastic bottles.

The conditions required for the complete degradation of a plastic monomer does not exist in the aquatic or non-aquatic environments which means that these microscopic particles remain intact for hundreds or even thousands of years.

How far have Microplastics spread, and why?

Microplastics have spread and polluted almost all ecosystems over the world, ranging from the oceans mainly, to habitats on land, and in the air. The extent of this spread is vast, with microplastics even reaching the Arctic and the Antarctic, which are at the north and south poles of the planet, showing just how far they have travelled. Research suggests that microplastic fragments are constantly travelling distances of almost 60 miles from where they get released. They have been found in the waters of lakes, rivers, seas, delta sediments and even in deep sea sediments deposited five kilometres below sea level. Microplastics are also becoming much more abundant in the soil, due to fauna like earthworms, which decompose larger plastic pieces into microplastics when they release waste.

Microplastics in our food

Microplastics have severe negative impacts on the food chain, due to the dangers that are passed on between the predators and prey. Marine sources of microplastics are the organisms- zooplankton, invertebrates, fish, seabirds, and whales. They either directly ingest these microplastics or do so indirectly as predators in the food chain. Non-Marine sources include the plastic packaging for the food that we use like bottled water, tea bags, tinned food, tap water, etc. Microplastics are often floating around homes and can easily end up in the food that we are eating.

Are they really a silent killer?

The microplastics that enter an organism are either excreted, get trapped in the stomach or intestinal lining, or move in the blood, and are therefore capable of reaching various organs and tissues in the body. Various toxic chemicals that are used in the manufacture of plastic, such as vinyl chloride, and dioxin can then leach into cells.

In Marine animals, there is evidence suggesting microplastics have inhibited brain activity in tilapia fish and in some cases caused the early death of whales.

Several studies on plastic's impact on animals have shown that at a high concentration, this could cause negative immune responses, reproductive disruption, endocrine disruption, and altered gene expression. Scientists have observed that these particles, when aggregated, are causing changes in blood proteins and in some cases making them non-functional.

It was believed that humans are not consuming as much microplastics as to cause any damage. However recent observations across the world have shown high levels of BPA (Bisphenol A) in Humans. This especially puts developing children and foetuses at a high risk, compared with adults exposed to identical levels of the contaminant. Similarly, high exposure to phthalate has been known to cause reproductive issues.

Many of the studies where these risks and issues were identified have been done on animals. But the human health effects and risks continue to be investigated and the importance of these exposures remains subject to debate. It is widely believed that the current safe levels of BPA and Phthalates are widely driven by industry pressures and is not really reflecting the real danger.

Studying the impacts of microplastics on human health is challenging because -

- people cannot be fed microplastics for experiments

- they can behave differently depending on physical and chemical surroundings

- their characteristics and toxicity may change as they pass through the food chain

- not much research has been done on what level of contamination will hurt us

Based on the limited data and the lengths of studies on humans, it can be said that the impact of microplastics is highly underestimated. With the growing volumes of plastic pollution around us and the direct and indirect ways we are consuming them, microplastics are slowly becoming a silent killer. The health impact is seen in so many areas and over a longer period but with increased concentrations it is possible that this will become urgent very soon. In my opinion there needs to be an advanced research on this, which is not interfered in by corporate interests, across the world.

How should we handle this?

The most logical and common solution to this is to reduce the plastic consumption that leads to plastic pollution around us. The ongoing production and usage of highly durable, but short-lived consumer products, is unsustainable. Around the world there must be a ban on single use plastic products.

More research and investment need to be done on finding alternative solutions that are equally durable but easily degradable.

The U.N needs to consider setting up legally binding agreements, as it has done on other global issues, like hazardous chemicals and waste.

Industry and Government can invest in infrastructure, to capture and recycle these materials, before they reach the environment.

There has to be a widespread awareness campaign to educate people in all parts of the world, as this is not an isolated problem, and the impact of it can be seen far away from the source of pollution.

Space Exploration – Where to next?

Oliver Evans

50 years since history was made when NASA astronaut Neil Armstrong touched down on the Moon and since the last of the 12 moonwalkers left in 1972, no one has since returned, which leaves us asking what next?

"You want to wake up in the morning and think the future is going to be great - and that's what being a spacefaring civilization is all about. It's about believing in the future and thinking that the future will be better than in the past. And I can't think of anything more exciting than going out there and being among the stars."

— ELON MUSK, SpaceX

Elon Musk (CEO of SpaceX and Tesla) intends to reach not just the Moon but to reach the Martian Planet Mars much sooner than expected. With an aspirational goal of sending the first cargo mission to Mars in 2022. The objectives for the first mission will be to confirm water resources, identify hazards, and put in place initial power, mining, and life support infrastructure. A second mission, with both cargo and crew, is targeted for 2024. The ships from these initial missions will also serve as the beginnings of the first Mars base, from which he can build a thriving city and eventually a self-sustaining civilization on Mars. You may wonder how all this is possible however Elon and SpaceX have already created the answer.

The Starship and Super Heavy Rocket

Building Moon bases and Mars cities will require the affordable delivery of significant quantities of cargo and people. The Starship enables the delivery of over 100t of useful mass to the surface of the Moon or Mars. This system is designed to ultimately carry as many as 100 people on long-duration, interplanetary flights. These reusable Spacecrafts will also enable Earth to Earth flights and can reduce the flight time drastically, for example, London to Hong Kong previously an 11 hour and 50 min flight can be completed in as little as 34 mins. This revolutionary Rocket is reusable and is an incredibly cheap alternative when compared to single-use rockets such as Saturn V (Apollo 11 Rocket). The Starship is predominantly made with stainless steel as an alternative to carbon fibre as it is cheaper and increases in strength as the temperature decreases in the cold depths of space. Stainless steel also will not be damaged significantly when the rockets enter/re-enter planets atmospheres.

The Rockets use kerosene-based fuels as opposed to NASA's favoured liquid hydrogen fuels and, given that SpaceX intends to advertise its services for commercial use, this could pose a threat to the environment through the production of carbon dioxide from the burning oxygen and the use of non-renewable fossil fuels. I believe that if SpaceX intends to commercialise their rockets in the future, fuel alternatives must be researched such as biofuels or liquid hydrogen which both cause far less harm to the environment and are clean renewable sources of fuel.

NASA is actively researching Mars with the intention of sending a new rover in 2020 to investigate the discovery of liquid water under the surface as well as gathering the all-important data needed for sending astronauts to Mars safely in the next 10 years.

The trip to Mars has always been viewed as a near-impossible task but I believe that thanks to SpaceX and NASA we will not be waiting much longer until the first humans set foot on the red planet.

<u>Is Ion propulsion the future of aerospace?</u>
Saketh Uppaladhadiam

Introduction

Currently, our main method for propulsion involves the use of propellant (mainly in the form of hydrocarbons or alcohols). The use of hydrocarbons for fuel requires extracting crude oil and separating it into different fractions. This is a very costly process and detrimental for the environment. In order to ensure the longevity of the planet, innovations in propulsion and petrol sciences aim to reduce the use of these chemicals and rely on more sustainable energy sources such as wind, solar or tidal. In order to answer the question, 'is ion propulsion the future of aerospace?' propulsion must first be defined. Propulsion is derived from two Latin words; *pro* meaning before or forwards and *pellere* meaning to drive. From this, we can derive that a propulsion system produces thrust on an object causing it to accelerate in a certain direction. In this academic journal advantages and disadvantages of the following propulsion systems will be discussed; the rocket, the jet engine, and ion propulsion.

The Rocket

A rocket is defined as a spacecraft or vehicle that obtains thrust through a rocket engine. Rockets are one of the most fundamental contraptions in engineering, and one of the oldest (dating back to 13th century China where the first gunpowder fuelled fireworks were launched).

The most common type of rocket is a chemical rocket. These rockets work by utilising a fuel (something to burn) and an oxidiser. The fuel and oxidiser can be stored separately and used to provide thrust in a combustion chamber or they can be stored together as a hybrid. Rockets that have the fuel and oxidiser combined are known as Solid propellant rockets. Another type of chemical rocket is a liquid rocket, which utilises a liquid fuel and a liquid oxidiser.
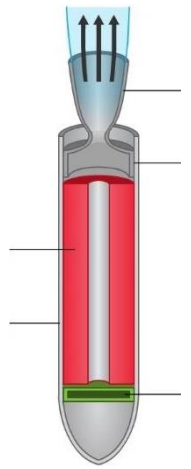
Advantages

The advantages of solid propellant rockets are that they are very easy to store and handle. This reduces cost as less specialist equipment is required to use the fuel and less time is wasted. Furthermore, solid rockets require much less space for fuel as the fuel-oxidiser hybrid can be condensed into a much smaller space than other fuel types. In addition to this, solid rockets are convenient when large amounts of thrust are required but budget is limited.

An advantage of a liquid propellant rocket is its high specific impulse. Specific impulse is defined as the change in momentum per unit mass for rocket fuels, commonly used to measure the efficiency of a propellant. Unlike solid rockets, the thrust for liquid rockets can be throttled, shut down or restarted.

In comparison to other propellants, solid and liquid propellants are cost-effective, do not require much space and are efficient.

Disadvantages

As solid rockets are a hybrid of the fuel and oxidiser, it is very difficult to control the thrust force once ignited. Therefore, solid rockets are generally used as small boosters to aid spacecraft in leaving Earth's atmosphere. Solid rockets also have lower specific impulse compared to liquid rockets.

The oxidisers for liquid propellant pose an issue as storable oxidisers (such as nitric acid and nitrogen tetroxide) are extremely toxic and reactive, giving rise to a range of health hazards and potential malfunctions. Furthermore, manufacturing of liquid propellant rockets involves much more machining and processing than other types of propellants.

However, both propellants pose large environmental hazards. Fuels required must be extracted from natural sources (namely crude oil) which releases vast amounts of carbon monoxide and dioxide into the atmosphere as well as damaging local eco-systems and habitats. The production of liquid oxidisers and fluorine involves the use of toxic chemicals that must be stored at cryogenic temperatures, heightening this impact on the environment. Almost all components involved

with these propellants involve the use of finite sources (sources that will not replenish in a meaningful human timeframe).

The Jet Engine

Unlike a rocket, a jet engine can be described as 'air-breathing', meaning that air is taken in and used to generate a thrust force. A jet engine works 'in stages', firstly by compressing air through a series of compression turbines, and then injecting it with a fuel. This high-pressure air and fuel is then combusted in a combustion chamber. In the combustion chamber, liquid kerosene is injected into the compressed air and burnt (temperatures can reach up to 1000 degrees Celsius). As the turbine has gained energy, this energy is lost by the air being exhausted through a series of turbines (as well as cooling down). This process produces extremely high amounts of thrust all while happening simultaneously (the General Electric GE90 Turbofan can generate 510,000N of force).

JET ENGINE CROSS SECTION
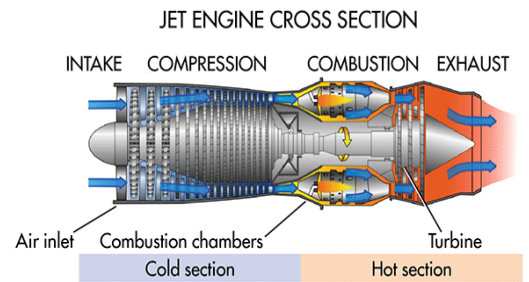
Advantages

Jet engines (specifically turbofan engines) are excellent for use at supersonic speeds as the turbines can slow the mass air input to subsonic speeds and will not break apart. Furthermore, jet engines have very high power to weight ratios (GE90 Turbofan has a power to weight ratio of 10.0kW/kg compared to a Suzuki Otto engine which has a power to weight ratio of 0.03kW/kg)

Disadvantages

As jet engines are 'air-breathing' they are not suitable for use at high altitudes as the air can be so thin that it is no longer suitable to provide thrust. Furthermore, jet engines are extremely expensive to manufacture and install.

Jet engines also have some of the environmental issues that rocket propulsion poses. As large amounts of kerosene fuel are used, greenhouse gases from the extraction of crude oil as well as combustion of fuel poses environmental damage.

Ion Propulsion

Ion propulsion is a form of electric propulsion currently used in some satellites and spacecraft. These kinds of systems utilise electric and/or magnetic fields to generate a thrust force on an object. There are different types of engines for ion propulsion, but the most common one is a Gridded ion thruster. This type of thruster uses inert gases such as xenon or krypton as a fuel. This is because they are odourless, tasteless and will not pose the risk of explosion.

A gridded ion thruster works by accelerating ions with electrostatic forces. The way these ions are accelerated is by using two electrodes (grids) near the end of the thruster. When the potential difference across these two electrodes is higher, the ions move faster (due to a stronger electric field). The electrodes contain many tiny holes (known as coaxial apertures). The function of these holes is to focus the ions into a jet. Through the large number of these apertures, thousands of jets are created which join to create an ion beam. This beam creates the thrust force required. However, as all of these ions are positively charged, an equal negative charge must be ejected from the thruster (otherwise the ions would simply return back to the engine).
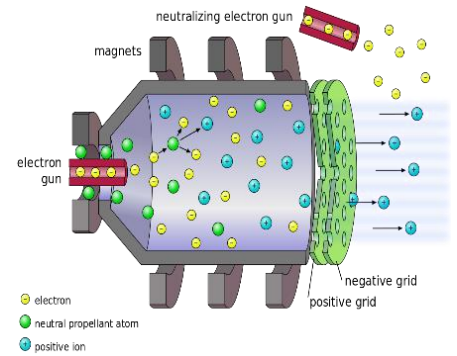
Advantages

Whereas chemical rockets have a limited thrust due to the nature of the chemicals used, the speed of the ions exhausted from an ion thruster is determined by the potential difference across the cathodes, which can theoretically be limitless. Furthermore, ion thrusters are capable for running for an extremely long time, making them appropriate for travel long distances (inter-planetary distances). Also, unlike the propulsion systems mentioned discussed above, ion propulsion can be achieved only using sustainable energy sources. In addition to this, ion thrusters have high specific impulse through the very high speeds of exhausted ions.

Disadvantages

Ion thrusters have a low thrust compared to chemical rockets and jet engines, meaning they would not be efficient for atmospheric travel. Also, an external power source is required for ion thrusters which could add weight and be expensive.

Conclusion

Ion thrusters are extremely useful for deep space travel and have already been used in some spacecraft. However, it would be difficult to use in situations where a high amount of thrust is needed for a short amount of time (leaving the atmosphere of the Earth or missiles). However, while the concept of ion propulsion has been realised for decades, only recently has it been used in practice. This means that the concept has high potential for further development. Planes, spacecraft and other vehicles could use a combination of jet engines, rocket propulsion and ion propulsion to achieve higher efficiency than before while minimising the environmental impact. For example, jet engines and rocket propulsion could be used in the early stages of a rocket launch to purely exit the atmosphere, with the canisters from the rocket propulsion and the jet engines falling off once in low orbit. Ion propulsion could then be used to propel the spacecraft to deep space. In conclusion, ion thrusters currently have economic and mechanical disadvantages compared to other types of propulsion but could potentially be used widely in the aerospace industry.

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CERNs LHC and why the years 2021-2026 will change physics as it is known now by extraordinary magnitudes for decades to come.

Varun Dinesh

Being informally known as "The world's largest, ongoing physics experiment", CERN's Large Hadron Collider is the world's most renowned and powerful particle accelerator. The LHC is a particle accelerator that pushes protons or ions to near the speed of light. It consists of a 27-kilometre ring of superconducting magnets with a number of accelerating structures that boost the energy of the particles along the way. The words in "Large Hadron Collider" refer to the size of the particle accelerator (27km circumference), the types of particles being accelerated (protons/ions) which belong to Hadron group, and "collider" because the particles form two beams travelling in opposite directions, which are made to collide at four points around the machine.

The CERN accelerator complex is a series of machines in succession with each one having higher energy potential than the previous one. Each machine accelerates a beam of particles to a given energy before injecting the beam into the next machine in the chain. This next machine brings the beam to an even higher energy and so on. The LHC is the last element of this chain, in which the beams reach their highest energies.

Inside the LHC, two particle beams travel at close to the speed of light before they are made to collide. The beams travel in opposite directions in separate beam passages – two tubes kept in an 'ultrahigh vacuum' state. They are guided around the accelerator ring by a strong magnetic field maintained by 9593 superconducting electromagnets. Within the machines, there are about 1,000,000,000 (1 billion) collisions per second. The electromagnets in the LHC are chilled to -271.3°C, equivalent to 1.9K (a temperature colder than outer space) to take advantage of this effect. The accelerator is connected to a vast distribution system of liquid helium, which cools the magnets, as well as to other supply services.

There are seven experiments installed at the LHC: ALICE, ATLAS, CMS, LHCb, LHCf, TOTEM and MoEDAL. They use detectors to analyse the countless number of particles produced by collisions in the accelerator. These experiments are run by collaborations of scientists from institutes all over the world. Each experiment is distinct and is characterized by its detectors.

The last ground-breaking successful experiment was conducted in July 2012 with the existence of the 'Higgs Boson' being proved. The 'Higgs boson' (particle) as well as the 'Higgs field' had been theorised in the 1960's by Peter Higgs, Robert Brout, Francois Englert, and some other scientists. The particle was found as a result of a joint effort from the CMS and ATLAS experiments of the LHC after decades of effort gone into finding it. That was not the end of the experiment however, as collaboration between the Large Electron-Positron Collider an the Tevatron particle collider then developed the search technique which enabled scientists to eliminate a significant part in Space in which the Higgs Boson could be 'hidden' in.

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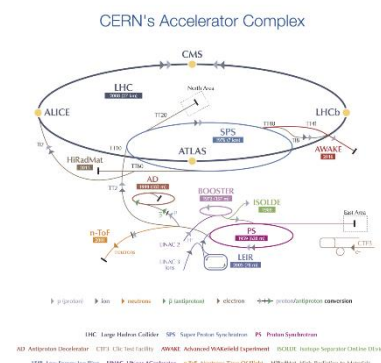
How is Big Data being managed?

Bharath Boyapati

Everywhere we look there is data being produced but now it's increasing, and it's increasing at an exceptionally fast rate. It is predicted that by 2030, 78 yottabytes of data will be produced (that's 1,000,000,000,000,000 GB!). So exactly how do we deal with all this data? To understand this topic, we need to understand what defines data and consequently what Big Data is.

Simply put, data is information such as facts and numbers used for analysis or decision-making. So, what is Big Data then? Big Data is also data but with a huge size; importantly, Big Data describes collections of data which has a large magnitude and is growing exponentially with time. The factor which differentiates Big Data from normal data is that fact that there is so much data being produced in such a short amount of time that none of the traditional data management tools can process it efficiently.

Some examples of Big Data:

- Almost 500+ terabytes of new data get ingested into the Facebook databases every day.

- The New York Stock Exchange generates about one terabyte of new trade every day.

- A jet engine in a commercial aircraft can generate almost 10+ terabytes in just 30 minutes.

So, with all this data, it is important we know how to handle it effectively. This is where data mining comes in. Data mining is the process of digging through big data sets to discover hidden connections and predict future trends, typically using different types of software packages. Some of the methods currently used in data mining:

- **Association (Relational Analysis)** finds correlations between two or more items by identifying the hidden pattern. For example, Relational Analysis is used by Spotify to help curate playlists that you might enjoy; they find correlations between the songs you listen to and the songs you show interest in (via adding them to 'my music', putting it on repeat etc.)

- *Classification* is used to distinguish data into smaller classes or groups. This is useful to accurately predict behaviour. For instance, a medical researcher who analyses cancer data uses classification to predict which medicine to prescribe.

- *Outlier Analysis* identifies the data items that do not comply with the expected pattern or expected behaviour. As you would expect, outlier analysis finds use in cases like credit card fraud detection, intrusion detection, fault detection etc.

- *Neural Networks* is based on biological neural networks (i.e. A collection of neurons with weighted connections). Neural networks are used to model the relationship between inputs and output. A great example of where this is used is in Artificial intelligence; neural networks form the basis of machine learning, where the computer will retain and use information from repeating actions repeatedly. As a computer repeats an action, it will have more data available to use in order to learn and improve.

These are the current methods of data mining, but what about the future? Personally, I would say that data mining will play a much more important role in the future with many businesses beginning to understand the implications and benefits of Big Data. With a growing population, businesses will do everything to compete and stand out against competitors. One of the most important things in achieving this is through how the businesses collect Big Data. I'll list some of the data mining trends that I believe could see itself being more prominent in the upcoming years:

- *Multimedia Data Mining* involves the extraction of data from different types of multimedia sources. Businesses can use multimedia data mining to classify data more accurately.

- *Ubiquitous Data Mining* involves the mining of data from mobile devices. Out of all the future trends, I believe that this will be the most problematic due to the growing awareness of data privacy and GDPR.

- *Distributed Data Mining* involves mining of huge amounts of information stored in different company locations. Therefore, Distributed Data Mining could be used to produce proper insights so that companies can maximize their potential.

- *Spatial and Geographic Data Mining* will be the newest form of data mining to be used in the future; it includes extracting information from environmental, astronomical and geographical to find patterns and trends. One of the biggest implications this will have is aiding the potential discoveries of extra-terrestrials.

- *Time Series and Sequence Data Mining* is the study of cyclical and seasonal trends. The implications of this type of data mining vary from agriculture to retailers.

To conclude, Big Data and Data Mining will help revolutionize the way businesses interact with customers through efficiently sorting data and providing businesses with information to make detailed and informed decisions, which would benefit the world.

Haashim Hussain

AI This acronym may mean little more to you than Arnold Schwarzenegger's Terminator, but what it stands for, *Artificial Intelligence*, has the potential to revolutionise the world as we know it. According to Google, AI is:

"The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages."

In basic terms, it is about the process in which specific software is created, allowing computers to transcend what was previously possible by taking much of the hard work off the shoulders of the software engineer; it is now the computers that teach themselves. This complex process is hard to understand, and even harder to program, but the initial seed that spawned the skyrocketing growth in the use of these *Neural Networks* was back in 1958.
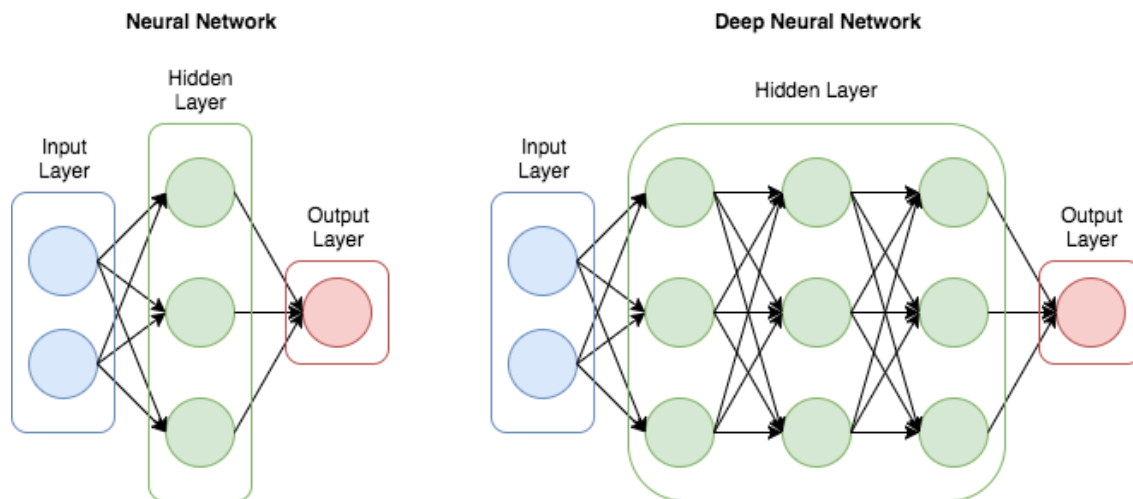
Rosenblatt's *Perceptron* marked the first ever modern-day *Neural Network*, and it was deceivingly simple. It could take inputs, and then based on some *Training Data*, which is input data alongside the expected outputs, the algorithm could "teach" itself how to convert the inputs into their respective outputs. Nowadays however, *Neural Networks* consist of countless neurones in sometimes up to hundreds of layers, allowing modern day algorithms to solve much more complex problems themselves, like in an app called "Gradient" that recently went viral, which, from a simple selfie, would attempt to reveal which celebrity you resembled the most.

However, one fundamental problem persists; THEY rely on *Training Data*.

This data is what teaches the algorithms how to interpret their input data to produce correct outputs. For the example of "Gradient" above, this training data would include a picture of a celebrity alongside their name, in an attempt to teach the algorithm that this face is related to this name. Attempting to solve this problem through *Hard Coding*, the idea that a software engineer writes every single output and input into the program, would have been futile, as each selfie is fundamentally different from the last. So, what's so bad with using this training data?

The problem arises within society itself. In the example of a facial recognition algorithm, a large amount of *Training Data* would be required to ensure that the algorithm has a high success rate, in the same way that we humans have to repeat the same task repeatedly so that we improve. However, this *Training Data* reflects the implicit biases of the society from

which it originates, and in the West this means that if you were training an algorithm like the one above, there would be a higher incidence of faces of white men or women than those of black men or women.

Therefore, a recurrent theme with these *Artificially Intelligent* algorithms is that they all struggle to identify people of darker skin tones. This problem was highlighted when the National Institute of Standards and Technology (in the US) investigated some mainstream facial recognition algorithms and found that quite literally all of them had significantly
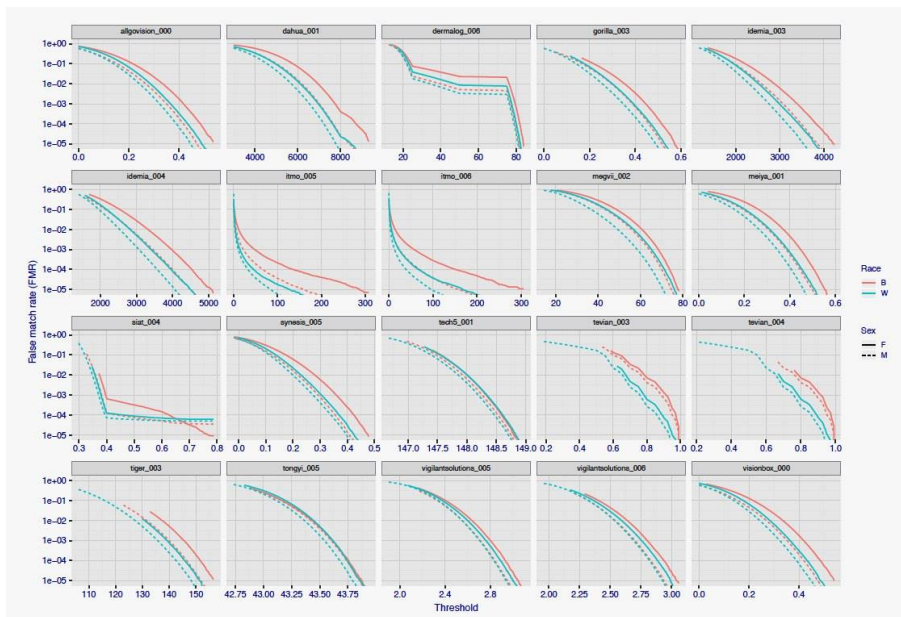
increased rates of failure amongst darker faces.

Each chart shown above represents a different facial recognition algorithm, and in each one where the red solid line is higher than the other lines, there is an evident gap between the algorithm's accuracy with darker skin tones and lighter ones. If this were a human identifying these images, it would be easy to label them as racist, and sexist, but in this case, it isn't the algorithm's fault. The cause is the *Training Data,* which trained these evidently biased algorithms. Despite this obvious issue, the UK and US are going ahead with plans to implement these racist algorithms into public spaces to help prevent crime, amongst other things. In fact, earlier this year, Gatwick airport replaced manual passport identification with an automatic system which uses one of these evidently biased algorithms.

But, is this bias all that bad?

Yes, yes, it is!

These biases can stack up, and despite the obvious gains in efficiency in airports that use this technology, there is an evident problem. It's like placing the law in the hands of a racist, sexist, homophobic judge, and despite faster processing of cases, there would be a higher incidence of unfair sentences due to the algorithm's dangerous, implicit biases.

China, however, has brazenly stridden ahead first into this torrent of developing technology despite the obvious risks. They use it to surveil every citizen in their country, with one CCTV camera for every 12 inhabitants, but the problem of processing all the data produced has led them to AI as their technological Moses, helping part the waves of useless information in search of gold, in the form of faces or crimes. Their algorithms are so advanced that they can identify faces in thronging crowds of thousands of people, and they push the ethics of AI to the extreme. Recently, a database generated by Yitu has been caught racially profiling members of society and classifying them as Uighur or not. Amidst the

Uighur crisis in Xinjiang, China's dubious application of AI like this highlights a deeper issue, that again, arises from the biases of society itself.

You should be scared. In a future where AI is supreme, privacy will be virtually nonexistent, and algorithms will determine whether or not you are likely to commit a crime, or be a victim of one, and this classification will inevitably be influenced by race and sex. A recent attempt at a censoring algorithm reportedly flagged tweets by African Americans 1.5x as frequently as offensive in comparison to other tweets, and these examples are enough to say that there is a problem with AI, as it relies fundamentally on data provided by biased humans. So, if humanity is biased, our AI will be too.

However, back to the question. AI is dangerous, yes, but that won't stop us from using it.

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Images courtesy of Google.

<u>The Impact of Smartphone Usage on Today's Youth</u>
Abhishek Saha

A new and powerful source is corrupting today's youth. Smartphones have flourished in the age of the internet. When used responsibly and with caution, they can be an excellent tool for education and entertainment. However, when used immaturely or carelessly, smartphones can be a dangerous medium capable of great damage. This article will discuss the various impacts smartphone use can have on teenagers, both physically and mentally.

Smartphones are an increasingly important part of our lives. Some teenagers go as far as to say that they can't live without them. This is the dangerous aspect of smartphones: addiction. According to the West Virginia Education Association, American teenagers spend an average of nine hours a day in front of screens.

Nearly half of the day.

I know myself how easy it is to get distracted by your phone. All it takes is one notification. Consequently, many students stay up till midnight doing work that they could've finished hours ago. During sleep, while your body rests, your brain is busy processing information from the day and forming memories. If you are sleep deprived, your ability to learn and retain new information may seriously be impaired. This has been confirmed by extensive medical research, highlighting just how detrimental certain impacts of your smartphones can be. This can affect your schoolwork, even more so for students like me preparing for A-Levels. Are you willing to take that risk?

Due to this research, it has been well established that smartphones make it more likely for us to waste time: valuable time. However, there are other, more serious dangers related to smartphone use. For instance, take social media. Sites like Instagram, Facebook, and Snapchat are becoming increasingly popular with Instagram having around 1 billion monthly million users. Can you believe that? 1 billion. This figure continues to rise even now as so many teenagers are allured to these sites due to their friends, family, or even favourite celebrities using it. Despite this, shocking statistic, many people don't realise the dangers associated with social media.

Bullying has been a part of human life for all recorded history, but social media is sparking a frightening increase. This harrowing trend is becoming more common as social networks are easily accessible at all times in most places. A study from OFCOM carried out in 2017 suggests that around 1 in 8 young adults have been bullied online. However, the National Crime Prevention Council says those numbers are far higher, especially since this study was taken nearly 3 years ago, suggesting that a massive 43% of teenagers have experienced online bullying. The worst part is that only around 38% of cyberbullying victims are willing to admit it to their parents. Only you can do something to ensure that you aren't part of that 43% in the near future.

Here is another fact I want you to think about. 24% of children who have been continuously cyberbullied have considered taking their life, and one in ten teenagers ultimately attempted to commit suicide. These are people who had lives. These are people who have left behind a grieving family. These are people just like you and me.

Even more distressing is the fact that this doesn't even scratch the surface of all the negative impacts social media can have. Many studies have proved scientifically that using social media makes you feel more isolated and depressed, contrary to popular belief. However, like me, at first, you will be rather sceptical of this fact. You may believe that your phone and social media allows you to express your feelings and make you happy You're wrong. If you think about it, on social media, all people do is compare. They compare their lives, their friends, even things as meaningless as clothes with others. Teenagers, especially, fall into the trap of comparing ourselves to others as we scroll through our phones and make judgements about how we measure up. This can lead to jealousy and often end up ruining life-long friendships. I don't believe that this is worth it: neither should you.

On the other hand, nowadays, there are many positives of having a smartphone; you can download any app you want, you can socialise with your friends, it can do millions of things. Despite the many negative impacts that smartphones can undoubtedly have, they are an essential part of our lives. Companies like Apple have sold over 1.3 billion iPhones since its launch, explicitly conveying the rising demand for smartphones and why it is nearly impossible to go without them. However, I don't believe that teenagers should be allowed to use smartphones as freely as we do. In my opinion, our usage should be controlled and monitored to prevent any of the negative impacts of smartphone use. Companies like

Apple have also highlighted the need for this by adding features that enable you to restrict the time spent on certain apps. Using this feature would enable you to enjoy the countless benefits of smartphones whilst having the assurance that you wouldn't experience an addiction to smartphones, an increasingly prevalent problem in today's society. Moreover, despite social media being a very large source of information as well as an immense platform for communication, I believe that its disadvantages do heavily outweigh its advantages and as a result, I encourage other teenagers to either stop using it or to heavily control their usage to prevent any bullying.

As I mentioned before, around 43% of teenagers have experienced online bullying. Do you want to risk being part of this 43%?

Humanities and Social Sciences

How 250,000 People Died to Save 67 American Soldiers

Calin Aneculaesei

When the U.S. responded to Pearl Harbour. The Imperial Army took out its fury on the Chinese people.

The Second World War was filled with fierce opposition from both sides after an enemy attack. This opposition often came in the form of counter-attacking the enemy, other times this would come in the form of retaliation against the population of the occupied zones.

The Imperial Japanese Army was well known for such actions with many taking pride in terrorizing the population of the occupied land. A shining example of this on a more individual level could be shown by the actions of Toshiaki Mukai (向井敏明) and Tsuyoshi Noda (野田毅), two army officers which competed to see who could decapitate 100 people first.

Vengefulness was at the heart of many of those who led the Japanese forces. As a result, it wouldn't come as a surprise that after the American retaliation attack on Tokyo in response to the Japanese bombing of Pearl Harbour would trigger one of the biggest mass killings of civilians ever seen in the history of warfare.

It is estimated that the retaliation attacks claimed an estimated quarter-million lives and would prompt comparisons to the 1937–38 Rape of Nanking because of its brutality.

The Doolittle Raid

Such mass retaliation came as a result of the Doolittle Raid. The Doolittle Raid was a bombing campaign headed by daredevil pilot Lt. Col. Jimmy Doolittle who commanded 16 US Bombers. On April 18, 1942, the bombers thundered into the skies over Tokyo and other key Japanese industrial cities in a surprise raid designed to avenge the attack on Pearl Harbour.

For the 80 volunteer raiders, who lifted off that morning the mission would be a one-way affair. After attacking Japan, most of the aircrews flew on to Free China where they hoped that their crash landing would be followed by the help of Chinese sympathisers to the American cause. This they got, but the ramification of the brief moment of hospitality shown by the citizens of Free China would echo across the nation.

The Rising Sun

Japan's high-ranking officials were appalled by the Doolittle raid as it not only damaged the image of the Eternal Empire through the destruction of its cities by the aggressor but also highlighted the tactical downfalls of not securing the Chinese coast.

In response to this perceived weakness, the Japanese military high command ordered an immediate campaign against strategically important airfields, issuing an operational plan in late April, just days after the Doolittle raid.

Even so, an ulterior motive would be noticed by those present in the places the Japanese would go on to invade punishing the Chinese allies of the United States forces, especially those towns where the American aviators had bailed out after the raid.

By early June, the devastation had begun. Father Wendelin Dunker observed the result of a Japanese attack on the town of Ihwang. In a statement he gave after the war he went on to say.

"They shot any man, woman, child, cow, hog, or just about anything that moved, they raped any woman from the ages of 10–65, and before burning the town they thoroughly looted it."

The Japanese marched into the city of Nancheng on June 11, beginning a reign of terror so despicable that missionaries would later dub it "the Rape of Nancheng." Soldiers rounded up 800 women and herded them into a storehouse outside the east gate. For one month the Japanese remained in Nancheng terrorising the innocent population of the city.

At the end of the occupation, Japanese forces systematically destroyed the city of ridding it of anything useful. Specialised teams stripped Nancheng of all radios, looted the hospitals of drugs and surgical instruments and wrecked the electrical infrastructure.

A special incendiary squad started its operation on July 7 in the city's southern section. "This planned burning was carried on for three days," one Chinese newspaper reported, "and the city of Nancheng became charred earth."

Over the summer, the Japanese laid waste to some 20,000 square miles. They looted towns and villages indiscriminately – like a pest. Soldiers devoured thousands of farm animals and destroyed the crops of the region leaving many to starve in the aftermath. They destroyed bridges, roads, and airfields. "Like a swarm of locusts, they left behind nothing but destruction and chaos," Dunker recounted.

Scorched Earth

As the Japanese troops retreated a campaign of scorched earth would be introduced with chemical warfare being the way this strategy was to be introduced. The perpetrators of this tactic were none other than the members of Unit 731, Japan's most despicable group of people who committed an incalculable amount of crimes against humanity during their time.

This trend would continue with what they planned next. What happened next was known as land bacterial sabotage, troops would contaminate wells, rivers, and fields, hoping to sicken local villagers as well as the Chinese forces, which would no doubt move back in and reoccupy the border region as soon as the Japanese departed.

Technicians filled water flasks with typhoid and paratyphoid bacteria, packaged them in boxes labelled "Water Supply" and flew them to Nanking. Once in Nanking, the flasks would be spread across the target areas where they would contaminate wells, marshes, and homes.

Soldiers also left 400 biscuits infected with typhoid near fences, under trees, and around bivouac areas to make it appear as though retreating forces had left them behind, knowing hungry locals would devour them.

Conclusion

To raise the morale of both American and Chinese citizens, America triggered one of the biggest massacres ever perpetrated by a singular country. In the end, around 250,000 people died in retaliation for the American attacks on the Japanese mainland.

It doesn't need to be said that the Japanese actions destroyed the morale of the American sympathisers situated in China as well as the opposition groups in the Japanese occupied zones of China. After news reached America of these massacres through the returning missionaries a consensus was reached. Japan had to pay. The attitude is best described with this closing quote.

"The Japanese have chosen how they want to represent themselves to the world. We shall take them at their own valuation, on their own showing. We shall not forget, and we shall see that a penalty is paid."

Why all boys should be feminists, and why everyone else should be one, too.
Ayush Sanghavi

Feminism: a global concept; a vehicle for positive change; but, remarkably and somewhat unsurprisingly rare in the all-boys' school which I attend. It seems that we are afraid of being feminists, and even when we are feminists, we are afraid of identifying ourselves as such. But why?

The word *feminism* carries a stigma. Teenage boys, and men too, will often typically associate feminism with other perceived 'negative' traits; take homosexuality for example. Feminism for males has thus become frequently attributed only to metrosexuals — or to those who are not 'true' men, of course. There is an absurd notion becoming disturbingly prevalent amongst today's generation: that being a feminist and having masculinity are mutually exclusive.

In her brilliant book-length essay '*We Should All Be Feminists'*, a text which has all the merit to become compulsory reading in schools, Chimamanda Ngozi Adichie puts forth numerous further reasons for the lack of young, male feminists. The **"word feminist is so heavy with…negative baggage"**, she writes; **"the idea of feminism itself, is…limited by stereotypes."** One such stereotype is that that feminists aim for dominance over men, trying to force their 'radical' ideas into existence under the guise of an equality-based movement. Indeed, derogatory phrases, such as the pejorative portmanteau 'feminazi', have even been entirely created (by a male, of course) in an attempt to encourage this stereotype, and more and more easily-led boys are choosing to believe it. The fundamental issue with these stereotypes is that they contradict the very definition of feminism: *'the belief that women should be allowed the same rights, power, and opportunities as men and be treated in the same way'*. If only males spent more time trying to understand the ideals of feminism than they do trying to mindlessly undermine it.

Adichie goes on to address the societal inadequacies in the traditional upbringing of boys: **"We define masculinity in a very *narrow* way"**, she states. **"We teach boys to be afraid of fear, of weakness, of vulnerability."** No doubt, such notions are almost ubiquitous in any predominantly male establishment — this includes, of course, boys' secondary schools — and these ideas only discourage boys from becoming feminists. By placing males in traditional roles of leadership and dominance from a young age, we internalise their privilege, and we generate within them a fear of equal rights for females. A vital point from Adichie reads as such: **"The *harder* a man feels compelled to be, the weaker his ego is."** And thus, boys speak of feminism as if it would automatically emasculate a male if he was one. We dismiss it quickly, we reject and baulk at valid, credible ideas — why? Because they make us feel uncomfortable, threatened, *weak* — even if these emotions are subconscious and we are rationally unaware of them. The monumental pressure and fear of social change have long been opponents to achieving global feminism; when one has privilege, they inherently don't want to give it up — and this is the root of why boys don't want to be feminists.

Literature gives us great examples of this pressure and fear of social change that surrounds feminism. In Henrik Ibsen's ground-breaking *A Doll's House*, the protagonist Nora emancipates herself from a life as a submissive trophy wife and emerges as an independent, feminist woman — and contemporary critics were outraged. The Countess of Jersey went so far as stating in 1880 that she **"did not think any actress who would appear in [one of Ibsen's plays] could be considered a lady"**. Why? Because she, even as a woman herself, had internalised sexist prejudices and thus was afraid of the loss of male dominance in society. In Bram Stoker's quintessential, late-nineteenth-century vampire novel *Dracula*, Lucy Westenra is decidedly feminist through her sexual liberation, independence over her body, and implied interest in polygamy. The ideas she presented touched on far too many traditional societal anxieties, however, and Stoker has her harrowingly killed with a stake through the heart, before she is posthumously decapitated, and her mouth is filled with garlic. Why? Because she represented a transformed society in which women had overt power — and this worried men. Even in 1979, critics of Angela Carter's astutely feminist *The Bloody Chamber and Other Stories* labelled it **"extreme"** due to the 'threat' put forward that women could indeed, use their intelligence to form a sort of power over the men. There seems to be an apparent trend here — that feminism is hindered because males (and even females) have internalised the fear of an upheaval of society as we know it; and thus, much of society has remained institutionally sexist and lackadaisical in its approach to feminism as a concept.

But it is boys especially who need to embrace the changes that global feminism would bring. Feminism falls under human rights; sexism is not just an issue that only women need take a stand against— it is something that is, by its very nature, a human problem. Males are undeniably in positions of privilege that women simply don't have; we need to use them to speak out, to remediate the discrimination and marginalisation of women that is experienced every day. The privilege and platform which boys are born into display exactly why all boys should be brought up as feminists — only they have the

opportunity to entirely redress the issue. **"What matters even more [than changes in policy and law]"**, states Adichie, **"is our attitude, our mindset."**

It is clear that global feminism is only a threat to sexists, not to ordinary males. It would remove the societal privileges of males, yes, but these benefits were not earned in the first place — they were simply given; global feminism would create a fairer, more meritocratic society, and would recognise the constant hardships still being suffered by the 52% of the world population that is female, thus paving the path for equality. The only apparently 'radical' change would be that girls and women would enjoy the same advantages that boys already do — not so 'radical' at all.

It is also important to state that being a feminist has never made anyone any less of a 'man'. It does not emasculate, invite ridicule, or as one of the most ridiculous counter-arguments reads, 'make you gay' (and on that front, why is it often that those who have an issue with feminism also find themselves against homosexuality?) Being both a male and a feminist simply implies insight of the privilege we hold, and empathy for our female counterparts. It is only right that we protest for equality. But considering this, we should not become feminists in the hope to make our female (or male) counterparts respect us more — or anything of the like. We should all be feminists in the same way that we should not be racist or homophobic — because it is a movement that simply strives for equality, and nothing more.

One of the most important lines in Adichie's essay states, **"Gender as it functions today is a grave injustice…We should all be angry."** And I am angry. I'm angry when female friends tell me of sexism they've experienced in social situations; I'm angry when I hear of sexism disrupting learning in schools; I'm angry when I read that the gender pay gap in the UK still stands at 8.9%. But I know that I have a responsibility to fight against this. And that is why as a seventeen-year-old boy, I am unashamedly unafraid to call myself a feminist.

<u>Why are there reasons for the trade war between Japan and South Korea?</u>
Christopher Egan

South Korea and Japan may seem like natural allies at the moment; two capitalist, democratic nations united by a mutual fear of influential China and paranoid North Korea continuously stockpiling nuclear weapons amid a breakdown in the US-North Korea Nuclear talks at Hanoi. Surely a recipe for good relations then, for many nations have been united by mutual fears throughout history: take Great Britain, threatened by Germany's growing arms, formed an alliance with France, hell bent on *revanche* for Alsace-Lorraine in the prelude to the Great War, ending an era of "splendid isolation".

Many nations are united by similar ideals, as proven in the cold war; Japan and South Korea are not at odds ideologically, but in the same camp in the face of nominally communist China and rigidly communist North Korea. Both countries are allies and trading heavily with the US, committing them to the wariness of China. So, why have relations between the countries deteriorated, so much so that 79% of South Koreans view the Japanese in a negative light and 39% of Japanese likewise? Mistrust stemming from history and territory provide the reasons, while the ongoing economic and trade war provide the symptoms of the heightened tensions.

It's been in the news, playing second fiddle to the US-China trade war in terms of publicity. However, their strained relations finally erupted in July 2019 in a trade war, after a long period of brewing suspicions.

Japan and South Korea have for a particularly long time embroiled themselves into a dispute over a couple of largely unpopulated islets – the Liancourt Rocks, situated practically equidistant from the two countries. They vie for the rich fishing grounds there (owing to the reefs surrounding the islets) and the gas deposits around the islands. To an outsider, this seems, say…'pointless'. The two countries are not locked in this dispute because the islands are critical to national interest or their economies - albeit they both try to claim the former- but rather due to the mutual desire to preserve their national prestige (over two rocks) and keep face. It must also be considered that the South Korean psyche still includes a grudge, especially in nationalist sectors that Japan greatly wronged Korea in World War 2, and as Japan took the Rocks from Korea in WW2, South Korea believes it to be its right to own the islands.

In addition, there are two other controversies, dating from World War 2 that have also caused strife for the relations between the countries – the issue of the "Comfort Women" – Korean women subjugated under Japanese rule who were forced to become prostitutes for Japanese soldiers across the empire; a war crime that a UN committee (2018) has attempted to force Japan to give out more compensation for, which Japan rejected on the basis that it already had. Naturally, Koreans want more from Japan for their crimes, leading to a cooling of already frosty diplomatic relations. The other controversy, which caused the recent flare-up, was that a South Korean court, in July 2019 forced Mitsubishi Heavy Industries to liquidate some assets in order to pay off claimants off compensation, in addition to the Supreme Court also ordering Mitsubishi to pay off 10 claimants last year. This proved to be a real annoyance for Japan, who considered it a 'rebuke' of the previously agreed compensation in the 1965 treaty which was seen as a be-all-and-end-all document for compensation. This situation also involved Nippon Steel, ordered to pay 4 claimants by the same Supreme Court.

These straining issues combined with the newly ordered compensation caused resentment in Japan, and increased the mistrust between the two nations, which then finally exploded into a trade war with Japan imposing control on tech parts and chemicals essential for South Korean tech companies' memory chips being exported from Japan. South Korea summarily retaliated by removing Japan from its go-to trade partners whitelist, showing anger towards Japan in retaliation.

The two countries are at each other's throats. But, like two quarrelling men shipwrecked on an island, they must collaborate and end the trade war, else China may start exploiting the wedge between them to further its own influence, for example in the South China Sea if left unchecked, or as both economies are affected negatively by the trade war, establish a greater dominance in the region. There are no solutions easily visible to this riddle – diplomacy cannot fix this with the wave of a magic wand. Prestige, Face and History must be reconciled and left behind for these two 'natural' acquaintances to progress especially in the face of China and Russia to the north-west of both nations.

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How has ESG impacted Investment decision making?

Shivam Suri

ESG stands for Environmental, Social and Governance. There is evidence to support the notion that ESG Factors have an advantageous role to play when integrated into investment analysis and portfolio construction. There is a belief that by ensuring that these factors are considered when companies are evaluated, we are better able to identify companies that are likely to deliver returns.

Responsible investing is widely understood as the integration of environmental, social and governance factors into investment processes and decision-making. Many investors recognise that ESG information about corporations is vital to understand corporate purpose, strategy and management quality of companies.

In addition, for many, the term "ESG" brings to mind environmental issues like climate change and resource scarcity. These are an element of ESG—and an important one—but the term means much more. It covers social issues like a company's labour practices, talent management, product safety and data security.

In the past, ESG considerations had a reputation for offering low returns. The term 'Responsible Investment'; had a stigma attached as many felt that it limited the number of companies that could be invested in and subsequently reduced the potential profit that could be made by investors. Companies that fell foul of ESG criteria often performed very well in stock markets thus disguising the impact of ESG considerations.

Investors recently have begun to identify ESG criteria as being significant determinants of company success. There was a belief that ESG was simply about environmental considerations. However, incidents such as the Union Carbide explosion in Bhopal, the BP Oil Spill and the recent emissions scandal faced by VW have been highlighted as issues which were resultant of companies not following ESG criteria. There are no suggestions that ESG criteria directly would have changed or prevented these incidents but by encouraging markets to consider these variables and by making the stock of companies who do not adhere to ESG Principles less attractive may achieve the same end goal. From an investment perspective applying these principles in investment decisions could have helped investors to avoid exposure to billion-dollar losses.

As ESG-minded business practices gain more traction, investment firms are increasingly tracking their performance. More and more investment banks and asset managers are offering ESG based strategies as options to investors. Research has shown that companies with strong ESG scores outperform companies without. The growth of social media and ease with which news travels across the world has also led to the growth in importance, relevance and visibility of ESG.

Environmental factors include climate change and the depletion of resources. As a result of this investors have begun to factor sustainability issues into their investment choices. The issues often represent externalities, such as influences on the functioning and revenues of the company which the company may not always have control over. There are many concerns but some of the main are Climate Change and Sustainability. The body of research providing evidence of global trends in climate change has led investors, pension funds and holders of insurance reserves, to begin to screen investments in terms of their impact on the perceived factors of climate change. Fossil fuel reliant industries are less attractive. A report was commissioned by the British government to provide an economic analysis of the issues associated with climate change 2006. Its conclusions pointed towards the necessity of including considerations of climate change and environmental issues in all financial calculations and that the benefits of early action on climate change would outweigh its costs.

In every area of the debate from the depletion of resources to the future of industries dependent upon diminishing raw materials, the question of the eventual obsolescence of a company's product or service is becoming central to the value assigned to that company. The long-term view is becoming prevalent among investors.[1]

Social concerns are focused on principles of diversity, human rights, consumer protection and animal welfare.

A company's recruitment policy is considered by investors. The belief is that the greater the pool of talent open to an employer the greater the likelihood of finding correct roles for employees. Gender equality, pay equality and elimination

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[1]https://en.wikipedia.org/wiki/Environmental,_social_and_corporate_governance

of discrimination in the workplace encourages diversity. Increased diversification throughout a firm is seen as key indicators of innovation and agility.

In 2006 the US Courts of Appeals ruled that there was a case to answer bringing the area of a company's social responsibilities squarely into the financial arena[1]. This area of concern is widening to include such considerations as the impact on local communities, the health and welfare of employees and a more thorough examination of a company's supply chain. There have been incidents recently where European companies have been fined because of failures in their operations in the third world.

Consumer protection refers to the protection that consumers have against unscrupulous firms. We have seen large scale publicity about payment protection schemes that were sold without consumers being fully aware of what they were signing up for.

Animal welfare concerns are seen as a consideration for investors. This refers to the welfare of animals destined for the food market and also the welfare of animals used for testing purposes. Investors use this information to understand the company and the market being analysed. Publicity about poor animal welfare can impact stock prices and associated returns.

Corporate governance covers the area of investigation into the rights and responsibilities of the management of a company—its board, shareholders and the various stakeholders in that company management structure is considered, the role of CEO and board members are considered. Ensuring that management structures are not overly autocratic is seen as beneficial for the success of a company and the mitigation of untoward practices.

From diversity to the establishment of corporate behaviours and values, the role that improving employee relations plays is growing in importance. Companies attract the best people by being the best employer. Much attention is paid to lists like the 'Top 100 places to work'. Work-Life balance is seen as increasingly important. Once again, the thought is that by offering employees the environment they need to succeed in, they are more likely to do better for themselves and the company.

Compensation is also a major consideration. The pay of senior executives is scrutinised by stockholders and investors. Besides executive compensation, equitable pay of other employees is a consideration in the governance of an organisation. This includes pay equity for employees of all genders.

In Summary, ESG presents a new way of analysing companies. This is a shift from simply focusing on performance. The underlying principle is that companies who do business in the right way are more likely to succeed in the long term. Companies who look after the environment, care for their customers and employees are more likely to do well. This seems to me to be nothing more than common sense and it is great that see that these considerations are becoming commonplace in investment decision making.

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A Brief Introduction to the Evil-ution of the Video Game Industry Business Model
Dhanyaal Hussain

In recent years there has been a complete overhaul of the widely accepted political rules surrounding decorum, respect, and the truth. In amongst this era-defining change, a word that has been thrown around is populism. Populism is usually used in reference to a candidate removed from the establishment and who dares to criticise it, such as Nigel Farage. It is also associated with right-wing ideas. However, the true meaning is more nuanced than that. The meaning of populism, in fact, is the appealing to the people that only they represent the views of the people. Even if they don't garner 100% or even a majority, they still claim to represent the only opinion of the people. This is because, as stated by Jan-Werner Mueller in his book What is Populism, they will claim that they are being sabotaged by institutions of the elite or the people that don't vote for them aren't truly the people. This is epitomised by Hungarian leader Victor Orban who talks about creating a 'Christian Homeland'. These sorts of xenophobic attitudes are usually found in populism as the creation of a single ethnicity state is what they would refer to as representative of the people. This attitude threatens our democracy and populists have no qualms about subverting our democratic institutions and rules. Mueller also says that populists imply that they represent everyone. While some may believe that this populism is a new phenomenon, it has always existed, on the fringes of Europe with people such as Jorg Häider and Geert Wilders, but has always been present in South America, for example with the left-wing populist Hugo Chavez, the former Venezuelan leader. However, a change in recent years is that these populist attitudes have seeped into mainstream parties. For example, with Trump and the Republicans, and Boris and the Conservatives. I believe that this is a watershed moment for European politics as populism had always been on the fringes but now it is the norm. I think it has forever damaged the political climate and has irreversibly changed the social norms.

With the elections of Emmanuel Macron in France and Mark Rutte in the Netherlands, it can be wrongly interpreted that populism has come and gone. Look below the surface, however, and a different picture will be painted. In May's European Parliament elections Macron's pro-European party was beaten by Marine Le Pen's National Rally and in March's Dutch regional elections, which indirectly elect the Senate, Rutte's party was beaten by Thierry Baudet's populist Forum for Democracy party. These populist leaders are as strong as ever and arguably growing. They are now focusing on creating a conveyor belt of new populist leaders inspired by the current crop. This is exemplified by the attempted creation of a populist academy in a monastery in Italy, although the lease was revoked by Italian authorities.

In addition, advances in technology have allowed populists to achieve their aims easier. The advent of social media has allowed these leaders to communicate directly with their followers, keeping the illusion of these leaders as true representatives of the ordinary people. This is best shown with Trump's now infamous Twitter account and the Turkish leader Erdogan's live FaceTime interview amidst the attempted coup in 2016.

The rise in these populist attitudes has borne a more divisive attitude amongst society has arguably led to our worst instincts coming to the fore. The 'Us and Them' attitude has now become the norm. Both sides of the political spectrum are no longer against saying vile things if it will win votes, such as Boris Johnson's comments over Muslim women or Trump's comments over Mexicans. Political sanity is lost and an agreement to disagree is gone. Even if you disagree with someone, and the words they spout you believe are wrong, surely throwing milkshakes at them or sending bomb threats is an insult to peace, society, and democracy itself. Even if these populist fringe parties fade away or the supposed centre regains its political stranglehold, the damage has been done. Our parties have all succumbed to populist ideas and values and society has lost its moral compass. Compassion has gone. Populism, in name, may disappear but its values are now ingrained in our political climate. Even our so-called moderates have adopted the idea of creating a common identity that only they represent, whether it be a European identity or equality. Politics has no longer become a debate of ideas over the best way to move society forward and leave behind a better world for our future generations but a choice of identities where you are either in or out.

Moreover, our democracies are threatened. Populists, by claiming to represent the 100%, can make a case for bypassing elections as they are already the perfect representative of the people. In addition, democratic institutions, such as the judiciary, and democratic values, like the rule of law, are happily subverted and undermined, exemplified by Erdogan's Turkey. Many populist leaders have been able to establish so-called illiberal democracies, like Orban in Hungary. Even if populists can't remove an entire system of checks and balances, they can undermine and destroy parts of them such as

Trump with freedom of press, exemplified by the revoking of CNN journalist Jim Acosta's White House pass. Democracy is built on the values of trust, peace, mutual respect to agree to disagree and equality. Those populist values of representing the 100% marginalise parts of society eroding equality and can lead to the tyranny of the majority over the minority. The western world has been quick to intervene in foreign countries over the idea of democracy so maybe it is now time we assess our own democracies and realise that if we keep going, they could soon disappear.

Populism isn't a new phenomenon, but it has moved from the fringes of European politics to the mainstream. As a part of the political sphere that is removed from the centre it may fade away but make no mistake: its values, morals, and attitudes have forever contaminated our society and all our politicians now engage in the dark arts of populism. Society is forever divided. Politics is not a gentleman's game anymore. It's a war and the loser may ultimately be democracy.

The Venn diagram approach
Robert Bowker

The world is a complex place. It is from this complexity, however, that I have come to appreciate interdisciplinary study, where real world problems are analysed using multiple disciplines, even if the issue is seemingly one-dimensional. A good example of this is the Financial Crisis in Europe, also known as the Eurozone Crisis or European Sovereign Debt Crisis. On the surface, this event seems entirely economic: it is a crisis within the European 'financial' and banking sectors and is commonly referred to as an 'Economic Crisis' due to its primary economic causes and effects. However, I will argue that the causes of the Eurozone Crisis were not entirely economic, nor even primarily economic, being instead a concoction of political, philosophical, and economic issues. To visually depict this complexity, and omitting some of the other disciplines that can be used to explain the Eurozone Crisis for the sake of simplicity, I think that a Venn diagram, being *a diagram that shows all possible logical relations between a finite collection of different sets*, is apt.
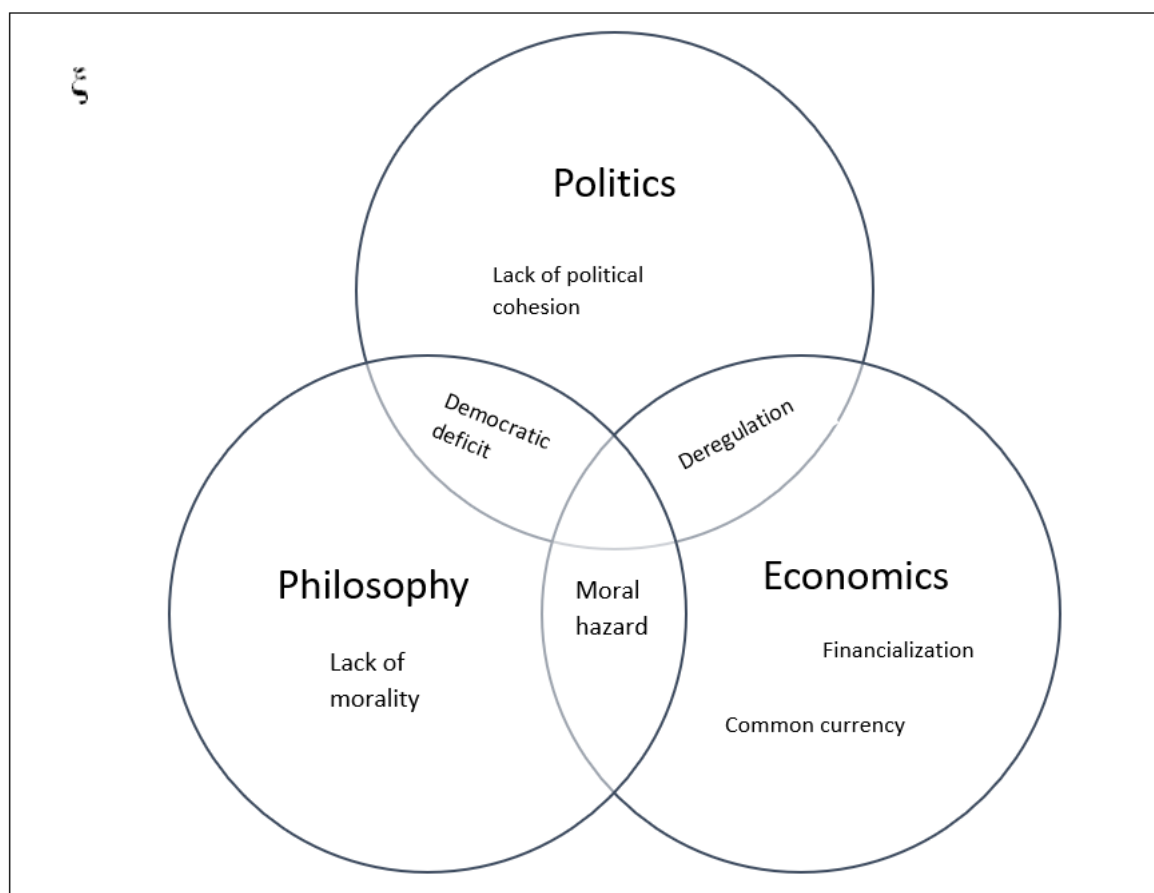
With the universal set being the Eurozone Crisis, each element is a cause of the Eurozone Crisis, and these elements fall into separate sets, which are the disciplines used to analyse this issue. It is from this perspective that I will begin my analysis.

Economics

Despite suggesting that one should not categorise the crisis as being purely economic, I will start with economics. Financialization, as in the Anglosphere, is a key issue as it led to the illusion of 'riskless global risk'. Subprime, riskier loans were divided up into slices which were in turn mixed with slices of other loans to form derivatives, the idea being that mixing debt with different risk ratings would reduce the risk overall; of course, as in the Anglosphere, this risk did not magically disappear, and it ultimately came back to haunt the lenders as borrowers began to default.

However, within the Eurozone, this perilous process was exacerbated by the European Monetary Union (EMU), established by the Maastricht Treaty of 1992 and put into force in 1993. The main problem with the union was that it

resulted in markets believing that all Europeans from richer states, such as Germany, and poorer states, such as Greece, had the same credit worthiness, when in fact the credit ratings of individuals, companies, and banks in countries such as Greece were the same as before and after they joined the EMU; for the sake of this article, I will from here use Germany and Greece as a paragon example of the lending relationship between economically diverse states, both in terms of wealth and their balance of payments position. So why did lenders in Germany begin to consider their counterparts in Greece as equivalent to their domestic borrowers? Firstly, all the countries in the EMU now made their income in euros. Moreover, the Maastricht Treaty provided terms only for entering the EMU, but no terms for exiting. As a result, the money earned in deficit states such as Greece would never be devalued vis-à-vis the money earned in surplus states like Germany, and so lending to these deficit states seemed as advantageous as lending to a German entity. Once this assumption was made, bankers in Germany went a step further as they came to see lending to economic agents in Greece as even more advantageous as lending to those in richer countries.

This was firstly due to a difference in the relative wealth of the economic agents in the two nations. Poorer countries like Greece generally had a low private indebtedness in comparison to richer economies like Germany, with most of the properties being owned outright in contrast to the scores of mortgages in Germany; in other words, Greece provided German bankers with a large market of prospective debtors. Secondly, Germany was, and is, a surplus nation, whereas Greece was, and is, a nation in deficit. This means that Germany exports more than it imports, whereas Greece imports more than it exports. This is important because many of the Greek imports come from Germany, and hence, a virtuous cycle formed for the German lenders, who send out loans to Greeks, only to see that money returning to the domestic economy as Greeks bought German exports, foreshadowing an increase in German domestic growth and justifying more lending. Moreover, German bankers could make a higher profit if they lent to Greek, rather than German, borrowers. This was a consequence of the large trade surplus between the two countries, which meant that whilst the German economy was experiencing a never-ending increase in the supply of money from its exports, Greece was seeing a never-ending decrease due its imports. The trade surplus for Germany was never-ending because the common currency made the exchange rate immune to devaluations, so the demand for German exports in Greece remained constant. Being awash with liquidity, German interest rates decreased, with the increase in the supply of money making it cheaper to borrower; this was in contrast to the decrease in the supply of money in Greece, resulting in higher interest rates and thus a higher spread between the interest rates of the two economies.[2] Hence, a German banker could make more profit lending to economic entities in deficit countries like Greece than lending domestically, or to other surplus nations, because they could charge higher interest rates in these deficit states. On top of this, German bankers, due to the large sums involved, could make the most money lending to the Greek state, and so they did.

This process of sending German surpluses over to Greece in the form of loans became more and more frenzied. By January 2010, the Greek public debt alone was 300 billion euros; it was clear to the newly elected Prime Minister, George Papandreou, that the Greek government stood no chance of servicing such a large sum.

Politics

I like to think of politics, being the governance of a country, as providing the boundaries for which the economy will work within. These boundaries may be objectives, regulations, or laws the government sets for the economy, affecting both the micro and macro levels of the economy. From this perspective, the government is responsible, directly or indirectly, for the consequences of both interventionist and laissez-faire policies. Hence, the deregulation of the financial system and the consequences of such deregulation, are not only economic issues, but political as well. This deregulation allowed banks to participate in their dubious derivatives trading in the way that they did, with risk managers in Europe and the Anglosphere signing off subprime loans as safe and reliable, when of course they were not. Taking Greece as an example, many Greek citizens, as well as the Greek state, would not have been eligible for the loans given to them if the European Union had not let the financial system become so independent.

This is only the tip of the iceberg for the Eurozone, however. From its very first manifestation as the 1950s, German-dominated and French administrated coal and steel cartel, some may see the European Union's philosophy as prioritising business over the people, as explained in the **philosophy section**; on a practical, political level, however, some have also

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[2] Spread – difference between the interest rates paid by the Greek and German governments

identified a lack of political cohesion necessary to prevent and effectively deal with crises such as this one. An interesting comparison can be made between the European Union and the USA, as, like Europe, the USA started out as a loose confederacy of fractious states. Whilst not advocating for the creation of a European Federation, I would like to touch upon a crucial difference between the European Union and the USA, which is the presence of a political recycling mechanism in the USA, and the absence of one in Europe. This is essentially the transferring of surpluses not via the market but via political institutions. As described in the **economics section**, the recycling of German surpluses to Greece on a market rather than intergovernmental level was a key cause of the Eurozone Crisis because these German surpluses were sent out as loans, resulting in an accumulation of debt that the Greek state was obliged, but unable, to pay back. Moreover, whilst the USA saw the Federal Bank and FDIC respond immediately to the 2008 Financial Crisis by funnelling money into the worst hit states, such as Nevada, saving Nevadan banks and dealing with bankruptcies and unemployment, the Greek state was given no such help.[3] Instead, in January 2010, Angela Merkel, Chancellor of Germany, and Jean-Claude Trichet, at the time President of the European Central Bank, said no to a bailout, no to interest rate relief, and no to the Greek state defaulting. This was in the face of almost a complete cessation of credit in Greece, meaning that the Greek state could no longer refinance its debt, and a negative growth in Greek national income, as the economy suffered from the effects of a global recession.

The ineffectiveness of this response was demonstrated by its reversal in May 2010, as the financial contagion from Greek, as well as Irish, Spanish, Portuguese, and Italian debt, which amounted to 704 billion euros, threatened to spread to France and Germany. Proud banks such as BNP Paribus or Finanz Bank would be taken over by regulators and forced to declare insolvency if countries like Greece defaulted. Hence, the largest loan in history was granted to Greece.

However, the lack of political cohesion within the European Union exacerbated the crisis further, with the bulk of this loan (over 91%) being used to support French and German banks by buying back from them bonds at full price despite the market value of these bonds devaluing by over 80%. This is an example of not only a lack of political cohesion, but a prioritisation of economic mutuality between the nations, as hundreds of billions of losses from the books of French and German banks were transferred to taxpayers across Europe, forcing even the poorest citizens from the weakest states to take on this burden.

Philosophy

So why did we see a lack of political cohesion within the Europe Union at the time of the crisis, and instead the prioritisation of economic mutuality? The answer lies within the philosophy of the European Union.

Following the Second World War, the USA decided to give up isolationism and take on the responsibility of rebuilding a stable global order. This involved the new global financial structure known as the Bretton Woods system, which was essentially a monetary system pegging all currencies involved to the value of the dollar, which was itself guaranteed by the value of gold. To support the dollar and prevent the spread of economic contagions through this system of fixed exchange rates, the USA set up several shock absorbers in the form of strong regional currencies; in Europe, the shock absorber would be Germany. Despite Germany experiencing the brunt of the war's devastation, it was considered to be a good candidate because it had retained its ability to be the industrial powerhouse of Europe, and this heavy industry would underpin and strengthen this regional currency. However, to allow Germany to be a shock absorber, it needed an economic hinterland of permanent deficit states to buy the products its industry produced and keep the deutsche Mark strong.

To create such a scenario, the Americans needed to unify a war-torn Europe. There were two major unifying European philosophies that the Americans could draw upon: the international Marxist Left or the conservative Central Europe tradition. Of course, capitalist America decided to use the latter, which was associated with terms such as 'Mitteleuropa' or 'Paneuropa'. However, a European Union consistent with Mitteleuropa and Paneuropa would have to operate in accordance with the prevailing European cartels, which limited competition between corporations, nations, capital and labour. As such, the philosophical tradition of the European Union originated from a Central Europe which 'would resemble one gigantic corporation structured hierarchically and governed by technocrats, whose job would be to

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[3] FDIC – Federal Deposit Insurance Corporation

depoliticize everything and minimize all conflicts'.[4] It was from this apolitical foundation, which foreshadowed the prioritisation of economic mutuality between the nations, that the 1950s, German-dominated and French administered coal and steel cartel was born, known as the European Coal and Steel Community, which was the first manifestation of the European Union. As such, a 'multinational bureaucracy vested with legal and political powers superseding national parliaments and democratic processes' was established in line with Count Coudenhove-Kalergi's vision of a Europe which 'supersede[d] democracy' by being a 'social aristocracy of the spirit'. However, these philosophical roots can be seen as reducing the political cohesion necessary to respond to the Eurozone Crisis, replacing it with an economic mutuality that caused and exacerbated the crisis. [5] [6]

A philosophical analysis can also be used effectively in pointing out the moral issues involved in the financial crisis, such as moral hazard. Moral hazard is when 'an economic agent makes a decision in their own best interest knowing that there are potential adverse risks, and that if problems result, the cost will be partly borne by other economic agents'.[7] This mentality was a key cause in both the 2008 Financial Crisis, as well as the Eurozone Crisis, as bankers and lenders were willing to lend to subprime borrowers because they could sell the debt to others, effectively passing the risk up the line.

Conclusion

I hope that this article has effectively described the causes of the Eurozone Crisis and demonstrated their interdisciplinary nature. Despite being quite simplistic, I have found a 'Venn diagram approach' useful in structuring my analysis, such that I have come to conclude that the Eurozone Crisis was a product of issues that were not entirely economic in nature.

[4] Yanis Varoufakis, *And The Weak Suffer What They Must?* (London, UK: Penguin Random House UK, 2016), p56.
[5] Yanis Varoufakis, *And The Weak Suffer What They Must?* (London, UK: Penguin Random House UK, 2016), p57.
[6] Ben Rosamond, *Theories of European Integration* (London, UK: Palgrave Macmillan, 2000), p21-22.
[7] Alain Anderton, *Economics Sixth Edition*, (Lancashire, UK: Anderton Press Limited, 2015), p122

Arts and Sports

Analysis of the Neoclassical Features in the Second Movement of Poulenc's Trio for Oboe, Bassoon and Piano
Andrew Hannaford

Much as early Classicism was a disregard of the extravagant grandeur of the late Baroque, the Neoclassicist movement retaliated against the ostentatious or overambitious music of German Romanticist or French Impressionist mimickers. Poulenc was a member of a group of French Modernist composers formed by Satie known as Les nouveaux jeunes, which became Les Six, and followed the ideals of film-maker and designer Jean Cocteau's 1918 call for "music for daily use," with its "feet on the ground". In the search for simplicity, they turned to popular melodies, using either very straightforward or exceedingly complex rhythms for variety. Poulenc himself found simplicity via a more Neoclassical route than some of Les Six, Stravinsky hugely influencing his unexpected harmonic turns and dissonances. Yet his music also shows influence from the grounding of Schubert, harmony of Chabrier, Schumann, and Fauré, and even the lyrical melodies of Ravel.

Conscripted in January 1918, and serving until 1921, Poulenc experienced the end of the war and the immediate period afterwards. The requirement for any morale-boosting entertainment taught Poulenc much about writing for whatever instruments were available, which paved the way for his chamber works and the unusual combinations of instruments within them. This use of pared-down performing forces was also part of the aesthetic of Neoclassicism, and Poulenc's chamber works of this interwar period were a key part of his Neoclassical output as a composer. Most of Poulenc's pieces featured a major part for the piano as it was his own instrument, and in his Trio for Piano, Oboe, and Bassoon (1926) this is no different. Poulenc's choice of oboe and bassoon to accompany the piano is very effective, as the double-reeds can both blend together and mingle with the piano, or draw out a tune, as the oboe does with its "très doux et mélancolique" melody.

In terms of melody, the opening four bars have a very Classical feel to them, feeling very balanced and well-shaped, with both the tune and accompaniment of the clear antecedent phrase played on the piano over a Bb tonic pedal. The bassoon then enters for the consequent phrase, playing a similarly lyrical and eloquent line, while the piano switches to a more accompaniment focused role, with the right hand weaving between scalic semiquaver arpeggios in sixths, and harmonising the melody, emphasising the dotted rhythm in bar seven. The consequent phrase ends by tonicising the dominant key of F with a perfect cadence in bars seven to eight, a typical resolution of a tonic pedal in a Classical style. The oboe joins for the next phrase a quaver early due to the pleasant metric change to 3/8, which leaves a sense of weightlessness and grace, maintaining the style galant of the movement, despite the Neoclassical use of metric modulation.

The oboe and bassoon then take the tune together in an octave texture, against an undulating piano accompaniment and repeated rising bass line, which goes away from the tonic Bb and tonicises Eb briefly. For the majority of the movement, however, the melody falls into either homorhythmic sections between the oboe and bassoon, or a meandering antiphonal dialogue between the oboe, bassoon, and occasionally right-hand piano. In either instance, the phrases tend to be four or eight bars long and usually well balanced. Nonetheless, in Neoclassical style, the phrases are altered in two cases by one bar metric modulations: once as mentioned to 3/8 in bar eight, and the other to 2/8 in bar fifty, adding further tension before the cadential point at the end of the B section whilst maintaining the phrasing. The metric modulations are not too jarring as they don't split the quaver pulse, which is fairly slow due to the andante tempo, and so create a tastefully light lilt rather than the dissonance created by some of Stravinsky's metric leaps, such as in his "Rite of Spring", which serve almost solely to break the listener's tactus in order to build or tension or develop a character. Poulenc brings back elements of the original theme in the bassoon in bars thirty-nine and forty, which happen to be right in the middle of the B section of the movement, where there should be no direct repeat of A section material, only development of fragments. Moreover, as if embracing this, the first two bars of the original theme are played in a rising chromatic sequence by the oboe. However, the theme returns in full in the short A' section (b.52), although this time in the dominant key of the movement, against the norm.

In the Neoclassical style, Poulenc employs a mix of simple and complex rhythms in this movement, and standard Classical dynamics that are rarely extreme. Starting with the simple, Poulenc opens mf, with fairly simple crotchets, semiquavers,

and dotted quaver rhythms, before introducing demi-semiquavers in bar 4. Demi-semiquaver runs become the norm to join phrases, often accompanied with an excited crescendo from piano to forte, but the overall dynamic remains mf. The first sforzando is seen at bar nineteen, emphasising the arrival of an E#dim7 and the last four bar phrase of the A section, whilst rhythmically to end the A section there is a new grace note pattern in bar twenty-two.

A light crescendo to forte in bar twenty-six adds a mild sense of climax to the start of the B section, before more grace notes are seen in the oboe and bassoon in bars twenty-seven and eight. There is a brief moment of respite in bar thirty, at mp, in advance of the climax of the movement in bars thirty-three to thirty-six, where we see a vast culminating crescendo to fff and vast bursts of energy from the fanfare-esque double semiquaver quaver rhythms (♫♪) and septuplets in the left hand creating seven against two cross-rhythmic dissonance. The rhythms then die away to become gentler again, mostly repeating previous rhythmic patterns until the end of the movement. On the contrary, the dynamics maintain a firm forte until bar forty-five, where there is a subito drop to piano into a more serene section; the piece only rises to mf again in bar fifty-six in the A' section, but then quietens to a finishing pp. Both the rhythm and the dynamics are predominantly Classical in style, but the few Modernist oddities Poulenc adds in serve as a reminder that this is in a twentieth century style.

In a similar vein, Poulenc's use of articulation tends to appear Classical in style until it reaches an extreme that would have been unheard of before the 19th century. The opening, and most of the A section, uses only slurs as articulation, with the occasional accent at the start of certain bars and phrases, for example in bars eight, nine, and eleven. Another point to mention is Poulenc's occasional use of bizarre performance directions, perhaps inspired by Satie's writing, whom he worked with, for example in bar ten he writes for the oboe to play serré, meaning tightly-bound or stringent. Most other directions tend to make more sense, like in the bassoon, to play sweetly, doux, in bar eleven, or très chanté in bar fifteen.

The first use of articulation marks other than slurs or accents occurs at bar twenty-three, where we see staccato in the left-hand of the piano, whilst the oboe is told unusually to play très doux et mélancolique, "very sweet and melancholic", which provides an odd juxtaposition of sonorities, allowing the oboe to float effortlessly over the accompaniment.

The next point of interest on the articulation front is at bar thirty-three at the emotional climax of the movement, where we see heavy and extreme use of accents and the bassoon is marked to play très marqué down a semiquaver run. The vigorous accents then continue in the piano, whilst the wind take a contrasting legato, très lié, line.

Poulenc occasionally changes the articulation of an imitated phrase to add variety, like in bars forty-seven to forty-eight, where the bassoon's imitation is lighter and more staccato, an almost ironic repeat of the legato oboe line. The rest of the piece's articulation appears predominantly Classical until the last four bars, where we see a large increase in the tranquillity of playing, with tied notes nearly three bars long, and copious amounts of slurs, which, in the piano, help to emphasise the offbeat repeated rhythms. Finally, the last chord is seen ambiguously tied over the double-barline, which comes across as a very abstract and Modernist way to end a movement and making it challenging for the performer to know how long to hold the note. As expected by Neoclassical standards, Poulenc uses very simple articulation markings in this movement, using them more intensely at climactic points.

Last, we can look at Poulenc's use of structure, tonality, and harmony. At first glance, the movement appears to be in ternary form, ABA'. However, this only takes into account for thematic material and not the tonality of the piece. The movement starts strongly in Bb major with a firm tonic pedal, however it swiftly goes on to tonicise the key of F (b.8), then Eb major (b.11), then briefly Db (b.12), which can be seen as a brief pivot towards Ab major, where we see a Neapolitan 6 (b.13) and a modal mixture of chords from the tonic minor, which then all resolves down into Db major via a perfect cadence (b.15). It is worth noting that we do not see the key of Bb major in the rest of the movement after switching to Db, which is a key argument against the movement being in ternary structure. After this, in bar seventeen we see a true unexpected harmonic shift to E minor, a very distant key from Db major, modulating via a flat vi chord in Db which can be seen as a iv chord in E minor, quickly established by a perfect cadence, which ends the phrase in bar eighteen. In bar twenty, following some new material played by the oboe, there is an imperfect cadence in B major/minor, and in twenty-one, we see the first instance of octatonicism in the movement, which could also be seen as a Neapolitan chord over a dominant F# pedal.

Moving into the B1 section, if we view the piece as ternary, there is no obvious perfect cadencial resolution from the F# going into bar twenty-three, as it resolves to a first inversion chord B minor chord. What follows is a twelve bar B1 section entirely in B minor, attempting to reach a perfect cadence but never doing so, as there are no instances where there is a root position chord, so tension is built up as the yearning for a full resolution becomes stronger. In bar thirty, we see the octatonicism return at the V7 to ib weak cadence, but this time with descending dominant sevenths and augmented sixth chords outlining the octatonic scale in the piano right-hand. The next phrase builds to the musical and emotional zenith of the piece at bar thirty-five, where the tension finally resolves through a cadential 6/4 leading to a tierce de Picardie fff explosion with a scintillating root position B major chord taking us into the B2 section.

Notwithstanding this huge release of energy that comes here, Poulenc quickly moves away from B major with an interrupted cadence (b.37-38) from a G7b reharmonisation of the B pedal, with diminished flavours due to an Ab being present in the chord, which should lead to C major or minor, but resolves instead to Ab major in first inversion, thereby creating a yearning for a root position C minor chord. Despite this yearning, we instead get a rising chromatic harmonic sequence of first inversion chords: the first inversion Ab major chord leads to A major with a C# in the bass, then Bb major over D, then Bb augmented over D, followed by B major over D#, and then B augmented over D#, before quasi-resolving to a C major over E, which gives us the inevitable resolution from the G7b in bar thirty-seven. This seems fairly straightforward, but there are a few points of potential Neoclassical interest. Namely, the sequence is irregular, as every bass note is held for two bars except for the C#, which is only held for one, and the use of so called 'wrong-note' harmony on the third beat of each bar between forty-one and forty-four, a typical Neoclassical gesture seen in the likes of Stravinsky's Petrushka.

Subsequently, we see a passage that is entirely diatonic (b.45-48), which builds on the yearning for a root position C major chord, but this diatonicism quickly descends into some chromatic harmony which takes us to the A' section. Where we expect to have a V - I in C major (b.51), we instead have a half diminished chord on the supertonic of F going to a perfect cadence, ii7(b5) - V7(b9) - I, in F major, which neither feels like the C major resolution we craved or the Bb major expected by the standards of ternary form, as we instead have the dominant, with even its own key signature. The return of the A section is also very short compared to the length of the B section, at only thirteen bars compared to the B's twenty-nine bar duration. The tonic pedal throughout the A' section not only creates, in essence, static harmony, but also gives the impression of the section being a form of coda rather than a reprise. Bars fifty-one to fifty-five fairly accurately repeat the opening of the piece, if we forgive the tonality, however, some other indications that this is not a typical A' section include the change in harmony of the answering phrase; the lack of a perfect cadence (b.58-59), such as in bars seven and eight of the piece, means that the finishing of the bassoon's melody by the oboe feels more like the initiation of a new phrase than the fruition of the last.

In bars fifty-nine and sixty-one we see movement away from the tonic pedal to subdominant harmonies, in effect forming an extended plagal cadence which draws the movement to its end. The chord in bar fifty-nine is a Bbmin(maj7)(maj13) in jazz terminology, whilst the chord in sixty-one is a less dissonant Bbmin7(b5) or a half-diminished seventh. The movement closes with a three-bar long F minor chord and an octatonic feel drawn out by the oboe and the right-hand piano. Finally, Poulenc ends with an emotionally charged and highly ambiguous F minor chord with a dissonant major seventh; here he adds a C, which is outside of the F octatonic scale but makes the chord more complete, by adding the fifth, and potentially acts as a leading note for the final movement's tonic of Db.

Overall, it is clear to see that Poulenc uses many techniques typical of the Neoclassical movement, which here are dominated by a firm grounding in the style galant balanced model of the early Classical period, but infiltrated with twentieth century tonal twists, metric shifts, and unsettled harmonic rifts.